National Science Foundation
Geosciences Directorate
Division of Ocean Sciences
Arlington, Virginia

FINDING OF NO SIGNIFICANT IMPACT (FONSI) PURSUANT TO THE NATIONAL ENVIRONMENTAL POLICY ACT (NEPA), 42 U.S.C. 4321, *et seq.* and DECISION DOCUMENT

Marine Geophysical Survey in the Atlantic Ocean off New Jersey, Summer 2015

OCE 1260237
Principal Investigator/Institution: Gregory Mountain, Rutgers University
Project Title: Collaborative Research: Community-Based 3D Imaging That Ties Clinoform Geometry to Facies Successions and Neogene Sea-Level Change

COLLABORATIVE PROPOSAL:
OCE 1259135
Principal Investigators/Institution: Craig Fulthorpe, James Austin, Mladen Nedimovic, University of Texas at Austin

A Final Amended Environmental Assessment (Final Amended EA) was prepared for the proposed rescheduling of a collaborative research project funded by the National Science Foundation (NSF) entitled, "Community-Based 3D Imaging That Ties Clinoform Geometry to Facies Successions and Neogene Sea-Level Change" (Proposed Action). Dr. Mountain of Rutgers University is the scientific lead for the proposed project, making Rutgers the lead institution. Drs. Fulthorpe, Austin, and Nedimovic of University of Texas at Austin (UT) are collaborators on the Proposed Action with Dr. Mountain; therefore, UT is a collaborating institution.

The Proposed Action includes a marine geophysical survey (or "seismic survey") to be conducted on board the Research Vessel *Marcus G. Langseth* (R/V *Langseth*) in the Atlantic Ocean off of New Jersey. The collaborative research project originally commenced in 2014 after all federal authorizations and approvals were issued. Due to mechanical issues with the ship, however, the 2014 survey was unable to be completed within the effective time period of the Incidental Harassment Authorization (IHA) and Biological Opinion/Incidental Take Statement (ITS) issued by the National Marine Fisheries Service (NMFS) and was ultimately postponed. NSF then proposed to reschedule the survey for the same timeframe in 2015. The purpose and scope of the proposed rescheduled 2015 activity has remained the same as that proposed in 2014, however, only the smaller of two possible acoustic sources (700in^3) would be used in 2015.

The Final Amended EA entitled, "Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015" (Report #

TA8349-3) (Attachment 1), was prepared by LGL Limited environmental research associates (LGL) on behalf of NSF and analyzed the potential impacts on the human and natural environment associated with the proposed rescheduling of the marine geophysical survey. The Final Amended EA tiers to the Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey (June 2011) and the Record of Decision (June 2012) (jointly referred to as PEIS) and the, "Final Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, July-Mid August 2014" (2014 Final EA) which was prepared for the 2014 survey. The Final Amended EA also incorporates by reference the analyses and conclusions set forth in the Final EAs, IHAs, the ITSs issued by NMFS for both the 2014 survey and the proposed rescheduled 2015 survey, and the responses from the Regional Coordinator for Essential Fish Habitat (EFH). The conclusions from the Final Amended EA were consistent with the conclusions of the PEIS and 2014 Final EA and were used to inform the Division of Ocean Sciences (OCE) management of potential environmental impacts of the survey. OCE has reviewed and concurs with the Final Amended EA findings. The Final Amended EA is incorporated into this Finding of No Significant Impact (FONSI) and Decision Document by reference as if fully set forth herein.

Project Objectives and Context

The purpose of the Proposed Action is to collect data across existing Integrated Ocean Drilling Program (IODP) Expedition 313 drill sites on the inner-middle shelf of the New Jersey continental margin to reveal the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to present (Attachment 1, Chapter 1 and Appendix B). Features such as river valleys cut into coastal plain sediments, now buried under a kilometer (km) of younger sediment and flooded by today's ocean, cannot be identified and traced with existing two-dimensional (2-D) seismic data, despite their existence being clearly indicated in sediment cores recovered during IODP Expedition 313. These and other erosional and depositional features would, under the Proposed Action, be imaged using three-dimensional (3-D) seismic data, enabling follow-on studies to identify the magnitude, time, and impact of major changes in sea level.

As was true of the 2014 survey, the Proposed Action would be a collaborative research effort, supporting scientists and graduate students.

Summary of Proposed Action and Alternatives

The procedures of the Proposed Action would be similar to those used during previous seismic surveys and would use conventional seismic methodology. The survey location is in the Atlantic Ocean off the coast of New Jersey, within the Exclusive Economic Zone of the United States (U.S.) and outside of state waters (Attachment 1, Figure 1). The survey would consist of approximately (~) 4900 km of transect lines (including turns) in water depths of ~20 meter (m) to 75 m deep. The survey would involve the R/V *Langseth* which is owned by NSF and operated on our behalf through a Cooperative Agreement entered in 2012 by Columbia University's Lamont-Doherty Earth Observatory (L-DEO). The R/V *Langseth* would operate as the source vessel which is proposed to deploy an array of four airguns with a total discharge volume of ~700 in^3. The receiving system is proposed to consist of hydrophone streamers and a Geometrics P-cable system. As the airgun array is towed along the survey lines, the hydrophone streamers would receive the returning acoustic signals and transfer the data to the on-board processing system. In addition to the operations of the airgun array, a multibeam echosounder (MBES) and sub-bottom profiler (SBP) are proposed to be operated from the R/V *Langseth* continuously throughout the cruise, but not during transit to the survey site. The survey is proposed to be a ~35 day survey, taking place during the period allowable under the IHA, June 1, 2015 to August 31, 2015. Seismic operations would be carried out for ~30 days, with the balance of the cruise occupied in transit (~2 days), equipment set-up and retrieval (~3 days), and contingency (~2 days). Some deviation in the length of the survey may be required, depending on logistics and weather; however, seismic operations would only occur during the timeframe allowable under the IHA.

One alternative to the Proposed Action would be to conduct the survey at an alternative time. Constraints for vessel operations and availability of equipment (including the vessel) and personnel would need to be considered for alternative cruise times. Additionally, weather constraints would inhibit vessel operations during certain times of year, such as winter. Avoiding critical time periods for sensitive species, such as the North Atlantic right whale migration period, is another factor for consideration in survey timing. Limitations on scheduling the vessel include the additional research studies planned on the vessel for 2015 and beyond. Other activities planned within the region also would need to be considered if the survey were scheduled for an alternative time.

Another alternative to conducting the Proposed Action would be the "No Action" alternative (i.e. do not request that an IHA be issued, and do not allow the proposed rescheduled research operations to be conducted). The "No Action" alternative would result in no disturbance to marine species attributable to the Proposed Action, but geological data of considerable scientific value and relevance increasing our understanding of sea level rise and the project objectives as described above would not be met. In addition, the professional and academic careers of the researchers and students who proposed to conduct the research would be negatively impacted should the Proposed Action and the collection of data not go forward.

Summary of environmental consequences

The Final Amended EA includes analysis on the affected environment (Chapter III) and the potential effects of the Proposed Action on the environment (Chapter IV). Potential impacts of the Proposed Action on the environment would be primarily a result of the operation of the airgun array. The potential effects of sounds from airguns on marine species, mammals, and sea turtles of particular concern, are described in detail in Attachment 1 (Chapter IV and PEIS Chapters 3 & 4) and might include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, and at least in theory, temporary or permanent hearing impairment, or non-auditory physical or physiological effects. It is unlikely that the Proposed Action would result in any cases of temporary or especially permanent hearing impairment, or any significant non-auditory physical or physiological effects. Some behavioral disturbance is expected, if animals are in the general area during seismic operations, but this would be localized, short-term, and involve limited numbers of animals. The potential effects from the other proposed acoustic sources were also considered, however, they would not be likely to have a significant effect on the environment (Attachment 1, Chapter IV; and PEIS Sections 3.4.7, 3.6.7, and 3.7.7).

The Proposed Action includes an extensive monitoring and mitigation program to further minimize potential impacts on the environment. Mitigation efforts include pre-cruise planning activities and operational activities (Attachment 1, Chapters II and IV; and PEIS 2.4.1.1). Pre-cruise planning mitigation activities included consideration of energy source optimization/minimization; survey timing (i.e., environmental conditions: seasonal presence of animals and weather; and, scientific personnel and equipment availability); and calculation of mitigation zones. The operational mitigation program would further minimize potential impacts to marine species that may be present during the conduct of the proposed research to a level of insignificance. As detailed in Attachment 1 (Chapters II and IV), the IHA (Attachment 1, Appendix D), and ITS (Section 10.4) issued by NMFS on May 7, 2015 for the Proposed Action, operational monitoring and mitigation measures would include: ramp ups; a minimum of one, but typically two dedicated observers maintaining a visual watch during all daytime airgun operations; two observers for 30 minutes before and during ramp-ups during the day and at night; passive acoustic monitoring (PAM) during the day and night to complement visual monitoring (unless the system and back-up systems are damaged during operations); and, power downs (or, if necessary, shut downs) when marine mammals, sea turtles, and endangered and threatened seabirds are detected in or are about to enter designated exclusion zones. Per the IHA and ITS, additional mitigation measures would include a one-minute shot interval for the 40-in^3 mitigation airgun, and power downs for groups (6 or more) of large whales. The fact that the small airgun array, as a result of its design, directs the majority of the energy downward, and less energy laterally, would also be an inherent mitigation measure.

With the planned monitoring and mitigation measures, unavoidable impacts to marine species that could be encountered would be expected to be minimal, and limited to short-term, localized changes in behavior and distribution near the seismic vessel. At most, effects on marine mammals may be interpreted as falling within the federal Marine Mammal Protection Act (MMPA) definition of "Level B Harassment" for those species managed by NMFS. No long-term or significant effects would be expected on individual marine mammals, sea turtles, seabirds, fish or the populations to which they belong or on their habitats.

The Final Amended EA also evaluated potential socioeconomic impacts of the Proposed Action. Because of the location of the Proposed Action and distance from shore, human activities in the area around the survey vessel would be limited to SCUBA diving, commercial and recreational fishing activities and other vessel traffic. Because of the nature and location of the Proposed Action, no impacts would be expected on marine-related local businesses such as coastal restaurants, hotels, and bait and tackle shops or to marine mammal tour boat activities. Fishing, SCUBA diving, vessel traffic, and potential impacts are described in further detail in the Final Amended EA, Chapter III and IV.

Recreational and commercial fisheries activities would not be precluded in the survey area. No fisheries activities except vessels in transit were observed in the survey area during the ~13 days that the R/V *Langseth* was there in July 2014. No fish kills or injuries were observed during 2014 survey activities. Similar past research seismic surveys in the proposed rescheduled 2015 survey area (2002, 1998, 1996, 1990) did not result in noticeable effects on commercial or recreational fish catches, based on a review of multi-year NMFS fish catch data in the months when seismic surveys were undertaken. Based on a review of National Automated Identification System (AIS) data, the number of fishing vessels equipped with AIS in June and July 2013 and

2014 was 21–27 per month, with only 4–6 of those vessels spending more than a few hours in the proposed survey area. L-DEO would coordinate with local SCUBA diving organizations and shops to avoid space-use conflicts. L-DEO would also issue Notices to Mariners to coordinate and provide updates on operations in the area. In June and July 2013 and 2014, there was only one AIS-identified dive boat passing through the survey area. No dive vessels were observed in the survey area during the ~13 days that the R/V *Langseth* was there in July 2014. It would be unlikely that the Proposed Action would have any impact on marine mammal tour boat activities due to the distance from the proposed survey site to the typical locations for those types of activities. Given the short duration of the survey and the temporary nature of potential environmental impacts, impacts to the local economy, such as to fisheries, SCUBA diving industry, and marine mammal tour boats would not be anticipated.

A survey at an alternative time would result in few net benefits. Marine mammals and sea turtles are expected to be found throughout the proposed survey area and throughout the time during which the Proposed Action would occur. Some marine mammal species are expected to occur in the area year-round, so altering the timing of the Proposed Action likely would result in no net benefits for those species. Some migratory species are expected to be farther north at the proposed rescheduled time of the survey, such as the North Atlantic right whale, so the proposed survey timing is beneficial for those species. Weather (i.e., operational safety of crew and vessel when deploying seismic gear) and availability of vessel, equipment, and personnel are also factors that need to be considered when scheduling the activity. Some of the deadliest recorded storms in New Jersey have occurred during September/October. One of the most deadly storms in recent history was Hurricane Sandy, which occurred during the October/November timeframe of 2012, and resulted in 73 deaths and cost billions of dollars in assistance. Furthermore, the scientific personnel (lead Principal Investigator (PI) and collaborating PIs) and R/V *Langseth* would likely not be available in September/October, and, therefore, the purpose and need of the proposed activities could not be met. There is also a timeliness factor involved with the Proposed Action; the professional and academic careers of the researchers and students involved with the Proposed Action are affected by the timing of data collection and there is a desire to have the scientific results incorporated into the broader scientific community in the near term.

The "No Action" alternative would remove the potential of the limited direct and indirect environmental consequences as described. However, it would preclude important scientific research from going forward that has distinct potential to address important environmental concerns related to sea level change in nearshore environments. The "No Action" alternative would result in a lost opportunity to obtain important scientific data and knowledge relevant to the geosciences and to society in general. The collaboration, involving PIs and students, would be lost along with the collection of new data, interpretation of these data, and introduction of new results into the greater scientific community and applicability of this data to other similar settings. Loss of NSF support often represents a significant negative impact to the academic infrastructure, including the professional and academic careers of the researchers, students, ship technicians and crew who are part of the U.S. Academic Research Fleet. The "No Action" alternative would not meet the purpose and need of the Proposed Action, but was carried through for analysis as required under Council on Environmental Quality regulations (40 C.F.R. 1502.14[d]).

NSF posted a Draft Environmental Assessment (Draft EA) on the NSF website for a 37 day public comment period on December 19, 2014. As the Draft Amended EA included information regarding marine mammals and threatened and endangered species in the proposed survey area, it was used for consultations with other regulatory agencies. NSF typically holds a 30 day public comment period on Draft EAs, however, because the public comment period for the Proposed Action overlapped several holidays, the period was extended an additional seven days. During the public comment period, NSF received a 30 day extension request from nine entities and individuals. The extension request was based on the main assertion that the document included the addition of 126 new published data and scientific literature sources. NSF compared the sources cited in the 2014 Final EA for the project issued on July 1, 2014, with the Draft Amended EA. The 2014 Final EA, which was issued nearly six months before the NSF Draft Amended EA, contained all but six of the sources identified in "Section VI. Literature Cited". Three of those sources were actually referenced in the 2014 Final EA document but were inadvertently omitted from the "Section VI. Literature Cited". Of the remaining three additional sources, one was the 2014 Final EA for the, "Seismic Reflection Scientific Research Surveys During 2014 and 2015 in Support of Mapping the US Atlantic Seaboard Extended Continental Margin and Investigating Tsunami Hazards" issued on August 21, 2014. Despite the addition of only a few sources of published data and scientific literature referenced in the Draft Amended EA, NSF decided to extend the public comment period by an additional 15 days above and beyond the 37 days it was planned to be open for comment. At the close of the comment period, eight comments from individuals and entities (one of which represented multiple organizations and individuals) on the Proposed Action were received by NSF (Attachment 1, Appendix F). NSF also reviewed and considered public comments received by the National Oceanic and Atmospheric Administration's (NOAA's) NMFS during a 30 day public comment period for the IHA process. After consideration of public comments received during both public comment periods and discussions during MMPA and Endangered Species Act (ESA) consultations with NMFS, refinements to the information in the Final Amended EA were made. The new information included in the Final Amended EA, however, did not alter the overall conclusions of the Draft Amended EA and remained consistent with the PEIS and the 2014 Final EA. In sum, after full consideration of the Draft Amended EA, the comments received on the Draft Amended EA, and the conclusions reached in the 2014 Final EA, the PEIS, the 2014 and 2015 IHAs, the 2014 and 2015 ITSs, the 2014 and 2015 responses from the Regional Coordinator for EFH, the 2014 and 2015 concurrences from U.S. Fish and Wildlife Service (USFWS) and the entire environmental compliance record, NSF issued its Final Amended EA concluding that implementation of the Proposed Action would not result in significant impacts.

Public Involvement and Coordination with Other Agencies and Processes

Endangered Species Act (ESA)

NSF engaged in formal consultation with NMFS and informal consultation with USFWS, pursuant to Section 7 of the ESA. NSF received confirmation on 14 January 2015 from USFWS that the proposed rescheduling of the survey from 2014 to 2015 would not change the effect of the Proposed Action on the species and their concurrence on the Proposed Action remained the same as in 2014 (Attachment 1, Appendix H). NMFS issued a Biological Opinion and an

Incidental Take Statement for the Proposed Action on May 7, 2015, and consultation was concluded (Attachment 1, Appendix C).

Marine Mammal Protection Act (MMPA)
On December 23, 2015, L-DEO submitted, on behalf of NSF, L-DEO, and Rutgers University to NMFS an IHA application pursuant to the MMPA. Following a 30 day public comment period, NMFS issued an IHA on May 7, 2015 (Attachment 1, Appendix D).

NMFS Marine Mammal Stranding Program
Although marine mammal strandings were not expected as a result of the Proposed Action, NMFS informed the Greater Atlantic Stranding Network coordinators and the Coordinator for the Marine Mammal Health and Stranding Program (MMHSRP) on 8 January 2015 that an IHA application for the Proposed Action had been received. Per the IHA, should any marine mammal strandings occur during the survey, NMFS and the NMFS Greater Atlantic Regional Fisheries Office Marine Mammal Response Coordinator would be contacted.

Magnuson-Stevens Act - Essential Fish Habitat (EFH)
The Magnuson-Stevens Act requires that a federal action agency consult with NMFS for actions that "may adversely affect" Essential Fish Habitat (EFH). On December 22, 2014, NSF contacted the EFH Regional Coordinator of the NOAA Greater Atlantic Regional Fisheries Office regarding consultation for the proposed activity. The EFH Regional Coordinator concluded that the Proposed Action may have an adverse effect on EFH, however, no specific EFH conservation recommendations were provided (Attachment 1, Appendix I). NOAA recommended additional research and monitoring to gain a better understanding of the potential effects that seismic surveys may have on EFH, federal managed species, their prey, and other NOAA trust resources for future NSF activities, however, this was not a consultation requirement and consultation was concluded.

NSF has nevertheless provided federal funding for the, "Fourth International Conference on Effects of Noise on Aquatic Life" (AN2016), which is a follow-on from international meetings held in Nyborg, Denmark (2007), Cork, Ireland (2010), and Budapest, Hungary (2013; www.an2013.org), all of which NSF also provided funding. The major goal of AN2016 will be to define the current state of knowledge on the impact of underwater noise and, in particular, explore the progress made in this field in the three years since the previous conference. The meeting will bring together researchers, regulators/policy makers, and industry with an interest in different animal groups, including marine mammals, turtles, fish and invertebrates. NSF also regularly participates in interagency committees and working groups related to anthropogenic sound in the marine environment, such as the Subcommittee on Ocean Science and Technology Interagency Task Force on Ocean Noise and Marine Life.

Coastal Zone Management Act (CZMA)
New Jersey: On October 8, 2014, NSF contacted the New Jersey Department of Environmental Protection (NJDEP) about NSF's interest in rescheduling the 2014 survey for a 30 day period within the same timeframe (June/July/August) in 2015, and a teleconference to discuss details further was arranged for October 15, 2014. On October 15, 2014, NSF and NJDEP held a teleconference about the Proposed Action. Although NSF reviewed New Jersey's (NJ's) Coastal

Management Program (CMP) Federal Consistency Listings (http://www.state.nj.us/dep/cmp/2008_fc_listing.pdf) and determined the activity to be unlisted, NSF asked NJDEP if they had interest in reviewing the Proposed Action under the Coastal Zone Management Act, and NJDEP confirmed their interest in conducting a consistency review. By providing early notice about the Proposed Action, NSF intended to allow for the maximum time available to discuss it with NJDEP and resolve any differences prior to submitting a Consistency Determination (CD) and/or during the 90 day consultation period following submission of a CD. At that time, per 15 C.F.R. Part 930.34(d), NSF also requested that NJDEP provide a list of relevant enforceable policies for the Proposed Action. Despite repeated requests, NJDEP did not, however, provide a list of relevant enforceable policies to NSF.

NSF submitted to NJDEP a CD on December 22, 2014 for the Proposed Action with the Draft Amended EA appended as Attachment 1 (Appendix K). On February 23, 2015, NSF received a letter from NJDEP dated February 11, 2014, requesting a 15 day extension pursuant to 15 C.F.R. 930.41(b) of the CZMA regulations. On March 6, 2015, NJDEP provided a consistency review to NSF. NJDEP found the NSF Proposed Action to be "inconsistent" with three enforceable policies of NJ's CMP. Per 15 C.F.R. 930.43, NSF encouraged NJDEP to work with NSF to resolve differences before the close of the 90 day consultation period, however, attempts were unsuccessful. NSF worked with NOAA's Office for Coastal Management (OCM) to resolve differences with NJDEP through informal mediation. Mediation efforts are ongoing and NSF remains hopeful that an agreement will ultimately be reached. Separately from the mediation efforts, NSF concluded in its Final Federal Consistency Determination for the Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015 (Final Determination) (Attachment 1, Appendix J) that, following review of NJDEP's consistency review and the entire environmental compliance record, the Proposed Action is consistent to the maximum extent practicable with the enforceable policies of NJ's CMP.

New York: On 1 August 2014, New York Department of State (NYDOS) submitted a letter to NSF expressing interest in the 2014 survey, stating that the survey area was within their off shore planning area of interest and requested review of any current or future proposed action for federal consistency. Per the requirements of the CZMA, NSF reviewed the New York CMP Federal Consistency Listings and determined that the Proposed Action was unlisted. Because of the substantial distance of the survey site from New York state waters, no effects would be expected on New York coastal uses or resources. Although under the CZMA unlisted review requests are required to go through OCM, in light of NYDOS' 1 August 2014 letter expressing particular interest in seismic surveys, NSF contacted NYDOS on 30 October 2014, to confirm the State's interest in reviewing the unlisted Proposed Action. On 9 January 2015, NYDOS confirmed interest in reviewing the Proposed Action. Per 15 C.F.R. 930.34, NSF, both in October 2014 and in subsequent contacts, requested that NYDOS identify relevant enforceable policies applicable to the Proposed Action, but none were identified.

On 16 January 2015, NSF submitted to NYDOS, "NSF Coastal Zone Management Act (CZMA) Consistency Determination" (CD), with the Draft Amended EA appended as Attachment 1 (Appendix K). On 13 March 2015, NYDOS requested a 15 day extension of time to review the CD and NSF acknowledged NYDOS's request the same day. NYDOS provided its response to

NSF's CD on 31 March 2015, which concurred with NSF's CD that the Proposed Action was consistent with the enforceable policies of New York's federally approved CMP. NYDOS included, however, several recommendations to modify the Proposed Action to reduce the likelihood of reasonably foreseeable effects on New York's coastal resources and uses: (1) the Proposed Action should avoid overlap to the maximum extent practicable with New York's commercial fishing use; and (2) the Proposed Action should be confined to operations during the Fall months to reduce the likelihood of reasonably foreseeable effects on fish stocks commercially important to New York. NYDOS's concurrence with NSF's CD, however, was not conditional on NSF adhering to these recommendations. NSF addressed NYDOS' recommendations in the Final Amended EA.

Conclusion and Decision

NSF has reviewed and concurs with the conclusions of the Final Amended EA (Attachment 1) that implementation of the Proposed Action will not have a significant impact on the environment. Consequently, implementation of the Proposed Action will not have a significant direct, indirect or cumulative impact on the environment within the meaning of the National Environmental Policy Act (NEPA). Because no significant environmental impacts will result from implementing the Proposed Action, an environmental impact statement is not required and will not be prepared. Therefore, no further study under NEPA is required.

As described above, NSF's compliance with the Marine Mammal Protection Act, Endangered Species Act, and Essential Fish Habitat under the Magnuson-Stevens Act has been completed. NSF has also complied with the Coastal Zone Management Act, submitting Consistency Determinations to the states of New York and New Jersey. The state of New York found the Proposed Action to be consistent with the enforceable policies of its federally approved CMP. The state of New Jersey found the Proposed Action to be inconsistent with three enforceable policies of its federally approved CMP. For the reasons identified in the Final Determination (Attachment 1, Appendix J), however, NSF has determined the Proposed Action to be consistent to the maximum extent practicable with the enforceable policies of New Jersey's federally approved Coastal Management Plan. As such, NSF has decided to authorize the Proposed Action to proceed over the State of New Jersey's objections.

Accordingly, on behalf of NSF, I authorize the issuance of a Finding of No Significant Impact for the Proposed Activity, the marine seismic survey proposed to be conducted on board the Research Vessel *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, during the effective time period of the IHA and hereby approve the Proposed Action to commence.

[signature] 26 MAY 2015

Bauke (Bob) Houtman
Integrative Programs Section Head
Division of Ocean Sciences

Date

Attachment 1: Final Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015

Attachment 1

Final Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015

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26 May 2015

LGL Report TA8349-3

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ABSTRACT

The State University of New Jersey at Rutgers (Rutgers), with funding from the U.S. National Science Foundation (NSF), proposes to reschedule a previously approved high-energy, three dimensional (3-D) seismic survey on the Research Vessel (R/V) *Marcus G. Langseth* (*Langseth*) in the northwest Atlantic Ocean ~33–92 km from the coast of New Jersey (27–87 km from New Jersey state waters) to occur in the summer of 2015. The NSF-owned *Langseth* is operated by Columbia University's Lamont-Doherty Earth Observatory (L-DEO) under an existing Cooperative Agreement. Although the *Langseth* is capable of conducting high energy seismic surveys using up to 36 airguns with a discharge volume of 6600 in^3, the proposed seismic survey would only use a small towed subarray of 4 airguns with a total discharge volume of ~700 in^3, which is the smaller powered of two source levels planned and used during the 2014 survey. The seismic survey would take place outside of U.S. state waters within the U.S. Exclusive Economic Zone (EEZ) in water depths ~20–75 m.

NSF, as the funding agency, has a mission to "promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense…". The proposed rescheduled seismic survey would collect data in support of a research proposal that was reviewed under the NSF merit review process and identified as an NSF program priority. A two-year continuing grant, contingent upon obtaining appropriate authorizations and completion of the NSF environmental review process, was awarded on 15 January 2014 and funds for both years have been released. The survey would provide data necessary to study the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to present and enable follow-on studies to identify the magnitude, time, and impact of major changes in sea level.

The survey was originally proposed and approved for implementation in 2014. NSF's environmental compliance process, including meeting all federal statutory and regulatory obligations, was completed for the survey on 1 July 2014, and the survey commenced. Because of mechanical issues with the vessel, the survey was unable to be completed during the effective periods set forth in the Incidental Harassment Authorization (IHA) and Incidental Take Statement (ITS) issued for the survey. According to the U.S. National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS), although the research objectives and survey had not changed from what was approved in 2014, a new IHA was required to conduct the same survey during a rescheduled time in 2015. A Draft Amended Environmental Assessment (EA) was prepared on behalf of NSF pursuant to the National Environmental Policy Act (NEPA) to address any environmental impacts associated with the rescheduled time for the survey, and in support of other necessary regulatory processes, including the IHA process. The Draft Amended EA was available for a 52-day public comment period. The Draft Amended EA was used as a basis for preparing this Final Amended EA. Comments received on the Draft Amended EA during the public comment period and consultations with regulating agencies were taken into consideration when preparing this Final Amended EA.

As operator of the *Langseth*, L-DEO, on behalf of itself, NSF, and Rutgers University, requested an IHA from NMFS to authorize the incidental, i.e., not intentional, harassment of small numbers of marine mammals should that occur during the proposed rescheduled seismic survey. The analysis in the Draft Amended EA supported the IHA application process and provided information on marine species not addressed by the IHA application, including seabirds and sea turtles that are listed under the U.S. Endangered Species Act (ESA), including candidate species. As analysis on endangered/threatened species was included, the Draft Amended EA was used to support ESA Section 7 consultations with NMFS and U.S. Fish and Wildlife Service (USFWS). The Draft Amended EA was also used in support of consultation with NMFS Greater Atlantic Regional Fisheries Office for Essential Fish Habitat (EFH)

under the Magnuson-Stevens Act and preparation of Consistency Determinations (CDs) pursuant to the Coastal Zone Management Act (CZMA). Alternatives addressed in the Final Amended EA consist of a corresponding program at a different time with issuance of an associated IHA and the no action alternative, with no IHA and no seismic survey. This Final Amended EA tiers to the Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey (June 2011) and Record of Decision (June 2012), referred to herein as PEIS. It also tiers to the "Final Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, July–Mid August 2014" (2014 Final EA), which was prepared for the 2014 survey. The proposed survey area off the coast of New Jersey is near one of the detailed analysis areas (DAAs) in the PEIS; however, this Final Amended EA and the 2014 Final EA were prepared because a different energy source level and configuration would be used for the proposed survey, and the proposed survey covers only shelf waters whereas the DAA was on the shelf and slope. Additionally, this Final Amended EA addresses the differences from and updates to the 2014 Final EA.

Various species of marine mammals inhabit the proposed survey area off the coast of New Jersey during certain times of the year. Several of these species are listed as ***endangered*** under the ESA: the sperm, North Atlantic right, humpback, sei, fin, and blue whales. Other ESA-listed species that could occur in the area are the ***endangered*** leatherback, hawksbill, green, and Kemp's ridley turtles and roseate tern, and the ***threatened*** loggerhead turtle and piping plover. The ***endangered*** Atlantic sturgeon and shortnose sturgeon could also occur in or near the study area. ESA-listed ***candidate species*** that could occur in the area are the cusk and dusky shark.

Potential impacts of the proposed rescheduled seismic survey on the environment would be primarily a result of the operation of the airgun array. A multibeam echosounder (MBES) and sub-bottom profiler (SBP) would also be operated. Impacts would be associated with underwater noise, which could result in avoidance behavior by some marine mammals, sea turtles, seabirds, and fish, and other forms of disturbance. An integral part of the planned survey is a monitoring and mitigation program designed to minimize potential impacts of the proposed activity on marine animals present during the proposed research, and to document as much as possible the nature and extent of any effects. Injurious impacts to marine mammals, sea turtles, and seabirds have not been proven to occur near airgun arrays, and are not likely to be caused by the other types of sound sources proposed to be used. However, despite the relatively low levels of sound emitted by the subarray of airguns, a precautionary approach would still be taken. The planned monitoring and mitigation measures would reduce the possibility of any effects.

As was the case with the approved 2014 survey, protection measures designed to mitigate the potential environmental impacts to marine mammals and sea turtles would include the following: ramp ups; typically two, but a minimum of one dedicated observer maintaining a visual watch during all daytime airgun operations; two observers 30 min before and during ramp ups during the day and at night; no start ups during poor visibility or at night unless at least the mitigation airgun has been operating; passive acoustic monitoring (PAM) via towed hydrophones during both day and night to complement visual monitoring (unless operational issues prevent it or the system and back-up system are both damaged during operations); and power downs (or if necessary shut downs) when marine mammals or sea turtles are detected in or about to enter designated exclusion zones. Per the IHA, during operations, a one 1-min shot interval would be used for the mitigation source, and source shutdown would occur if concentrations of large whales were encountered. NSF, Rutgers, L-DEO, and its contractors are committed to applying these measures in order to minimize potential effects on marine mammals and sea turtles and other environmental impacts.

With the planned monitoring and mitigation measures, unavoidable impacts to each species of marine mammal and sea turtle that could be encountered would be expected to be limited to short-term, localized changes in behavior and distribution near the seismic vessel. At most, effects on marine mammals may be interpreted as falling within the U.S. Marine Mammal Protection Act (MMPA) definition of "Level B Harassment" for those species managed by NMFS. No long-term or significant effects would be expected on individual marine mammals, sea turtles, seabirds, fish, the populations to which they belong, or their habitats.

LIST OF ACRONYMS

~	approximately
ALWTRP	Atlantic Large Whale Take Reduction Plan
AMVER	Automated Mutual-Assistance Vessel Rescue
BOEM	Bureau of Ocean Energy Management
CEQ	Council of Environmental Quality
CETAP	Cetacean and Turtle Assessment Program
CITES	Convention on International Trade in Endangered Species
CZMA	Coastal Zone Management Act
DAA	Detailed Analysis Area
dB	decibel
DoN	Department of the Navy
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ESA	(U.S.) Endangered Species Act
EZ	Exclusion Zone
FAO	Food and Agriculture Organization of the United Nations
FM	Frequency Modulated
GIS	Geographic Information System
h	hour
hp	horsepower
HRTRP	Harbor Porpoise Take Reduction Plan
Hz	Hertz
IHA	Incidental Harassment Authorization (under MMPA)
in	inch
IOC	Intergovernmental Oceanographic Commission of UNESCO
IODP	Integrated Ocean Drilling Program
IUCN	International Union for the Conservation of Nature
kHz	kilohertz
km	kilometer
kt	knot
L-DEO	Lamont-Doherty Earth Observatory
LFA	Low-frequency Active (sonar)
m	meter
min	minute
MBES	Multibeam Echosounder
MFA	Mid-frequency Active (sonar)
MMPA	(U.S.) Marine Mammal Protection Act
ms	millisecond
NEPA	(U.S.) National Environmental Policy Act
NJ	New Jersey
NEFSC	Northeast Fisheries Science Center
NMFS	(U.S.) National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration

NRC	(U.S.) National Research Council
NSF	National Science Foundation
OBIS	Ocean Biogeographic Information System
OCM	(NOAA) Office for Coastal Management
OCS	Outer Continental Shelf
OEIS	Overseas Environmental Impact Statement
OAWRS	Ocean Acoustic Waveguide Remote Sensing
p or pk	peak
PEIS	Programmatic Environmental Impact Statement
PI	Principal Investigator
PTS	Permanent Threshold Shift
PSO	Protected Species Observer
RL	Received level
rms	root-mean-square
R/V	research vessel
s	second
SAR	U.S. Marine Mammal Stock Assessment Report
SBP	Sub-bottom Profiler
SCUBA	Self-contained underwater breathing apparatus
SEFSC	Southeast Fisheries Science Center
TTS	Temporary Threshold Shift
SEL	Sound Exposure Level
SPL	Sound Pressure Level
UME	Unusual mortality event
UNEP	United Nations Environment Programme
U.S.	United States of America
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
USN	U.S. Navy
μPa	microPascal
vs.	versus
WCMC	World Conservation Monitoring Centre

I. PURPOSE AND NEED

The purpose of this Final Amended Environmental Assessment (EA) is to provide the information needed to assess the potential environmental impacts associated with the rescheduling of a previously approved marine geophysical survey that would use a 4-airgun subarray during the proposed seismic survey off the coast of New Jersey. The survey was originally proposed for implementation in July–mid August 2014. NSF's environmental compliance process, including meeting all federal legal and regulatory obligations, was completed for the project on 1 July 2014, and the survey commenced. Because of mechanical issues with the vessel, the survey was unable to be completed during the effective periods of the Incidental Harassment Authorization (IHA) and Incidental Take Statement (ITS) issued for the survey. According to NMFS, a new IHA Application was required to reschedule the survey in 2015.

This Final Amended EA was prepared pursuant to the National Environmental Policy Act (NEPA), and tiers to the Programmatic Environmental Impact Statement (PEIS)/Overseas Environmental Impact Statement (OEIS) for Marine Seismic Research funded by the National Science Foundation or Conducted by the U.S. Geological Survey (NSF and USGS 2011) and Record of Decision (NSF 2012), referred to herein as the PEIS. It also tiers to the "Final Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, July–Mid August 2014" (2014 Final EA), which was prepared for the 2014 survey. The proposed rescheduled survey area off the coast of New Jersey is near one of the detailed analysis areas (DAAs) presented in the PEIS; however, a different energy source level and configuration would be used for the proposed rescheduled survey, which covers only shelf waters, whereas the DAA was on the shelf and slope. This Final Amended EA was prepared to consider the survey proposed for 2015, provide updates, and address differences in the analysis prepared for the 2014 survey and the PEIS DAA. The Final Amended EA provides details of the proposed action at the site-specific level and addresses potential impacts of the proposed rescheduled seismic survey on marine mammals, as well as other species of concern in the area, including sea turtles, seabirds, fish, and invertebrates. This Final Amended EA was based on analysis prepared in a Draft Amended EA. The Draft Amended EA was used in support of an application for an Incidental Harassment Authorization (IHA) from the National Marine Fisheries Service (NMFS), Section 7 consultations under the Endangered Species Act (ESA), and preparation of Consistency Determinations (CDs) under the Coastal Zone Management Act (CZMA). The IHA allows for non-intentional, non-injurious "take by harassment" of small numbers of marine mammals[1] during the proposed rescheduled seismic survey directed by Rutgers in the Atlantic Ocean off New Jersey. The Draft Amended EA was used in support of consultation with NMFS Greater Atlantic Regional Fisheries Office for Essential Fish Habitat (EFH) under the Magnuson-Stevens Act. The Draft Amended EA was made available for a 52-day public comment period. Public comments received and discussions during consultations with regulatory agencies were taken into consideration when preparing this Final Amended EA.

Mission of NSF

NSF was established by Congress under the National Science Foundation Act of 1950 (Public Law 810507, as amended) and is the only federal agency dedicated to the support of fundamental research and

[1] To be eligible for an IHA under the U.S. Marine Mammal Protection Act (MMPA), the proposed "taking" (with mitigation measures in place) must not cause serious physical injury or death of marine mammals, must have negligible impacts on the species and stocks, must "take" no more than small numbers of those species or stocks, and must not have an unmitigable adverse impact on the availability of the species or stocks for legitimate subsistence uses.

education in all scientific and engineering disciplines. Further details on the mission of NSF are described in § 1.2 of the PEIS.

Purpose of and Need for the Proposed Action

As noted in the PEIS, § 1.3, NSF, based on its mission, has a continuing need to fund seismic surveys that enable scientists to collect data essential to understanding complex Earth processes recorded in sediments on and beneath the ocean floor. NSF fulfills this need through funding research such as seismic surveys. The proposed collaborative research objectives and efforts associated with the proposed rescheduled survey remain unchanged from those planned in 2014. The purpose of the proposed action is to collect data across existing Integrated Ocean Drilling Program (IODP) Expedition 313 drill sites on the inner-middle shelf of the New Jersey continental margin to reveal the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to the present. Features such as river valleys cut into coastal plain sediments, now buried under a km of younger sediment and flooded by today's ocean, cannot be identified and traced with existing two-dimensional (2-D) seismic data, despite their existence being clearly indicated in sediment cores recovered during IODP Expedition 313. These and other erosional and depositional features would be imaged using three-dimensional (3-D) seismic data and would enable follow-on studies to identify the magnitude, time, and impact of major changes in sea level. The proposed rescheduled seismic survey would collect data in support of a research proposal (Appendix B) that has been reviewed under the NSF merit review process and identified as an NSF program priority to meet NSF's critical need to foster an understanding of Earth processes.

Background of NSF-funded Marine Seismic Research

The background of NSF-funded marine seismic research is described in § 1.5 of the PEIS.

Statutory and Regulatory Setting

The statutory and regulatory setting of this Final Amended EA is described in § 1.8 of the PEIS, including the

- National Environmental Protection Act (NEPA);
- Marine Mammal Protection Act (MMPA);
- Endangered Species Act (ESA);
- Magnuson-Stevens Act for Essential Fish Habitat (EFH); and
- Coastal Zone Management Act (CZMA).

II. Alternatives Including Proposed Action

In this Final Amended EA, three alternatives are evaluated: (1) the proposed rescheduled seismic survey and issuance of an associated IHA, (2) a corresponding seismic survey at an alternative time, along with issuance of an associated IHA, and (3) a no action alternative. Additionally, two alternatives were considered but were eliminated from further analysis. A summary table of the proposed action, alternatives, and alternatives eliminated from further analysis is provided at the end of this section.

Proposed Action

The project objectives and context, activities, and mitigation measures for Rutgers' proposed rescheduled seismic survey are described in the following subsections. The proposed action remains the same as those described for the 2014 survey, except where noted.

(1) Project Objectives and Context

Rutgers proposes to conduct a 3-D seismic survey using Columbia University's Lamont-Doherty Earth Observatory (L-DEO) operated Research Vessel (R/V) *Marcus G. Langseth* (*Langseth*) on the inner-middle shelf of the New Jersey continental margin (Fig. 1). As noted previously, the goal of the proposed research is to collect and analyze data on the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to present. Despite their existence being clearly indicated in sediment cores recovered during IODP Expedition 313, features such as river valleys cut into coastal plain sediments, now buried under a km of younger sediment and flooded by today's ocean, cannot be resolved in existing 2-D seismic data to the degree required to map shifting shallow-water depositional settings in the vicinity of clinoform rollovers. To achieve the project's goals, the lead Principal Investigator (PI), Dr. G. Mountain (Rutgers University), and collaborating PIs Drs. J. Austin, C. Fulthorpe, and M. Nedimović (University of Texas at Austin), propose to use a 3-D seismic reflection survey to map sequences around existing IODP Expedition 313 drill sites and analyze their spatial/temporal evolution. Objectives that would then be met include establishing the impact of known Ice House base-level changes on the stratigraphic record; providing greater understanding of the response of nearshore environments to changes in elevation of global sea level; and determining the amplitudes and timing of global sea-level changes during the mid-Cenozoic. The project objectives remain the same as those described for the 2014 survey.

(2) Proposed Activity

(a) Location of the Activity

The proposed 3-D box/survey area is located in the Atlantic Ocean, ~33–92 km off the coast of New Jersey and 27–87 km from New Jersey state waters (Fig. 1). This area is defined by the coordinates at the four corners (including turns and run-in and run-out of each line) in degrees and decimal minutes: 39°38.00'N, 73°44.36'W; 39°43.12'N, 73°41.00'W; 39°25.30'N, 73°06.12'W; and 39°20.06'N, 73°10.06'W.

Water depths across the survey area are ~20–75 m. The proposed rescheduled seismic survey would be conducted outside of state waters and within the U.S. EEZ during ~30 days between June and August 2015. Although the proposed survey area is near the NW Atlantic DAA described in the PEIS, it does not include intermediate- and deep-water depths. The survey location would be the same as that for the 2014 survey.

(b) Description of the Activity

The procedures to be used for the proposed rescheduled survey would be the same as those proposed for the 2014 survey and similar to those used during previous NSF-funded seismic surveys and would use conventional seismic methodology. The proposed rescheduled survey would involve one source vessel, the *Langseth*, which is owned by NSF and operated on its behalf by Columbia University's L-DEO through a Cooperative Agreement entered into in 2012, and one support vessel. The *Langseth* would deploy two pairs of subarrays of 4 airguns as an energy source; the subarrays would fire alternately, with a total volume of ~700 in^3. The receiving system would be a passive component of the proposed activity and would consist of a system of hydrophones: four 3000-m hydrophone streamers at 75-m spacing, or preferentially, a combination of one 3000-m hydrophone streamer and a Geometrics P-Cable system. As the airgun array is towed along the survey lines, the hydrophone streamers would receive the returning acoustic signals and transfer the data to the on-board processing system.

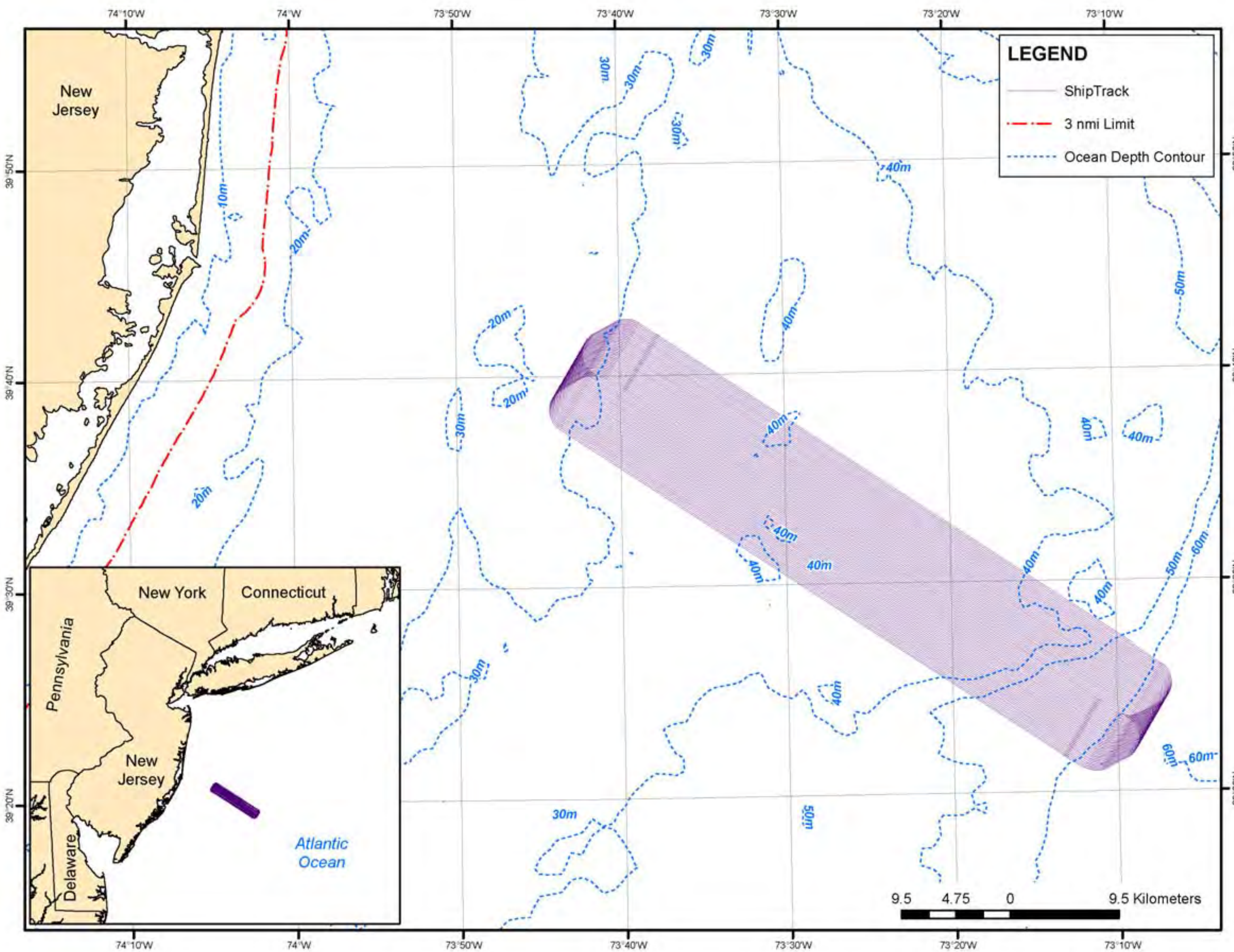

FIGURE 1. Location of the proposed seismic survey in the Atlantic Ocean off the coast of New Jersey.

A total of ~4900 km of 3-D survey lines, including turns, would be shot in an area 12 x 50 km with a line spacing of 150 m in two 6-m wide race-track patterns (Fig. 1). There would be additional seismic operations in the survey area associated with airgun testing and repeat coverage of any areas where initial data quality is sub-standard. In our calculations [see § IV(3)], 25% has been added for those additional operations. The survey parameters noted here support the proposed research goals and therefore differ from the NW Atlantic DAA survey parameters presented in the PEIS. The same transect lengths and area of survey proposed for 2015 was analyzed for the 2014 survey. Because of mechanical/equipment issues on the survey vessel along with weather issues (including Hurricane Arthur), the full 3-D array of equipment could not be deployed in 2014. Given equipment limitations, only ~61 h of seismic survey data were collected in 2014, with only ~43 h at full power (700 in^3) on survey tracklines. Of the 43 h of data collected, ~22 h were of substandard data quality because of equipment damage from rough seas. However, the existing data did allow confirmation that the smaller 700-in^3 source array was suitable for the project, therefore eliminating potential use of the larger 1400-in^3 array originally proposed in 2014.

In addition to the operations of the airgun array, a multibeam echosounder (MBES) and a sub-bottom profiler (SBP) would be operated from the *Langseth* continuously throughout the survey, but not during transits. All planned geophysical data acquisition activities would be conducted with on-board assistance by the scientists who have proposed the study. The vessel would be self-contained, and the crew would live aboard the vessel with some personnel transfer on/off the *Langseth* by a small vessel.

(c) Schedule

The *Langseth* would depart from New York and spend ~8 h in transit to the proposed survey area. Setup, deployment, and streamer ballasting would take ~3 days. The seismic survey would take 30 days plus 2 contingency days, and the *Langseth* would spend one day for gear retrieval and transit back to New York. The survey would be conducted during summer (June–August) 2015. Operations could be delayed or interrupted because of a variety of factors including equipment malfunctions and weather-related issues, but use of the airguns would not occur outside of the effective IHA period.

(d) Vessel Specifications

The *Langseth* is described in § 2.2.2.1 of the PEIS. The vessel speed during seismic operations would be ~4.5 kt (~8.3 km/h).

The support vessel would be a multi-purpose offshore utility vessel similar to the *Northstar Commander*, which is 28 m long with a beam of 8 m and a draft of 2.6 m. It is powered by a twin-screw Volvo D125-E, with 450 hp for each screw.

(e) Airgun Description

During the proposed rescheduled survey, the airgun array to be used would be the full 4-string array with most of the airguns turned off (see § II 3(a) for an explanation of the source level selection). The active airguns would be 4 airguns in one string on the port side forming Source 1, and 4 airguns in one string on the starboard side forming Source 2. These identical port and starboard sources would be operated in "flip-flop" mode, firing alternately as the ship progresses along the track, as is common for 3-D seismic data acquisition. Therefore, the source volume would not exceed 700 in^3 at any time. Whereas the full array is described and illustrated in § 2.2.3.1 of the PEIS, the smaller subarrays proposed for this survey are described further in Appendix A. The subarrays would be towed at a depth of 4.5 or 6 m. The shot interval would be ~5-6 s (~12.5 m). Because the choice of the precise tow depth would not be made until the survey because of sea and weather conditions, we have assumed the use of 6 m for the impacts analysis and take estimate calculations, as that results in the farthest sound propagation. Mitigation zones have been calculated for the source level and tow depths, (see below and Appendix A, Table A2), and during operations the relevant mitigation zone would be applied.

During the attempted survey in 2014, the 700-in^3 airgun array was determined to be sufficient to image the geological targets of research interest. Therefore, the 1400-in^3 array proposed as an operational possibility in the 1 July 2014 Final EA was eliminated from the analysis in the Draft Amended EA and this Final Amended EA.

(f) Additional Acoustical Data Acquisition Systems

Along with the airgun operations, two additional acoustical data acquisition systems would be operated during the survey, but not during transits: an MBES and a SBP. The ocean floor would be mapped with the Kongsberg EM 122 MBES and a Knudsen Chirp 3260 SBP. These sources are described in § 2.2.3.1 of the PEIS.

(3) Monitoring and Mitigation Measures

Standard monitoring and mitigation measures for seismic surveys are described in § 2.4.4.1 of the PEIS and are described to occur in two phases: pre-cruise planning and during operations. The following sections describe the efforts during both stages for the proposed actions.

(a) Planning Phase

As discussed in § 2.4.1.1 of the PEIS, mitigation of potential impacts from the proposed activity begins during the planning phase of the proposed activity. Several factors were considered during the planning phase of the proposed activity, including

1. Energy Source—Part of the considerations for the proposed rescheduled survey was to evaluate whether the research objectives could be met with a smaller energy source than the full, 36-airgun, 6600-in^3 *Langseth* array, and it was decided that the scientific objectives could be met using an energy source comprising 4 airguns (total volume 700 in^3 volume) towed at a depth of ~4.5 or 6 m. Two such subarrays of 4 airguns would be used alternately (flip-flop mode); one would be towed on the port side, the other on the starboard side. Therefore, the source volume would not exceed 700 in^3 at any time. We have assumed in the impacts analysis and take estimate calculations the use of the 4-airgun array towed at 6 m as that would result in the farthest sound propagation. Based on the research goals and current knowledge of environmental conditions in the survey area based on the 2014 activity, the 1400-in^3 source level proposed for possible use in 2014 is no longer viewed necessary and has not been included in this analysis. For the DAA off the coast of New Jersey included in the PEIS, the energy source level analyzed was a pair of 45/105-in^3 Generator-Injector (GI) guns, but this source level was not viewed as adequate for meeting the research goals of the proposed survey.
2. Survey Timing—The PIs worked with L-DEO and NSF to identify potential times to carry out the survey taking into consideration key factors such as environmental conditions (i.e., the seasonal presence of marine mammals, sea turtles, and seabirds), weather conditions, personnel, equipment, and optimal timing for other proposed seismic surveys using the *Langseth*. Some marine mammal species are expected to occur in the area year-round, so altering the timing of the proposed project likely would result in no net benefits for those species. Some migratory species are expected to be farther north at the time of the survey, so the survey timing is beneficial for those species.
3. Mitigation Zones—During the planning phase, mitigation zones for the proposed rescheduled survey were calculated based on modeling by L-DEO for both the exclusion zone (EZ) and the

safety zone; these zones are given in Table 1 and Appendix Table A2. A more detailed description of the modeling process used to develop the mitigation zones can be found in Appendix A. Received sound levels in deep water have been predicted by L-DEO for the 4-airgun array and the single Bolt 1900LL 40-in^3 airgun that would be used during power downs. Scaling factors between those arrays and the 18-airgun, 3300-in^3 array, taking into account tow depth differences, were developed and applied to empirical data for the 18-airgun array in shallow water in the Gulf of Mexico from Diebold et al. (2010). The use of the 4-airgun array towed at 6 m is assumed in the impacts and take estimate analysis as that would result in the farthest sound propagation. During actual operations, however, the corresponding mitigation zone would be applied for the selected source level. The 1 July 2014 Final EA included mitigation zones and take calculations for a 1400-in^3 array, however, that source level has been determined to be unnecessary and is not included in this analysis.

Table 1 shows the 180-decibel (dB) EZ and 160-dB "Safety Zone" (distances at which the rms sound levels are expected to be received) for the mitigation airgun and the 4-airgun subarray. The 160 and 180-dB re 1 μPa_{rms} distances are the criteria currently specified by NMFS (2000) for cetaceans. The 180-dB distance has also been used as the EZ for sea turtles, as required by NMFS in most other recent seismic projects per the IHAs. Pursuant to the Biological Opinion (BO) issued in 2014 and that issued in 2015 (Appendix C), a 166-dB distance would be used for Level B takes for sea turtles. Per the IHA for the survey issued in 2014 (Appendix D of the 1 July 2014 Final EA), the EZ was increased by 3 dB (therefore operational mitigation would be at the 177-dB isopleth), which added ~50% to the power-down/shut-down radius, but the IHA issued in 2015 (Appendix D) did not increase the EZ. NSF is in agreement with the EZ approach taken in the 2015 IHA and does not view the overly precautionary approach of increasing the EZ taken in the 2014 IHA as appropriate; therefore, it is not included here. A recent retrospective analysis of acoustic propagation of *Langseth* sources in a coastal/shelf environment from the Cascadia Margin off Washington suggests that predicted (modeled) radii (using an approach similar to that used here) for *Langseth* sources were 2–3 times larger than measured in shallow water, so in fact were very conservative (Crone et al. 2014). Similarly, preliminary analysis by Crone (2015, pers. comm.) of data collected during the 2014 survey off New Jersey confirmed that *in situ* measurements and estimates of the 160- and 180-dB distances collected by the *Langseth* hydrophone streamer were significantly smaller than the predicted operational mitigation radii.

Southall et al. (2007) made detailed recommendations for new science-based noise exposure criteria. In December 2013, the National Oceanic and Atmospheric Administration (NOAA) published draft guidance for assessing the effects of anthropogenic sound on marine mammals (NOAA 2013a), although at the time of preparation of this Final Amended EA, the date of release of the final guidelines and how they would be implemented are unknown. As such, this Final Amended EA has been prepared in accordance with the current NOAA acoustic practices, and the procedures are based on best practices noted by Pierson et al. (1998), Weir and Dolman (2007), Nowacek et al. (2013), and Wright (2014).

Enforcement of mitigation zones via power and shut downs would be implemented in the Operational Phase, as noted below and prescribed by the IHA.

TABLE 1. Predicted distances to which sound levels ≥180 and 160 dB re 1 μPa_{rms} would be received during the proposed 3-D survey off New Jersey, using a 4-airgun, 700-in^3 subset of 1 string at 4.5- or 6-m tow depth and the 40-in^3 airgun. Radii are based on scaling described in the text of Appendix A and Figures A2 to A6, and the assumption that received levels on an rms basis are, numerically, 10 dB higher than the SEL values.[2]

Source and Volume	Water Depth	Predicted RMS Radii (m)	
		180 dB	160 dB
4-airgun subarray (700 in^3) @ 4.5 m	<100 m	378	5240
4-airgun subarray (700 in^3) @ 6 m	<100 m	439	6100
Single Bolt airgun (40 in^3) @ 6 m	<100 m	73	995

(b) Operational Phase

Marine species, including marine mammals and sea turtles, are known to occur in the proposed survey area. However, the number of individual animals expected to be approached closely during the proposed activity would be relatively small in relation to regional population sizes. To minimize the likelihood that potential impacts could occur to the species and stocks, monitoring and mitigation measures proposed during the operational phase of the proposed activity, which are consistent with the PEIS and past IHA requirements, include

1. monitoring by protected species observers (PSOs) for marine mammals, sea turtles, seabirds, and fish;
2. passive acoustic monitoring (PAM);
3. PSO data and documentation;
4. mitigation during operations (speed or course alteration; power-down, shut-down, and ramp-up procedures; and special mitigation measures for rare species, species concentrations, and sensitive habitats).

The proposed operational mitigation measures are standard for all high-energy seismic surveys, per the PEIS, and, therefore, are not discussed further here. Special mitigation measures were considered for this proposed survey. Although it is very unlikely that a North Atlantic right whale would be encountered, the airgun array would be shut down if one is sighted at any distance from the vessel because of the species' rarity and conservation status. It is also unlikely that concentrations of large whales of any species would be encountered, but if so, they would be avoided, or the airgun array would be powered down. The latter is a new mitigation measure specified in the 2015 IHA, as is defining "concentrations" as groups of 6 or more individuals that do not appear to be traveling, and using a 1-min shot interval for the mitigation airgun. NSF, L-DEO and Rutgers would be committed to implementing the requirements set forth in the IHA and ITS.

[2] Sound sources are primarily described in sound pressure level (SPL) units. SPL is often referred to as rms or "root mean square" pressure, averaged over the pulse duration. Sound exposure level (SEL) is a measure of the received energy in a pulse and represents the SPL that would be measured if the pulse energy were spread evenly over a 1-s period.

With the proposed monitoring and mitigation provisions, potential effects on most if not all individuals would be expected to be limited to minor behavioral disturbances. Those potential effects would be expected to have negligible impacts both on individual marine mammals and on the associated species and stocks. Ultimately, survey operations would be conducted in accordance with all applicable U.S. federal regulations and IHA requirements.

Alternative 1: Alternative Survey Timing

An alternative to issuing the IHA for the period requested and to conducting the project then would be to conduct the project at an alternative time, such as late spring or early fall (avoiding the North Atlantic right whale migration season) implementing the same monitoring and mitigation measures as under the Proposed Action, and requesting an IHA to be issued for that alternative time. An evaluation of the effects of this Alternative Action is given in § IV.

Alternative 2: No Action Alternative

An alternative to conducting the proposed activity is the "No Action" alternative, i.e., do not request that an IHA be issued and do not allow the proposed rescheduled research operations to be conducted. If the research is not conducted, the "No Action" alternative would result in no disturbance to marine mammals because of the absence of the proposed activity. Although the No-Action Alternative is not considered a reasonable alternative because it does not meet the purpose and need for the Proposed Action, per Council of Environmental Quality (CEQ) regulations it is included and carried forward for analysis in § IV.

Alternatives Considered but Eliminated from Further Analysis

(1) Alternative E1: Alternative Location

The New Jersey continental margin has for decades been recognized as among the best siliciclastic passive margins for elucidating the timing and amplitude of eustatic change during the "Ice House" period of Earth history, when glacioeustatic changes shaped continental margin sediment sections around the world. There is a fundamental need to constrain the complex forcing functions tying evolution and preservation of the margin stratigraphic record to base-level changes. This could be accomplished by following the transect strategy adopted by the international scientific ocean drilling community. This strategy involves integration of drilling results with seismic imaging. In keeping with this strategy, the proposed rescheduled seismic survey would acquire a 3-D seismic volume encompassing the three existing IODP Expedition 313 (Exp313) drill sites on the inner-middle shelf of the New Jersey margin. Exp313, the latest chapter in the multi-decade Mid-Atlantic Transect, represents the scientific community's best opportunity to link excellently sampled and logged late Paleogene-Neogene prograding clinoforms to state-of-the-art 3-D images. Exp313 borehole data would provide lithostratigraphy, geochronology, and paleobathymetry. 3-D seismic imaging would put these sampled records in a spatially accurate, stratigraphically meaningful context. Such imagery would allow researchers to map sequences around Exp313 sites with a resolution and confidence previously unattainable, and to analyze their spatio-temporal evolution.

No other scientific ocean drilling boreholes are available on the New Jersey shelf or elsewhere that provide such high sediment recoveries and high-quality well logs as those of Exp313. The need to tie the proposed 3-D survey to Exp313 drill sites means that it is not possible to conduct the survey in a different area. Also, positioning a 3-D volume requires broad coverage by pre-existing 2-D seismic data. Such data, collected over more than two decades, are readily available on the New Jersey shelf. Furthermore, the proposed research underwent the NSF merit review process, and the science, including the site location, was determined to be meritorious.

(2) Alternative E2: Use of Alternative Technologies

As described in § 2.6 of the PEIS, alternative technologies to the use of airguns were investigated to conduct high-energy seismic surveys. At the present time, these technologies are still not feasible, commercially viable, or appropriate to meet the Purpose and Need. Additional details about these technologies are given in the Final USGS EA (RPS 2014a).

Table 2 provides a summary of the proposed action, alternatives, and alternatives eliminated from further analysis.

TABLE 2. Summary of Proposed Action, Alternatives Considered, and Alternatives Eliminated.

Proposed Action	Description
Proposed Action: Conduct a marine geophysical survey in the Atlantic Ocean off New Jersey	Under the Proposed Action, a 3-D seismic reflection survey would take place in the Atlantic Ocean off New Jersey during the summer of 2015. When considering transit; equipment deployment, maintenance, and retrieval; weather; marine mammal activity; and other contingencies, the proposed activity would be expected to be completed in ~36 days. The standard monitoring and mitigation measures identified in the NSF PEIS would apply and are described in further detail in this document (§ II [3]), along with the requirements identified by the federal regulating agencies. All necessary permits and authorizations, including an IHA, were requested and received from regulatory bodies in 2014 and again in 2015.
Alternatives	Description
Alternative 1: Alternative Survey Timing	Under this Alternative, the survey operations would be conducted at a different time of the year, such as late spring or early fall. The standard monitoring and mitigation measures identified in the NSF PEIS would apply. These measures are described in further detail in this document (§ II [3]) and would apply to survey activity conducted during an alternative survey time period, along with any additional requirements identified by federal regulating agencies as a result of the proposed change. All necessary permits and authorizations, including an IHA, would be requested from the regulatory bodies.
Alternative 2: No Action	Under this Alternative, no proposed activity would be conducted and seismic data would not be collected. No permits and authorizations, including an IHA, would be requested from regulatory bodies, as the Proposed Action would not be conducted.
Alternatives Eliminated from Further Analysis	Description
Alternative E1: Alternative Location	The survey location has been specifically identified because of the data available for that location, including borehole data from three IODP Expedition 313 drill sites that would provide lithostratigraphy, geochronology, and paleobathymetry, and broad coverage by pre-existing 2-D seismic data. The proposed 3-D seismic imaging would put these sampled records in a spatially accurate, stratigraphically meaningful context. Such imagery would allow researchers to map sequences around the drill sites with a resolution and confidence previously unattainable, and to analyze their spatio-temporal evolution. Furthermore, the proposed science underwent the NSF merit review process, and the science, including the site location, was determined to be meritorious. Therefore, conducting the proposed survey at a different location was eliminated from further consideration.
Alternative E2: Alternative Survey Techniques	Under this Alternative, alternative survey techniques would be used, such as marine vibroseis, which could potentially reduce impacts on the marine environment. Alternative technologies were evaluated in the PEIS, § 2.6. At the present time, however, these technologies are still not feasible, commercially viable, or appropriate to meet the Purpose and Need. NSF currently owns the *Langseth*, and its primary capability is to conduct seismic surveys; no other viable technologies are available to NSF. Therefore, this Alternative was eliminated from further consideration.

III. AFFECTED ENVIRONMENT

As described in the PEIS, Chapter 3, the description of the affected environment focuses only on those resources potentially subject to impacts. Accordingly, the discussion of the affected environment (and associated analyses) has focused mainly on those related to marine biological resources, as the proposed short-term activity has the potential to impact marine biological resources within the proposed Project area. These resources are identified in Section III, and the potential impacts to these resources are discussed in Section IV. Initial review and analysis of the proposed Project activity determined that the following resource areas did not require further analysis in this Final Amended EA:

- *Air Quality/Greenhouse Gases*—Project vessel emissions would result from the proposed activity; however, these short-term emissions would not result in any exceedance of federal Clean Air standards. Emissions would be expected to have a negligible impact on the air quality within the survey area;
- *Land Use*—All proposed activities would be in the marine environment. Therefore, no changes to current land uses or activities in the Project area would result from the proposed Project;
- *Safety and Hazardous Materials and Management*—No hazardous materials would be generated or used during proposed activities. All Project-related wastes would be disposed of in accordance with federal and international requirements;
- *Geological Resources (Topography, Geology and Soil)*—The proposed Project would result in no displacement of soil and seafloor sediments. The proposed activity would not adversely affect geologic resources as no impacts would occur;
- *Water Resources*—No discharges to the marine environment are proposed within the Project area that would adversely affect marine water quality. Therefore, there would be no impacts to water resources resulting from the proposed Project activity;
- *Terrestrial Biological Resources*—All proposed Project activities would occur in the marine environment and would not impact terrestrial biological resources;
- *Socioeconomic and Environmental Justice*—Implementation of the proposed Project would not affect, beneficially or adversely, socioeconomic resources, environmental justice, or the protection of children. No changes in the population or additional need for housing or schools would occur. Because of the location of the proposed activity and distance from shore, human activities in the area around the survey vessel would be limited to SCUBA diving, commercial and recreational fishing activities and other vessel traffic. Because of the nature and location of the proposed activity, no impacts would be expected on marine-related local businesses such as coastal restaurants, hotels, and bait and tackle shops. Fishing, SCUBA diving, vessel traffic, and potential impacts are described in further detail in §§ III and IV. Additionally, there is a marine mammal watching industry in New Jersey. Because of the distance from shore to the proposed survey site, it is unlikely that marine mammal watching boat tours would coincide with the proposed survey site or be impacted by the proposed activity. Most activities are conducted within ~20 km of the coast, with the majority occurring closer inshore. Some boat tours occur well south (~100 km) of the proposed survey area around Cape May and in Delaware Bay. Some dolphin watching cruises take place off Atlantic City fairly close to shore. Tours typically are ~1.5–3 h long. Although marine mammals around the seismic survey may avoid the vessel during operations, this behavior would be of short duration and temporary. Given the distance from shore to the proposed activity, the likely distance from any of the few marine mammal

watching activities, and the short and temporary duration of any potential impacts to marine mammals, it would be unlikely that the marine mammal watching industry would be affected by the proposed activity, and, therefore, this issue is not analyzed further in this assessment. Furthermore, no whale watching vessels were encountered by the *Langseth* during the ~13 days the vessel was in the survey area in 2014. No other socioeconomic impacts would be expected as a result of the proposed activity;

- *Visual Resources*—No visual resources would be expected to be negatively impacted as the area of operation is significantly outside of the land and coastal view shed; and
- *Cultural Resources*—With the following possible exceptions, there are no known cultural resources in the proposed Project area. One shipwreck, a known dive site, is in or near the survey area (see Fig. 2 in § III): the *Lillian* (Galiano 2009; Fisherman's Headquarters 2014; NOAA 2014a). Shipwrecks are discussed further in § IV. Airgun sounds would have no effects on solid structures; no significant impacts on shipwrecks would be expected (§ IV). No impacts to cultural resources would be expected.

Physical Environment and Oceanography

The water off the U.S. east coast consists of three water masses: coastal or shelf waters, slope waters, and the Gulf Stream. Coastal waters off Canada, which originate mostly in the Labrador Sea, move southward over the continental shelf until they reach Cape Hatteras, North Carolina, where they are entrained between the Gulf Stream and slope waters. North of Cape Hatteras, an elongated cyclonic gyre of slope water that forms because of the southwest flow of coastal water and the northward flowing Gulf Stream is present most of the year and shifts seasonally relative to the position of the north edge of the Gulf Stream. Slope water eventually merges with the Gulf Stream water. The Gulf Stream flows through the Straits of Florida and then parallel to the continental margin, becoming stronger as it moves northward. It turns seaward near Cape Hatteras and moves northeast into the open ocean.

The shelf waters off New Jersey are part of the Mid-Atlantic Bight, which includes shelf waters from Cape Hatteras to southern Cape Cod. The shelf is dominated by a sandy to muddy-sandy bottom (Steimle and Zetlin 2000; USGS 2000 *in* DoN 2005). The shelf off New Jersey slopes gently and uniformly seaward to the shelf-slope transition 120–150 km offshore in water depths 120–160 m (Carey et al. 1998 *in* GMI 2010). The shelf edge off New Jersey is incised by the Hudson Canyon to the north and the Wilmington Canyon to the south. Several smaller canyons also occur along the shelf edge. The Hudson Canyon is the largest canyon off the east coast of the U.S. The proposed survey area is entirely on the shelf.

The shelf waters off New Jersey become stratified in the spring as the water warms, and are fully stratified throughout the summer, i.e., warmer, fresher water accumulates at the surface and denser, colder, more saline waters occur near the seafloor. The stratification breaks down in fall because of mixing by wind and surface cooling (Castelao et al. 2008). Summer upwelling occurs off New Jersey, where nutrient-rich cold water is brought closer to the surface and stimulates primary production (Glenn et al. 2004; NEFSC 2013a). The primary production of the northeast U.S. continental shelf is 1536 mg C/m^2/day (Sea Around Us 2013). The salinity of shelf water usually increases with depth and is generally lower than the salinity of water masses farther offshore primarily because of the low-salinity input from rivers and estuaries.

There are numerous artificial reefs in shelf waters off New Jersey, including materials such as decommissioned ships, barges, and reef balls or hollow concrete domes (Steimle and Zetlin 2000; Figley 2005); these reefs can provide nursery habitat, protection, and foraging sites to marine organisms. Since 1984, more than 3500 of these artificial patch reefs have been constructed off New Jersey (Figley 2005).

Protected Areas

Several federal Marine Protected Areas (MPAs) or sanctuaries have been established ~500 km north of the proposed survey area, primarily with the intention of preserving cetacean habitat (Hoyt 2005; CetaceanHabitat 2013). These include the Cape Cod Bay Northern Right Whale Critical Habitat Area, the Great South Channel Northern Right Whale Critical Habitat Area east of Cape Cod, the Gerry E Studds Stellwagen Bank National Marine Sanctuary in the Gulf of Maine, and Jeffrey's Ledge, a proposed extension to the Stellwagen Bank National Marine Sanctuary. The Monitor National Marine Sanctuary is located to the southeast of Cape Hatteras, North Carolina. There are also five state Ocean Sanctuaries in Massachusetts waters including Cape Cod, Cape Cod Bay, Cape and Islands, North Shore, and South Essex Ocean Sanctuaries (Mass.Gov 2013). These sanctuaries include most Massachusetts state waters except for the area east of Boston. In addition, three Canadian protected areas also occur in the Northwest Atlantic for cetacean habitat protection, including the Bay of Fundy Right Whale Conservation Area, Roseway Basin Right Whale Conservation Area, and Gully Marine Protected Area off the Scotian Shelf. The proposed survey is not located within or near any federal, state, or international MPA or sanctuary.

The Harbor Porpoise Take Reduction Plan (HPTRP) is intended to reduce the interactions between harbor porpoises and commercial gillnets in four management areas: waters off New Jersey, Mudhole North, Mudhole South, and Southern Mid Atlantic (NOAA 2010b). The HPTRP is not relevant to this EA because harbor porpoises are not expected to occur in the survey area.

Marine Mammals

Thirty-one cetacean species (6 mysticetes and 25 odontocetes) could occur near the proposed survey site (Table 3). Six of the 31 species are listed under the U.S. Endangered Species Act (ESA) as ***Endangered***: the North Atlantic right, humpback, blue, fin, sei, and sperm whales. In fact, only five species were observed during the 13-day cruise in 2014, all when seismic sources were inactive, including one humpback whale, plus one unidentified baleen whale and one unidentified dolphin (RPS 2014b). An additional four cetacean species, although present in the wider western North Atlantic Ocean, likely would not be found near the proposed survey area between ~39–40°N because their ranges generally do not extend as far north (Clymene dolphin, *Stenella clymene*; Fraser's dolphin, *Lagenodelphis hosei*; melon-headed whale, *Peponocephala electra*; and Bryde's whale, *Balaenoptera brydei*). Although the secondary range of the beluga whale (*Delphinapterus leucas*) may range as far south as New Jersey (Jefferson et al. 2008), and there have been at least two sightings off the coast of New Jersey (IOC 2013), this species is not included here as it is unlikely to be encountered during the proposed survey. Similarly, no pinnipeds are included; harp seals (*Pagophilus groenlandicus*) and hooded seals (*Cystophora cristata*) are rare in the proposed survey area, and gray (*Halichoerus grypus*) and harbor seals (*Phoca vitulina*) have a more northerly distribution during the summer (DoN 2005), therefore are not expected to occur there during the survey. No pinnipeds were observed during the 13-day cruise in 2014. As pinnipeds would not be expected to be encountered or taken during the survey, takes were not assessed here or requested in the IHA application. Information on grey, harbor, and harp seals was included in the 2014 and 2015 NMFS EAs for this project, and is incorporated into this Final Amended EA by reference as if fully set forth herein (Appendix E). NMFS did authorize a small number of takes of pinnipeds in the IHA, and their analysis in support of issuing takes of pinnipeds is incorporated into this Final Amended EA.

General information on the taxonomy, ecology, distribution and movements, and acoustic capabilities of marine mammals are given in § 3.6.1 and § 3.7.1 of the PEIS. The proposed survey area off New Jersey is near one of the DAAs in the PEIS. The general distributions of mysticetes and odontocetes in this region of the Atlantic Ocean are discussed in § 3.6.2.1 and § 3.7.2.1 of the PEIS,

TABLE 3. The habitat, occurrence, regional population sizes, and conservation status of marine mammals that could occur in or near the proposed survey area in the Northwest Atlantic Ocean off New Jersey.

Species	Habitat	Occurrence in survey area in summer	Regional/SAR abundance estimates[1]	ESA[2]	IUCN[3]	CITES[4]
Mysticetes						
North Atlantic right whale	Coastal and shelf	Rare	455 / 455[5]	EN	EN	I
Humpback whale	Mainly coastal, banks	Common	11,600[6] / 823[7]	EN	LC	I
Minke whale	Mainly coastal	Rare	138,000[8] / 20,741[9]	NL	LC	I
Sei whale	Mainly offshore	Uncommon	10,300[10] / 357[11]	EN	EN	I
Fin whale	Slope, pelagic	Uncommon	26,500[12] / 3522[5]	EN	EN	I
Blue whale	Coastal, shelf, pelagic	Rare	855[13] / 440[5]	EN	EN	I
Odontocetes						
Sperm whale	Pelagic	Common	13,190[14] / 2288[15]	EN	VU	I
Pygmy sperm whale	Off shelf	Uncommon	N.A. / 3785[16]	NL	DD	II
Dwarf sperm whale	Off shelf	Uncommon	N.A. / 3785[16]	NL	DD	II
Cuvier's beaked whale	Pelagic	Uncommon	N.A. / 6532[17]	NL	LC	II
Northern bottlenose whale	Pelagic	Rare	N.A. / N.A.	NL	DD	II
True's beaked whale	Pelagic	Rare	N.A. / 7092[18]	NL	DD	II
Gervais' beaked whale	Pelagic	Rare	N.A. / 7092[18]	NL	DD	II
Sowerby's beaked whale	Pelagic	Rare	N.A / 7092[18]	NL	DD	II
Blainville's beaked whale	Pelagic	Rare	N.A. / 7092[18]	NL	DD	II
Rough-toothed dolphin	Mainly pelagic	Rare	N.A. / 271[5]	NL	LC	II
Bottlenose dolphin	Coastal, offshore	Common	N.A / 89,080[19]	NL^	LC	II
Pantropical spotted dolphin	Mainly pelagic	Rare	N.A. / 3333[5]	NL	LC	II
Atlantic spotted dolphin	Mainly coastal	Common	N.A. / 44,715[5]	NL	DD	II
Spinner dolphin	Coastal, pelagic	Rare	N.A. / N.A.	NL	DD	II
Striped dolphin	Off shelf	Uncommon	N.A. / 54,807[5]	NL	LC	II
Short-beaked common dolphin	Shelf, pelagic	Common	N.A. / 173,486[5]	NL	LC	II
White-beaked dolphin	Shelf <200 m	Rare	10s–100s of 1000s[20] / 2003[5]	NL	LC	II
Atlantic white-sided dolphin	Shelf and slope	Uncommon	10s–100s of 1000s[21] / 48,819[5]	NL	LC	II
Risso's dolphin	Mainly shelf, slope	Common	N.A. /18,250[5]	NL	LC	II
False killer whale	Pelagic	Extralimital	N.A. / N.A.	NL	DD	II
Pygmy killer whale	Mainly pelagic	Rare	N.A. / N.A.	NL	DD	II
Killer whale	Coastal	Rare	N.A. / N.A.	NL*	DD	II
Long-finned pilot whale	Mainly pelagic	Uncommon	780K[22] / 26,535[5]	NL[†]	DD	II
Short-finned pilot whale	Mainly pelagic	Uncommon	780K[22] / 21,515[5]	NL	DD	II
Harbor porpoise	Coastal	Rare	~500K[23] / 79,883[24]	NL	LC	II

N.A. = Data not available or species status was not assessed.
[1] SAR (stock assessment report) abundance estimates are from the 2013 U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments (Waring et al. 2014) as noted, and regional abundance estimates are for the North Atlantic regions as noted.
[2] U.S. Endangered Species Act; EN = Endangered, NL = Not listed
[3] Codes for IUCN classifications from IUCN Red List of Threatened Species (IUCN 2013): EN = Endangered; VU = Vulnerable; LC = Least Concern; DD = Data Deficient
[4] Convention on International Trade in Endangered Species of Wild Fauna and Flora (UNEP-WCMC 2013): Appendix I = Threatened with extinction; Appendix II = not necessarily now threatened with extinction but may become so unless trade is closely controlled
[5] Estimate for the Western North Atlantic Stock (Waring et al. 2014)
[6] Best estimate for the western North Atlantic in 1992–1993 (IWC 2013)
[7] Minimum estimate for the Gulf of Maine stock (Waring et al. 2014)
[8] Best estimate for the North Atlantic in 2002–2007 (IWC 2013)

[9] Estimate for the Canadian East Coast Stock (Waring et al. 2014)
[10] Estimate for the Northeast Atlantic in 1989 (Cattanach et al. 1993)
[11] Estimate for the Nova Scotia Stock (Waring et al. 2014)
[12] Best estimate for the North Atlantic in 2007 (IWC 2013)
[13] Estimate for the central and northeast Atlantic in 2001 (Pike et al. 2009)
[14] Estimate for the North Atlantic (Whitehead 2002)
[15] Estimate for the North Atlantic Stock (Waring et al. 2014)
[16] Combined estimate for pygmy and dwarf sperm whales, Western North Atlantic Stock (Waring et al. 2014)
[17] Estimate for the Western North Atlantic Stock (Waring et al. 2014)
[18] Combined estimate for *Mesoplodon* spp. Western North Atlantic stocks (Waring et al. 2014)
[19] Combined estimate for the Western North Atlantic Offshore Stock and the Northern Migratory Coastal Stock (Waring et al. 2014)
[20] High tens to low hundreds of thousands in the North Atlantic (Reeves et al. 1999a)
[21] Tens to low hundreds of thousands in the North Atlantic (Reeves et al. 1999b)
[22] Estimate for both long- and short-finned pilot whales in the central and eastern North Atlantic in 1989 (IWC 2013)
[23] Estimate for the North Atlantic (Jefferson et al. 2008)
[24] Estimate for the Gulf of Maine/Bay of Fundy Stock (Waring et al. 2014)
* Killer whales in the eastern Pacific Ocean, near Washington state, are listed as endangered under the U.S. ESA but not in the Atlantic Ocean.
^ The Western North Atlantic Coastal Morphotype stocks, ranging from NJ to FL, are listed as depleted under the U.S. Marine Mammal Protection Act, as are some other stocks to the south of the proposed survey area.
† Considered a strategic stock.

respectively. Additionally, information on marine mammals in this region is included in § 4.2.2.1 of the Bureau of Ocean Energy Management (BOEM) Final PEIS for Atlantic OCS Proposed Geological and Geophysical Activities, Mid-Atlantic and South Atlantic Planning Areas (BOEM 2014). The rest of this section deals with more specific species distribution off the coast of New Jersey. For the sake of completeness, an additional six odontocetes that are expected to be rare or extralimital in the proposed survey area are included here, but were not included in the PEIS.

The main sources of information used here are the 2010 and 2013 U.S. Atlantic and Gulf of Mexico marine mammal stock assessment reports (SARs: Waring et al. 2010, 2014), the Ocean Biogeographic Information System (OBIS: IOC 2013), and the Cetacean and Turtle Assessment Program (CETAP 1982). The SARs include maps of sightings for most species from NMFS' Northeast and Southeast Fisheries Science Centers (NEFSC and SEFSC) surveys in summer 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010, and 2011. OBIS is a global database of marine species sightings. CETAP covered 424,320 km of trackline on the U.S. outer continental shelf from Cape Hatteras to Nova Scotia. Aerial and shipboard surveys were conducted over a 39-month period from 1 November 1978 to 28 January 1982. The mid-Atlantic area referred to in the following species accounts included waters south of Georges Bank down to Cape Hatteras, and from the coast out to ~1830 m depth. The Department of the Navy (DoN) marine resource assessment for the Northeast Operating Areas (DoN 2005) contains maps of species sightings from numerous sources.

(1) Mysticetes

North Atlantic Right Whale (*Eubalaena glacialis*)

The North Atlantic right whale is known to occur primarily in the continental shelf waters off the eastern U.S. and Canada, from Florida to Nova Scotia (Winn et al. 1986; Jefferson et al. 2008). There are five well-known habitats in the northwest Atlantic used annually by right whales (Winn et al. 1986; NMFS 2005). These include the winter calving grounds in coastal waters of the southeastern U.S. (Florida/Georgia); spring feeding grounds in the Great South Channel (east of Cape Cod); late winter/spring feeding grounds and nursery grounds in Massachusetts Bay and Cape Cod Bay; summer/fall feeding and nursery grounds in the Bay of Fundy; and summer/fall feeding grounds on the Nova Scotian Shelf. In addition, Jeffreys Ledge, off the coast of northern Massachusetts, New Hampshire, and Maine, could be an important fall feeding area for right whales and an important nursery area during summer, especially in July and August (Weinrich et al. 2000). The first three habitats were designated as Critical Habitat Areas by NMFS (1994).

There is a general seasonal north-south migration of the North Atlantic population between feeding and calving areas, but right whales could be seen anywhere off the Atlantic U.S. throughout the year (Gaskin 1982). The seasonal occurrence of right whales in mid-Atlantic waters is mostly between November and April, with peaks in December and April (Winn et al. 1986) when whales transit through the area on their migrations to and from breeding grounds or feeding grounds. The migration route between the Cape Cod summer feeding grounds and the Georgia/Florida winter calving grounds, known as the mid-Atlantic corridor, has not been considered to include "high use" areas, yet the whales clearly move through these waters regularly in all seasons (Reeves and Mitchell 1986; Winn et al. 1986; Kenney et al. 2001; Reeves 2001; Knowlton et al. 2002; Whitt et al. 2013).

North Atlantic right whales are found commonly on the northern feeding grounds off the north-eastern U.S. during early spring and summer. The highest abundance in Cape Cod Bay is in February and April (Winn et al. 1986; Hamilton and Mayo 1990) and from April to June in the Great South Channel east of Cape Cod (Winn et al. 1986; Kenney et al. 1995). Throughout the remainder of summer and into fall (June–November), they are most commonly seen farther north on feeding grounds in Canadian waters, with peak abundance during August, September, and early October (Gaskin 1987). Morano et al. (2012) and Mussoline et al. (2012) indicated that right whales are present in the southern Gulf of Maine year-round and that they occur there over longer periods than previously thought.

Some whales, including mothers and calves, remain on the feeding grounds through the fall and winter. However, the majority of the right whale population leaves the feeding grounds for unknown wintering habitats and returns when the cow-calf pairs return. The majority of the right whale population is unaccounted for on the southeastern U.S. winter calving ground, and not all reproductively-active females return to the area each year (Kraus et al. 1986; Winn et al. 1986; Kenney et al. 2001). Other wintering areas have been suggested, based upon sparse data or historical whaling logbooks; these include the Gulf of St. Lawrence, Newfoundland and Labrador, coastal waters of New York and between New Jersey and North Carolina, Bermuda, and Mexico (Payne and McVay 1971; Aguilar 1986; Mead 1986; Lien et al. 1989; Knowlton et al. 1992; Cole et al. 2009; Patrician et al. 2009).

Knowlton et al. (2002) provided an extensive and detailed analysis of survey data, satellite tag data, whale strandings, and opportunistic sightings along State waters of the mid-Atlantic migratory corridor[3], from the border of Georgia/South Carolina to south of New England, including waters in the proposed seismic survey area, spanning the period from 1974 to 2002. The majority of sightings (94%) along the migration corridor were within 56 km of shore, and more than half (64%) were within 18.5 km of shore (Knowlton et al. 2002). Water depth preference was for shallow waters; 80% of all sightings were in depths <27 m, and 93% were in depths <45 m (Knowlton et al. 2002). Most sightings >56 km from shore occurred at the northern end of the corridor, off New York and south of New England. North of Cape Hatteras, most sightings were reported for March–April. Sighting data analyzed by Winn et al. (1986) dating back to 1965 showed that the occurrence of right whales in the mid Atlantic, including the proposed survey area, peaked in April and December (Winn et al. 1986). A review of the mid-Atlantic whale sighting and tracking data archive from 1974 to 2002 showed right whale sightings off the coast of New Jersey throughout the year, except during May–June, August, and November (Beaudin Ring 2002).

[3] Multi-year datasets for the analysis were provided by the New England Aquarium, North Atlantic Right Whale Consortium, Oregon State University, Coastwise Consulting Inc., Georgia Department of Natural Resources, University of North Carolina Wilmington, Continental Shelf Associates, CETAP, NOAA, and University of Rhode Island.

The Interactive North Atlantic Right Whale Sighting Map showed 32 sightings in the shelf waters off New Jersey between 2006 and 2012 (NEFSC 2013b). Two of these sightings occurred just to the north of the proposed survey site. Three sightings were made in June, and none were made in July. However, two sightings were made during July to the far east of the proposed survey area (NEFSC 2013b). There are also at least eight sightings of right whales off New Jersey in the Ocean Biogeographic Information System (OBIS; IOC 2013), which were made during the 1978–1982 Cetacean and Turtle Assessment Program (CETAP) surveys (CETAP 1982).

Palka (2006) reviewed North Atlantic right whale density in the U.S. Navy NE Operating Area based on summer abundance surveys conducted during 1998–2004. One of the lowest whale densities (including right whales) was found in the mid-Atlantic stratum, which includes the proposed survey area. However, survey effort for this stratum was also the lowest; only two surveys were conducted. No right whales were sighted.

Whitt et al. (2013) surveyed for right whales off the coast of New Jersey using acoustic and visual techniques from January 2008 to December 2009. Whale calls were detected off New Jersey year-round and four sightings were made: one in November, one in December, one in January just to the west of the survey area, and one cow-calf pair in May. In light of these findings, Whitt et al. (2013) suggested expanding the existing critical habitat to include waters of the mid-Atlantic. NMFS (2010) previously noted that such a revision could be warranted, but no revisions have been made to the critical habitat yet.

Federal and Other Action.—In 2002, NMFS received a petition to revise and expand the designation of critical habitat for the North Atlantic right whale. The revision was declined and the critical habitat designated in 1994 remained in place (NMFS 2005). Another petition for a revision to the critical habitat was received in 2009 that sought to expand the currently designated critical feeding and calving habitat areas and include a migratory corridor as critical habitat (NMFS 2010). NMFS noted that the requested revision may be warranted; on 20 February 2015, NMFS (2015) proposed to expand the northeastern foraging critical habitat to cover the entire area between the Canada-U.S. EEZ line and Cape Cod, out to ~200-m depth, and the southeastern calving critical habitat to cover coastal waters from Cape Fear, North Carolina, to just north of Cape Canaveral, Florida, but not to include the migratory corridor. The designation of critical habitat does not restrict activities within the area or mandate any specific management action. However, actions authorized, funded, or carried out by federal agencies that may have an impact on critical habitat must be consulted upon in accordance with Section 7 of the ESA, regardless of the presence of right whales at the time of impacts. Impacts on these areas that could affect primary constituent elements such as prey availability and the quality of nursery areas must be considered when analyzing whether habitat may be adversely modified.

A number of other actions have been taken to protect North Atlantic right whales, including establishing the Right Whale Sighting Advisory System designed to reduce collisions between ships and right whales by alerting mariners to the presence of the whales (see NEFSC 2012); a Mandatory Ship Reporting System implemented by the U.S. Coast Guard in the right whale nursery and feeding areas (USCG 1999, 2001; Ward-Geiger et al. 2005); recommended shipping routes in key right whale aggregation areas (NOAA 2006, 2007, 2013b); regulations to implement seasonal mandatory vessel speed restrictions in specific locations (Seasonal Management Areas or SMAs) during times when whales are likely present, including ~37 km around points near the Ports of New York/New Jersey (40.495ºN, 73.933ºW) and Philadelphia and Wilmington (38.874ºN, 75.026ºW) during 1 November–30 April (NMFS 2008); temporary Dynamic Management Areas (DMAs) in response to actual whale sightings, requiring gear modifications to traps/pots and gillnets in areas north of 40°N with unexpected right whale aggregations (NOAA 2012a); and a voluntary seasonal (April 1 to July 31) Area to be Avoided in the

Great South Channel off Massachusetts (NOAA 2013b). Furthermore, in its Final PEIS (BOEM 2014), BOEM proposed that no seismic surveys would be authorized within right whale critical habitat from 15 November to April 15, nor within the Mid-Atlantic and Southeast U.S. SMAs from 1 November to 30 April. Additionally, seismic surveys would not be allowed in active DMAs. The proposed survey area is not in any of these areas.

North Atlantic right whales likely would not be encountered during the proposed rescheduled survey.

Humpback Whale (*Megaptera novaeangliae*)

In the North Atlantic, a Gulf of Maine stock of the humpback whale is recognized off the northeastern U.S. coast as a distinct feeding stock (Palsbøll et al. 2001; Vigness-Raposa et al. 2010). Whales from this stock feed during spring, summer, and fall in areas ranging from Cape Cod to Newfoundland. In the spring, greatest concentrations of humpback whales occur in the western and southern edges of the Gulf of Maine. During summer, the greatest concentrations are found throughout the Gulf of Maine, east of Cape Cod, and near the coast from Long Island to northern Virginia. Similar distribution patterns are seen in the fall, although sightings south of Cape Cod Bay are less frequent than those near the Gulf of Maine. From December to March, there are few occurrences of humpback whales over the continental shelf of the Gulf of Maine, and in Cape Cod and Massachusetts Bay (Clapham et al. 1993; Fig. B-5a *in* DoN 2005).

GMI (2010) reported 17 sightings of humpback whales during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with sightings during every season (including 1 in spring and 4 in summer[4]). There are >40 OBIS sighting records of hump-back whales for the continental shelf off New Jersey, including sightings near the proposed survey area (IOC 2013). There was one sighting of a humpback whale during the 13-day cruise in 2014.

Common Minke Whale (*Balaenoptera acutorostrata*)

Four populations of the minke whale are recognized in the North Atlantic, including the Canadian East Coast stock that ranges from the eastern U.S. coast to Davis Strait (Waring et al. 2013). Minke whales are common off the U.S. east coast over continental shelf waters, especially off New England during spring and summer (CETAP 1982). Seasonal movements in the Northwest Atlantic are apparent, with animals moving south and offshore from New England waters during the winter (Fig. B-11a *in* DoN 2005; Waring et al. 2013). There are approximately 30 OBIS sightings of minke whales off New Jersey (IOC 2013), most of which were observed in the spring and summer during CETAP surveys (CETAP 1982).

GMI (2010) reported four sightings of minke whales during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009: two during winter and two during spring. Two sightings were also reported during summer NEFSC and SEFSC surveys between 1998 and 2011 on the shelf break off New Jersey (Waring et al. 2013). Minke whales likely would not be encountered during the proposed rescheduled survey.

Sei Whale (*Balaenoptera borealis*)

Two stocks of the sei whale are recognized in the North Atlantic: the Labrador Sea Stock and the Nova Scotia Stock; the latter has a distribution that includes continental shelf waters from the northeastern U.S. to areas south of Newfoundland (Waring et al. 2013). The southern portion of the Nova

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[4] GMI defined spring as 11 April–21 June and summer as 22 June–27 September.

Scotia stock's range includes the Gulf of Maine and Georges Bank during spring and summer (Waring et al. 2013). Peak sightings occur in spring and are concentrated along the eastern edge of Georges Bank into the Northeast Channel and the southwestern edge of Georges Bank (Fig. B-6a *in* DoN 2005; Waring et al. 2013). Mitchell and Chapman (1977) suggested that this stock moves from spring feeding grounds on or near Georges Bank to the Scotian Shelf in June and July, eastward to Newfoundland and the Grand Banks in late summer, back to the Scotian Shelf in fall, and offshore and south in winter. During summer and fall, most sei whale sightings occur in feeding grounds in the Bay of Fundy and on the Scotian Shelf; sightings south of Cape Cod are rare (Fig. B-6a *in* DoN 2005).

There are at least three OBIS sightings of sei whales off New Jersey, and several more sightings to the south of the proposed survey area (IOC 2013). Palka (2012) reported one sighting on the shelf break off New Jersey in water depths ranging from 100–2000 m during June–August 2011 surveys. There were no sightings of sei whales during the CETAP surveys (CETAP 1982).

Fin Whale (*Balaenoptera physalus*)

Fin whales are present in U.S. shelf waters during winter, and are sighted more frequently than any other large whale at this time (DoN 2005). They occur year-round in shelf waters of New England and New Jersey (CETAP 1982; Fig. B-8a *in* DoN 2005). Winter sightings are most concentrated around Georges Bank and in Cape Cod Bay. During spring and summer, most fin whale sightings are north of 40ºN, with smaller numbers on the shelf south of there, including off New Jersey (Fig. B-8a *in* DoN 2005). During fall, almost all fin whales move out of U.S. waters to feeding grounds in the Bay of Fundy and on the Scotian Shelf, remain at Stellwagen Bank and Murray Basin (Fig. B-8a *in* DoN 2005), or begin a southward migration (Clark 1995).

GMI (2010) reported 37 sightings of fin whales during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with sightings during every season (including 11 in spring and 4 in summer). Acoustic detections were also made during all seasons (GMI 2010). Numerous sightings were also made off New Jersey during NEFSC and SEFSC summer surveys between 1995 and 2011, with two sightings on the shelf and other sightings on the shelf break and beyond (Waring et al. 2013). There are 170 OBIS sightings of fin whales off New Jersey (IOC 2013), most of which were made during the CETAP surveys (CETAP 1982).

Blue Whale (*Balaenoptera musculus*)

In the western North Atlantic, the distribution of the blue whale extends as far north as Davis Strait and Baffin Bay (Sears and Perrin 2009). Little is known about the movements and wintering grounds of the stocks (Mizroch et al. 1984). Acoustic detection of blue whales using the U.S. Navy's Sound Surveillance System (SOSUS) program has tracked blue whales throughout most of the North Atlantic, including deep waters east of the U.S. Atlantic EEZ and subtropical waters north of the West Indies (Clark 1995).

Wenzel et al. (1988) reported the occurrence of three blue whales in the Gulf of Maine in 1986 and 1987, which were the only reports of blue whales in shelf waters from Cape Hatteras to Nova Scotia. Several other sightings for the waters off the east coast of the U.S. were reported by DoN (2005). Wenzel et al. (1988) suggested that it is unlikely that blue whales occur regularly in the shelf waters off the U.S. east coast. Similarly, Waring et al. (2010) suggested that the blue whale is, at best, an occasional visitor in the U.S. Atlantic EEZ.

During CETAP surveys, the only two sightings of blue whales were made south of Nova Scotia (CETAP 1982). There are two offshore sightings of blue whales in the OBIS database to the southeast of New Jersey and several sightings to the north off New England and in the Gulf of Maine (IOC 2013). Blue whales likely would not be encountered during the proposed rescheduled survey.

(2) Odontocetes

Sperm Whale (*Physeter macrocephalus*)

In the northwest Atlantic, the sperm whale generally occurs in deep water along the continental shelf break from Virginia to Georges Bank, and along the northern edge of the Gulf Stream (Waring et al. 2001). Shelf edge, oceanic waters, seamounts, and canyon shelf edges are also predicted habitats of sperm whales in the Northwest Atlantic (Waring et al. 2001). Off the eastern U.S. coast, they are also known to concentrate in regions with well-developed temperature gradients, such as along the edges of the Gulf Stream and warm core rings, which may aggregate their primary prey, squid (Jaquet 1996).

Sperm whales appear to have a well-defined seasonal cycle in the Northwest Atlantic. In winter, most historical records are in waters east and northeast of Cape Hatteras, with few animals north of 40ºN; in spring, they shift the center of their distribution northward to areas east of Delaware and Virginia, but they are widespread throughout the central area of the Mid-Atlantic Bight and southern tip of Georges Bank (Fig. B-10a in DoN 2005; Waring et al. 2013). During summer, they expand their spring distribution to include areas east and north of Georges Bank, the Northeast Channel, and the continental shelf south of New England (inshore of 100 m deep). By fall, sperm whales are most common south of New England on the continental shelf but also along the shelf edge in the Mid-Atlantic Bight (Fig. B-10a in DoN 2005; Waring et al. 2013).

There are several hundred OBIS records of sperm whales in deep waters off New Jersey and New England (IOC 2013), and numerous sightings were reported on and seaward of the shelf break during CETAP surveys (CETAP 1982) and during summer NEFSC and SEFSC surveys between 1998 and 2011 (Waring et al. 2013).

Pygmy and Dwarf Sperm Whales (*Kogia breviceps* and *K. sima*)

In the northwest Atlantic, both pygmy and dwarf sperm whales are thought to occur as far north as the Canadian east coast, with the pygmy sperm whale ranging as far as southern Labrador; both species prefer deep, offshore waters (Jefferson et al. 2008). Between 2006 and 2010, 127 pygmy and 32 dwarf sperm whale strandings were recorded from Maine to Puerto Rico, mostly off the southeastern U.S. coast; five strandings of pygmy sperm whales were reported for New Jersey (Waring et al. 2013).

There are 14 OBIS sightings of pygmy or dwarf sperm whales in offshore waters off New Jersey (IOC 2013). Several sightings of *Kogia* sp. (pygmy or dwarf sperm whales) for shelf-break waters off New Jersey were also reported during summer NEFSC and SEFSC surveys between 1995 and 2011 (Waring et al. 2013).

Cuvier's Beaked Whale (*Ziphius cavirostris*)

In the northwest Atlantic, Cuvier's beaked whale has stranded and been sighted as far north as the Nova Scotian shelf, and occurs most commonly from Massachusetts to Florida (MacLeod et al. 2006). Most sightings in the northwest Atlantic occur in late spring or summer, particularly along the continental shelf edge in the mid-Atlantic region (CETAP 1982; Waring et al. 2001, 2013). Mapping of combined beaked whale sightings in the northwest Atlantic suggests that beaked whales are rare in winter and fall, uncommon in spring, and abundant in summer in waters north of Virginia, off the shelf break and over the continental slope and areas of high relief, including the waters off New Jersey (Fig. B-13a *in* DoN 2005).

DoN mapped several sightings of Cuvier's beaked whales during the summer along the shelf break off New Jersey (Fig. B-13a *in* DoN 2005). One sighting was made off New Jersey during the CETAP surveys (CETAP 1982). Palka (2012) reported one sighting on the shelf break off New Jersey in water depths 100–2000 m during June–August 2011 surveys. There are eight OBIS sighting records of Cuvier's beaked whale in offshore waters off New Jersey (IOC 2013).

Northern Bottlenose Whale (*Hyperoodon ampullatus*)

Northern bottlenose whales are considered extremely uncommon or rare within waters of the U.S. Atlantic EEZ (Reeves et al. 1993; Waring et al. 2010), but there are known sightings off New England and New Jersey (CETAP 1982; McLeod et al. 2006; Waring et al. 2010). Two sightings of three individuals were made during the CETAP surveys; one sighting was made during May to the east of Cape Cod and the second sighting was made on 12 June along the shelf edge east of Cape May, New Jersey (CETAP 1982). Three sightings were made during summer surveys along the southern edge of Georges Bank in 1993 and 1996, and another three sightings were made in water depths 1000–4000 m at ~38–40ºN during NEFSC and SEFSC surveys between 1998 and 2006 (Waring et al. 2010). In addition, there is one OBIS sighting off New England in 2005 made by the Canadian Department of Fisheries and Oceans (IOC 2013). DoN (2005) also reported northern bottlenose whale sightings beyond the shelf break off New Jersey during spring and summer. Northern bottlenose whales likely would not be encountered during the proposed rescheduled survey.

True's Beaked Whale (*Mesoplodon mirus*)

In the Northwest Atlantic, True's beaked whale occurs from Nova Scotia to Florida and the Bahamas (Rice 1998). Carwardine (1995) suggested that this species could be associated with the Gulf Stream. DoN did not report any sightings of True's beaked whale off New Jersey (Fig. B-13a *in* DoN 2005); however, several sightings of undifferentiated beaked whales were reported for shelf break waters off New Jersey during summer NEFSC and SEFSC surveys between 1995 and 2011 (Waring et al. 2013). There are no OBIS sightings of True's beaked whale off New Jersey, but there is one stranding record off North Carolina and one record off New England (IOC 2013). There are numerous other stranding records for the east coast of the U.S. (Macleod et al. 2006). True's beaked whales likely would not be encountered during the proposed rescheduled survey.

Gervais' Beaked Whale (*Mesoplodon europaeus*)

Based on stranding records, Gervais' beaked whale appears to be more common in the western Atlantic than in the eastern Atlantic (Macleod et al. 2006; Jefferson et al. 2008). Off the U.S. east coast, it occurs from Cape Cod Bay, Massachusetts (Moore et al. 2004) to Florida, with a few records in the Gulf of Mexico (Mead 1989). DoN mapped two sightings of Gervais' beaked whale during summer to the south of the proposed survey area and numerous other sightings along the shelf break off the northeast coast of the U.S. (Fig. B-13a *in* DoN 2005). Palka (2012) reported three sightings in deep offshore waters during June–August 2011 surveys off the northeastern coast of the U.S. There are four OBIS stranding records of Gervais' beaked whale for Virginia, but no records for New Jersey (IOC 2013). Gervais' beaked whales likely would not be encountered during the proposed rescheduled survey.

Sowerby's Beaked Whale (*Mesoplodon bidens*)

Sowerby's beaked whale occurs in cold temperate waters of the North Atlantic (Mead 1989). In the western North Atlantic, it is found from at least Massachusetts to the Labrador Sea (Mead et al. 2006; Jefferson et al. 2008). Palka (2012) reported one sighting on the shelf break off New Jersey during June–August 2011 surveys. There are also at least five OBIS sighting records in deep waters off New Jersey (IOC 2013). DoN mapped one stranding in New Jersey in fall and one in Delaware in spring, but no sightings off New Jersey (Fig. B-13a *in* DoN 2005). Sowerby's beaked whales likely would not be encountered during the proposed rescheduled survey.

Blainville's Beaked Whale (*Mesoplodon densirostris*)

In the western North Atlantic, Blainville's beaked whale is found from Nova Scotia to Florida, the Bahamas, and the Gulf of Mexico (Würsig et al. 2000). There are numerous strandings records along the east coast of the U.S. (Macleod et al. 2006). DoN mapped several sightings of Blainville's beaked whale during summer along the shelf break off the northeastern coast of the U.S. (Fig. B-13a *in* DoN 2005). There is one OBIS sighting record in offshore waters to the southeast of New Jersey and one in offshore waters off New England (IOC 2013). Blainville's beaked whales likely would not be encountered during the proposed rescheduled survey.

Rough-toothed Dolphin (*Steno bredanensis*)

The rough-toothed dolphin is distributed worldwide in tropical, subtropical, and warm temperate waters (Miyazaki and Perrin 1994). They are generally seen in deep, oceanic water, although they can occur in shallow coastal waters in some locations (Jefferson et al. 2008). The rough-toothed dolphin rarely ranges north of 40°N (Jefferson et al. 2008).

One sighting of 45 individuals was made south of Georges Bank seaward of the shelf edge during the CETAP surveys (CETAP 1982), and another sighting was made in the same areas during 1986 (Waring et al. 2010). In addition, two sightings were made off New Jersey to the southeast of the proposed survey area during 1979 and 1998 (Waring et al. 2010; IOC 2013). Palka (2012) reported a sighting in deep offshore waters off New Jersey during June–August 2011 surveys. Rough-toothed dolphins likely would not be encountered during the proposed rescheduled survey.

Common Bottlenose Dolphin (*Tursiops truncatus*)

In the northwest Atlantic, the common bottlenose dolphin occurs from Nova Scotia to Florida, the Gulf of Mexico and the Caribbean, and south to Brazil (Würsig et al. 2000). There are regional and seasonal differences in the distribution of the offshore and coastal forms of bottlenose dolphins off the U.S. east coast. Although strandings of bottlenose dolphins are a regular occurrence along the U.S. east coast, since July 2013, an unusually high number of dead or dying bottlenose dolphins (971 as of 8 December 2013; 1175 as of 16 March 2014; 1283 as of 18 May 2014; 1546 as of 19 October 2014; and 1660 as of 15 April 2015) have washed up on the mid-Atlantic coast from New York to Florida (NOAA 2015a). NOAA declared an unusual mortality event (UME), the tentative cause of which is thought to be cetacean morbillivirus. As of 22 December 2014, 270 of 291 dolphins tested were confirmed positive or suspect positive for morbillivirus. NOAA personnel observed that the affected dolphins occur in nearshore waters, whereas dolphins in offshore waters >50 m deep did not appear to be affected (Environment News Service 2013), but have stated that it is uncertain exactly what populations have been affected (NOAA 2015a). In addition to morbillivirus, the bacteria *Brucella* was confirmed in 37 of 144 dolphins tested as of 22 December 2014 (NOAA 2015a). The NOAA web site is updated frequently, and it is apparent that the strandings initially had been moving south; in the 4 November 2013 update, dolphins had been reported washing up only as far south as South Carolina, and in the 8 December 2013 update, strandings were also reported in Georgia and Florida. Since mid 2014, the UME appears to have ended in the northern states: in the 8 months between 17 August 2014 and 15 April 2015, there were 1, 4, 2, and 1 strandings in NY, NJ, DE, and MD, respectively, as compared to pre-UME (2007–2012) annual strandings of 6, 15, 10, and 5 in NY, NJ, DE, and MD, respectively (NOAA 2015a).

Evidence of year-round or seasonal residents and migratory groups exist for the coastal form of bottlenose dolphins, with the so-called "northern migratory management unit" occurring north of Cape Hatteras to New Jersey, but only during summer and in waters <25 m deep (Waring et al. 2010). The offshore form appears to be most abundant along the shelf break and is differentiated from the coastal form by occurring in waters typically >40 m deep (Waring et al. 2010). Bottlenose dolphin records in the Northwest Atlantic suggest that they generally can occur year-round from the continental shelf to deeper waters over the abyssal plain, from the Scotian Shelf to North Carolina (Fig. B-14a *in* DoN 2005).

GMI (2010) reported 319 sightings of bottlenose dolphins during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with most sightings made during spring and summer. Palka (2012) also reported numerous sightings on the shelf break off New Jersey in water depths ranging from 100–2000 m during June–August 2011 surveys. There are also several hundred OBIS records off New Jersey, including sightings near the proposed survey area on the shelf and along the shelf edge (IOC 2013). There was one sighting of 10 bottlenose dolphins during the 13-day cruise in 2014.

Pantropical Spotted Dolphin (*Stenella attenuata*)

Pantropical spotted dolphins generally occur in deep offshore waters between 40°N and 40°S (Jefferson et al. 2008). There have been a few sightings at the southern edge of Georges Bank (Waring et al. 2010). In addition, there are at least 10 OBIS sighting records for waters off New Jersey that were made during surveys by the Canadian Wildlife Service between 1965 and 1992 (IOC 2013). Pantropical spotted dolphins likely would not be encountered during the proposed rescheduled survey.

Atlantic Spotted Dolphin (*Stenella frontalis*)

In the western Atlantic, the distribution of the Atlantic spotted dolphin extends from southern New England, south to the Gulf of Mexico, the Caribbean Sea, Venezuela, and Brazil (Leatherwood et al. 1976; Perrin et al. 1994; Rice 1998). During summer, Atlantic spotted dolphins are sighted in shelf waters south of Chesapeake Bay, and near the continental shelf edge, on the slope, and offshore north of there, including the waters of New Jersey (Fig. B-15a *in* DoN 2005; Waring et al. 2014). Several sightings were also reported during summer NEFSC and SEFSC surveys between 1998 and 2011 on the shelf break off New Jersey (Waring et al. 2014). There are two OBIS sighting records northeast of the survey area and at least eight records to the southeast of the survey area (IOC 2013). There was one sighting of 12 Atlantic spotted dolphins during the 13-day cruise in 2014.

Spinner dolphin (*Stenella longirostris*)

The spinner dolphin is pantropical in distribution, with a range nearly identical to that of the pantropical spotted dolphin, including oceanic tropical and sub-tropical waters between 40ºN and 40ºS (Jefferson et al. 2008). The distribution of spinner dolphins in the Atlantic is poorly known, but they are thought to occur in deep waters along most of the U.S. coast; sightings off the northeast U.S. coast have occurred exclusively in offshore waters >2000 m (Waring et al. 2010). Several sightings were mapped by DoN (Fig. B-16 *in* DoN 2005) for offshore waters to the far east of New Jersey. There are also seven OBIS sighting records off the eastern U.S. but no records near the proposed survey area or in shallow water (IOC 2013). Spinner dolphins likely would not be encountered during the proposed rescheduled survey.

Striped Dolphin (*Stenella coeruleoalba*)

In the western North Atlantic, the striped dolphin occurs from Nova Scotia to the Gulf of Mexico and south to Brazil (Würsig et al. 2000). Off the northeastern U.S. coast, striped dolphins occur along the continental shelf edge and over the continental slope from Cape Hatteras to the southern edge of Georges Bank (Waring et al. 2014). In all seasons, striped dolphin sightings have been centered along the 1000-m depth contour, and sightings have been associated with the north edge of the Gulf Stream and warm core rings (Waring et al. 2014). Their occurrence off the northeastern U.S. coast seems to be highest in the summer and lowest during the fall (Fig. B-17a *in* DoN 2005).

There are ~100 OBIS sighting records of striped dolphins for the waters off New Jersey to the east of the proposed survey area, mainly along the shelf break (IOC 2013). Numerous sightings were also reported during summer NEFSC and SEFSC surveys between 1998 and 2011 off the shelf break (Waring et al. 2014).

Short-beaked Common Dolphin (*Delphinus delphis*)

The short-beaked common dolphin occurs from Cape Hatteras to Georges Bank during mid January–May, moves onto Georges Bank and the Scotian Shelf during mid summer and fall, and has been observed in large aggregations on Georges Bank in fall (Selzer and Payne 1988; Waring et al. 2014). Sightings off New Jersey have been made during all seasons (Fig. B-19a *in* DoN 2055). GMI (2010) reported 32 sightings of short-beaked common dolphins during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with sightings during fall and winter. There are over 100 OBIS sighting records near the proposed survey area off New Jersey, with most sightings near the shelf edge, but there are also several sightings in shelf waters (IOC 2013). There were 4 sightings of a total of 45 short-beaked common dolphins during the 13-day cruise in 2014.

White-beaked Dolphin (*Lagenorhynchus albirostris*)

The white-beaked dolphin is widely distributed in cold temperature and subarctic North Atlantic waters (Reeves et al. 1999a), and mainly occurs over the continental shelf, especially along the shelf edge (Carwardine 1995). It occurs in immediate offshore waters of the east coast of the North America, from Labrador to Massachusetts (Rice 1998). Off the northeastern U.S. coast, white-beaked dolphins are mainly found in the western Gulf of Maine and around Cape Cod (CETAP 1982; Fig. B-20a *in* DoN 2005; Waring et al. 2010). There are two OBIS sighting records to the east of the proposed survey area off New Jersey, and one to the south off North Carolina (IOC 2013). White-beaked dolphins likely would not be encountered during the proposed rescheduled survey.

Atlantic White-sided Dolphin (*Lagenorhynchus acutus*)

The Atlantic white-sided dolphin occurs in cold temperate to subpolar waters of the North Atlantic in deep continental shelf and slope waters (Jefferson et al. 2008). In the western North Atlantic, it ranges from Labrador and southern Greenland to ~38ºN (Jefferson et al. 2008). There are seasonal shifts in Atlantic white-sided dolphin distribution off the northeastern U.S. coast, with low numbers in winter from Georges Basin to Jeffrey’s Ledge and very high numbers in spring in the Gulf of Maine. In summer, Atlantic white-sided dolphins are mainly distributed northward from south of Cape Cod with the highest numbers from Cape Cod north to the lower Bay of Fundy; sightings off New Jersey appear to be sparse (Fig. B-21a *in* DoN 2005). There are over 20 OBIS sighting records in the shelf waters off New Jersey, including near the proposed survey area (IOC 2013).

Risso’s Dolphin (*Grampus griseus*)

The highest densities of Risso’s dolphin occur in mid latitudes ranging from 30° to 45°, and primarily in outer continental shelf and slope waters (Jefferson et al. 2013). Off the northeast U.S. coast during spring, summer, and autumn, Risso’s dolphins are distributed along the continental shelf edge from Cape Hatteras to Georges Bank, but they range into oceanic waters during the winter (Waring et al. 2014). Mapping of Risso’s dolphin sightings off the U.S. east coast suggests that they could occur year-round from the Scotian Shelf to the coast of the southeastern U.S. in waters extending from the continental shelf to the continental rise (DoN 2005). Off New Jersey, the greatest number of sightings occurs near the continental slope during summer (Fig. B-22a *in* DoN 2005).

There are at least 170 OBIS records near the proposed survey area off New Jersey, including shelf waters and at the shelf edge (IOC 2013). Numerous sightings were also reported during summer NEFSC and SEFSC surveys between 1998 and 2011 for the shelf break off New Jersey (Waring et al. 2014). There was one sighting of a Risso's dolphin during the 13-day cruise in 2014.

Pygmy Killer Whale (*Feresa attenuata*)

The pygmy killer whale is pantropical/subtropical, generally occurring between 40ºN and 35ºS (Jefferson et al. 2008). There is no abundance estimate for the pygmy killer whale off the U.S. east coast because it is rarely sighted during surveys (Waring et al. 2010). One group of six pygmy killer whales was sighted off Cape Hatteras in waters >1500 m deep during a NMFS vessel survey in 1992 (Hansen et al. 1994 *in* Waring et al. 2010). There are an additional three OBIS sighting records to the southeast of the proposed survey area (Palka et al. 1991 *in* IOC 2013). Pygmy killer whales likely would not be encountered during the proposed rescheduled survey.

False Killer Whale (*Pseudorca crassidens*)

The false killer whale is found worldwide in tropical and temperate waters generally between 50ºN and 50ºS (Odell and McClune 1999). It is widely distributed, but not abundant anywhere (Carwardine 1995). In the western Atlantic, it occurs from Maryland to Argentina (Rice 1998). Very few false killer whales were sighted off the U.S. northeast coast in the numerous surveys mapped by DoN (2005). There are 13 OBIS sighting records for the waters off the eastern U.S., but none are near the proposed survey area (IOC 2013). False killer whales likely would not be encountered during the proposed rescheduled survey.

Killer Whale (*Orcinus orca*)

In the western North Atlantic, killer whales occur from the polar ice pack to Florida and the Gulf of Mexico (Würsig et al. 2000). Based on historical sightings and whaling records, killer whales apparently were most often found along the shelf break and offshore in the northwest Atlantic (Katona et al. 1988). They are considered uncommon or rare in waters of the U.S. Atlantic EEZ (Katona et al. 1988). Killer whales represented <0.1 % of all cetacean sightings (12 of 11,156 sightings) in CETAP surveys during 1978–1981 (CETAP 1982). Four of the 12 sightings made during the CETAP surveys were made offshore from New Jersey. Off New England, killer whales are more common in summer than in any other season, occurring nearshore and off the shelf break (Fig. B-24 *in* DoN 2005). There are 39 OBIS sighting records for the waters off the eastern U.S., but none off New Jersey (IOC 2013). Killer whales likely would not be encountered during the proposed rescheduled survey.

Long- and Short-finned Pilot Whales (*Globicephala melas* and *G. macrorhynchus*)

There are two species of pilot whale, both of which could occur in the survey area. The long-finned pilot whale (*G. melas*) is distributed antitropically, whereas the short-finned pilot whale (*G. macrorhynchus*) is found in tropical, subtropical, and warm temperate waters (Olson 2009). In the northwest Atlantic, pilot whales often occupy areas of high relief or submerged banks and associated with the Gulf Stream edge or thermal fronts along the continental shelf edge (Waring et al. 1992). The ranges of the two species overlap in the shelf/shelf-edge and slope waters of the northeastern U.S. between New Jersey and Cape Hatteras, with long-finned pilot whales occurring to the north (Bernard and Reilly 1999). During winter and early spring, long-finned pilot whales are distributed along the continental shelf edge off the northeast U.S. coast and in Cape Cod Bay, and in summer and fall they also occur on Georges Bank, in the Gulf of Maine, and north into Canadian waters (Fig. B-25a *in* DoN 2005).

There are at least 200 OBIS sighting records for pilot whales for the waters off New Jersey, including sightings over the shelf; these sightings include *Globicephala* sp. and *G. melas* (IOC 2013). Numerous sightings were also reported during summer NEFSC and SEFSC surveys between 1998 and 2007 for the shelf break off New Jersey (Waring et al. 2014).

Harbor Porpoise (*Phocoena phocoena*)

The harbor porpoise inhabits cool temperate to subarctic waters of the Northern Hemisphere (Jefferson et al. 2008). There are likely four populations in the western North Atlantic: Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, Newfoundland, and Greenland (Gaskin 1984, 1992). Individuals found off the eastern U.S. coast likely would be almost exclusively from the Gulf of Maine/Bay of Fundy stock.

Harbor porpoises concentrate in the northern Gulf of Maine and southern Bay of Fundy during July–September, with a few sightings ranging as far south as Georges Bank and one off Virginia (Waring et al. 2014). In summer, sightings mapped from numerous sources extended only as far south as off northern Long Island, New York (Fig. B-26a *in* DoN 2005). During October–December and April–June, harbor porpoises are dispersed and range from New Jersey to Maine, although there are lower densities at the northern and southern extremes (DoN 2005; Waring et al. 2014). Most would be found over the continental shelf, but some are also encountered over deep waters (Westgate et al. 1998). During January–March, harbor porpoises concentrate farther south, from New Jersey to North Carolina, with lower densities occurring from New York to New Brunswick (DoN 2005; Waring et al. 2014).

GMI (2010) reported 51 sightings of harbor porpoise during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with sightings during fall and winter. There are 10 OBIS sighting records for the waters off New Jersey during March–June, most of which are from the CETAP surveys (CETAP 1982; IOC 2013). Harbor porpoises likely would not be encountered during the proposed rescheduled survey.

Sea Turtles

Two species of sea turtle, the leatherback and loggerhead turtles, are common off the U.S. east coast. Kemp's ridley and green turtles also occur in this area at much lower densities. A fifth species, the hawksbill turtle, is considered very rare in the northwest Atlantic Ocean. In fact, only one species was observed and identified during the 13-day cruise in 2014, the loggerhead turtle. Thirteen additional shelled sea turtles were also sighted, but were not identified. General information on the taxonomy, ecology, distribution and movements, and acoustic capabilities of sea turtles are given in § 3.4.1 of the PEIS. The general distribution of sea turtles in the northwest Atlantic is also discussed in § 3.4.2.1 of the PEIS and § 4.2.3.1 of the BOEM Final PEIS (BOEM 2014). The rest of this section deals specifically with their distribution off the northeastern coast of the U.S., particularly off New Jersey.

(1) Leatherback Turtle (*Dermochelys coriacea*)

Leatherback turtles commonly occur along the eastern U.S. coast and as far north as New England (Eckert 1995a), although important nesting areas occur only as far north as Florida (NMFS and USFWS 2013a). Leatherback occurrence in New England waters has been documented for many years, with most historic records during March–August focused around the Gulf of Maine and Georges and Browns Banks; in fall, they were focused more southerly in New England bays and sounds (Lazell 1980). Leatherbacks tagged off Cape Breton and mainland Nova Scotia during summer remained off eastern Canada and the northeastern U.S. coast before most began migrating south in October (James et al. 2005); foraging adults off Nova Scotia mainly originate from Trinidad (NMFS and USFWS 2013a). Some of these tags remained attached long enough to observe northward migrations, with animals leaving nesting grounds during February–March and typically arriving north of 38ºN during June, usually in areas within several hundred km of where they were observed in the previous year. Virtually all of the leatherbacks in sighting records off the northeastern U.S. occurred in summer off southern New Jersey, the southeastern tip of Long Island, and southern Nova Scotia (Fig. C-2a *in* DoN 2005).

GMI (2010) reported 12 sightings of leatherback sea turtles on the continental shelf off New Jersey during surveys conducted in January 2008–December 2009, with all sightings occurring during summer. There are over 200 OBIS sighting records for the waters off New Jersey (IOC 2013). Palka (2012) also reported several sightings off northern New Jersey south of Long Island during June–August 2011 surveys.

(2) Green Turtle (*Chelonia mydas*)

Important feeding areas for green turtles in U.S. waters are primarily located in Florida and southern Texas, but Long Island Sound and inshore waters of North Carolina appear to be important to juveniles during summer months (NMFS and USFWS 2007). Small numbers of juvenile green turtles have occurred historically in Long Island and Nantucket Sounds in New England (Lazell 1980). There are few sighting records, but DoN (Fig. C-5 *in* DoN 2005) suggested that small numbers can be found from spring to fall as far north as Cape Cod Bay, including off New Jersey. There are seven OBIS sightings of green turtles off the coast of New Jersey (IOC 2013). Palka (2012) also reported several sightings off northern New Jersey south of Long Island during June–August 2011 surveys.

(3) Loggerhead Turtle (*Caretta caretta*)

Major nesting areas for loggerheads in the western North Atlantic are located in the southeastern U.S., principally southern Florida, but also as far north as the Carolinas and occasionally Virginia; the nesting season is from May to August (Spotila 2004). Most females tagged on North Carolina nesting beaches traveled north to forage at higher latitudes (primarily off New Jersey, Maryland, and Delaware) during summer, and south to wintering grounds off the southeastern U.S. in the fall (Hawkes et al. 2007).

Some juveniles make seasonal foraging migrations into temperate latitudes as far north as Long Island, New York (Shoop and Kenney 1992 *in* Musick and Limpus 1997). Lazell (1980) reported that loggerheads were historically common in New England waters and the Gulf of Maine. Sighting records of loggerheads off the northeastern U.S. were in all seasons in continental shelf and slope waters from Cape Cod to southern Florida, with greatest concentrations in mid-continental shelf waters off New Jersey during the summer (Fig. C-3a *in* DoN 2005). There are increased stranding records of loggerheads from Cape Cod Bay and Long Island Sound in the fall (DoN 2005); loggerheads may be unable to exit these inshore habitats, which can result in hypothermia as temperatures drop in late fall (Burke et al. 1991 *in* DoN 2005).

GMI (2010) reported 69 sightings of loggerhead turtles on the continental shelf off New Jersey during surveys conducted in January 2008–December 2009; sightings occurred from spring through fall, with most sightings during summer. There are over 1000 OBIS sighting records off the coast of New Jersey, including within the proposed project area (IOC 2013). Palka (2012) also reported several sightings off northern New Jersey south of Long Island during June–August 2011 surveys. There were 16 sightings of a single loggerhead turtle during the 13-day cruise in 2014.

(4) Hawksbill Turtle (*Eretmochelys imbricata*)

The hawksbill is the most tropical of all sea turtles, generally occurring between ~30ºN and ~30ºS (Eckert 1995b). In the Atlantic Ocean, most nesting beaches are in the Caribbean Sea as far north as

Cuba and the Bahamas (NMFS and USFWS 2013b). It is considered very rare and possibly extralimital in the northwest Atlantic (Lazell 1980; Eckert 1995b). Nonetheless, DoN (Fig. C-6 *in* DoN 2005) mapped two hawksbill turtle sightings off New Jersey (one during spring and one during fall) and several south of New Jersey. In addition, there is one OBIS sighting record offshore New Jersey, east of the proposed survey area (SEFSC 1992 *in* IOC 2013).

(5) Kemp's Ridley Turtle (*Lepidochelys kempii*)

Kemp's ridley turtle has a more restricted distribution than other sea turtles, with adults primarily located in the Gulf of Mexico; some juveniles also feed along the U.S. east coast, including Chesapeake Bay, Delaware Bay, Long Island Sound, and waters off Cape Cod (Spotila 2004). Nesting occurs primarily along the central and southern Gulf of Mexico coast during May–late July (Morreale et al. 2007). There have also been some rare records of females nesting on Atlantic beaches of Florida, North Carolina, and South Carolina (Plotkin 2003). After nesting, female Kemp's ridley turtles travel to foraging areas along the coast of the Gulf of Mexico, typically in waters <50 m deep from Mexico's Yucatan Peninsula to southern Florida; males tend to stay near nesting beaches in the central Gulf of Mexico year-round (Morreale et al. 2007). Only juvenile and immature Kemp's ridley turtles appear to move beyond the Gulf of Mexico into more northerly waters along the U.S. east coast.

Hatchlings are carried by the prevalent currents off the nesting beaches and do not reappear in the neritic zone until they are about two years old (Musick and Limpus 1997). Those juvenile and immature Kemp's ridley turtles that migrate northward past Cape Hatteras probably do so in April and return southward in November (Musick et al. 1994). North of Cape Hatteras, juvenile and immature Kemp's ridleys prefer shallow-water areas, particularly along North Carolina and in Chesapeake Bay, Long Island Sound, and Cape Cod Bay (Musick et al. 1994; Morreale et al. 1989; Danton and Prescott 1988; Frazier et al. 2007). There are historical summer sightings and strandings of Kemp's ridley turtles from Massachusetts into the Gulf of Maine (Lazell 1980). Occasionally, individuals can be carried by the Gulf Stream as far as northern Europe, although those individuals are considered lost to the breeding population. Virtually all sighting records of Kemp's ridley turtles off the northeastern U.S. were in summer off the coast of New Jersey (Fig. C-4a *in* DoN 2005). There are 60 OBIS sighting records off the coast of New Jersey, some within the proposed survey area (SEFSC 1992 *in* IOC 2013). Kemp's ridley turtle has been the most common sea turtle observed at the Oyster Creek Nuclear Generating Station located in Forked River, New Jersey (Houlahan and Paez 2014).

Seabirds

Two ESA-listed seabird species could occur in or near the Project area: the ***Threatened*** piping plover and the ***Endangered*** roseate tern. Neither species was observed during the 13-day cruise in 2014. General information on the taxonomy, ecology, distribution and movements, and acoustic capabilities of seabird families are given in § 3.5.1 of the PEIS.

(1) Piping Plover (*Charadrius melodus*)

The Atlantic Coast Population of the piping plover is listed as ***Threatened*** under the U.S. ESA, and the species is listed as ***Near Threatened*** on the IUCN Red List of Threatened Species (IUCN 2013). It breeds on coastal beaches from Newfoundland to North Carolina during March–August and it winters along the Atlantic Coast from North Carolina south, along the Gulf Coast, and in the Caribbean (USFWS 1996). Its marine nesting habitat consists of sandy beaches, sandflats, and barrier islands (Birdlife International 2013). Feeding areas include intertidal portions of ocean beaches, mudflats, sandflats, and shorelines of coastal ponds, lagoons, or salt marshes (USFWS 1996). Wintering plovers are generally found on barrier islands, along sandy peninsulas, and near coastal inlets (USFWS 1996).

Because it is strictly coastal, the piping plover likely would not be encountered at the proposed survey site.

(2) Roseate Tern (*Sterna dougallii*)

The Northeast Population of the roseate tern is listed as ***Endangered*** under the U.S. ESA, and the species is listed as ***Near Threatened*** on the IUCN Red List of Threatened Species (IUCN 2013). It breeds on islands along the northeast coast of the U.S from New York to Maine and north into Canada, and historically as far south as Virginia (USFWS 1998, 2010). It is thought to migrate beginning in mid September through the eastern Caribbean and along the north coast of South America, and to winter mainly on the east coast of Brazil (USFWS 2010). During the breeding season, roseate terns forage over shallow coastal waters, especially in water depths <5 m, sometimes near the colony and at other times at distances of over 30 km. They usually forage over shallow bays, tidal inlets and channels, tide rips, and sandbars (USFWS 2010).

Because of its distribution during the breeding season, the roseate tern likely would not be encountered at the proposed survey site.

Fish, Essential Fish Habitat, and Habitat Areas of Particular Concern

(1) ESA-Listed Fish and Invertebrate Species

There are two fish species listed under the ESA as ***Endangered*** that could occur in the study area: the New York Bight distinct population segment (DPS) of the Atlantic sturgeon, and the shortnose sturgeon. There are two species that are candidates for ESA listing: the cusk and the Northwest Atlantic and Gulf of Mexico DPS of the dusky shark. There are no listed or candidate invertebrate species. In the July 2014 Final EA, the great hammerhead shark was also included as a Candidate Species, but it has been removed from that status.

(a) Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*)

Five DPSs of the Atlantic sturgeon are listed under the U.S. ESA, one as ***Threatened*** and four as ***Endangered***, including the New York Bight DPS, and the species is listed as ***Near Threatened*** on the IUCN Red List of Threatened Species (IUCN 2014). It is a long-lived, late maturing (11–21 years in the Hudson River), anadromous fish. Spawning adults migrate upriver in spring, beginning in April–May in the mid Atlantic. The New York Bight DPS primarily uses the Delaware and Hudson rivers for spawning. Following spawning, males can remain in the river or lower estuary until fall, and females usually exit the rivers within 4–6 weeks. Juveniles move downstream and inhabit brackish waters for a few months before moving into nearshore coastal waters (NOAA 2012b).

(b) Shortnose Sturgeon (*Acipenser brevirostrum*)

The shortnose sturgeon is listed as ***Endangered*** throughout its range under the U.S. ESA and ***Vulnerable*** on the IUCN Red List of Threatened Species (IUCN 2014). It is an anadromous species that spawns in coastal rivers along the east coast of North America from Canada to Florida. The shortnose sturgeon prefers the nearshore marine, estuarine, and riverine habitats of large river systems, and apparently does not make long-distance offshore migrations (NOAA 2013c).

(c) Cusk (*Brosme brosme*)

The cusk is an ESA ***Candidate Species*** throughout its range, and has not been assessed for the IUCN Red List. In the Northwest Atlantic, it occurs from New Jersey north to the Strait of Belle Isle and the Grand Banks of Newfoundland and rarely to southern Greenland. It is a solitary, benthic species found in rocky, hard bottom areas to a depth of 100 m. In U.S waters, it occurs primarily in deep water of the central Gulf of Maine (NOAA 2013d).

(d) Dusky Shark (*Carcharhinus obscurus*)

The Northwest Atlantic and Gulf of Mexico DPS of the dusky shark is an ESA ***Candidate Species***, and the species is listed as ***Vulnerable*** on the IUCN Red List of Threatened Species (IUCN 2014). It is a coastal-pelagic species that inhabits warm temperate and tropical waters throughout the world. In the Northwest Atlantic, it is found from southern Massachusetts and Georges Bank to Florida and the northern Gulf of Mexico. The dusky shark occurs in both inshore and offshore waters, although it avoids areas of low salinity from the surface to depths of 575 m. Along U.S. coasts, it undertakes long temperature-related migrations, moving north in summer and south in fall (NMFS 2013b).

(2) Essential Fish Habitat (EFH)

EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity". "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish. "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities (NMFS 2013c). The entire eastern seaboard from the coast to the limits of the EEZ is EFH for one or more species or life stage for which EFH has been designated.

Two fishery management councils, created by the 1976 Magnuson Fisheries Conservation and Management Act (renamed Magnuson Stevens Fisheries Conservation and Management Act in 1996) are responsible for the management of fishery resources, including designation of EFH, in federal waters of the survey area: the Mid-Atlantic Fishery Management Council (MAFMC) and the New England Fishery Management Council (NEFMC). The Highly Migratory Division of the National Marine Fisheries Service in Silver Spring, MD, manages highly migratory species (sharks, swordfish, billfish, and tunas).

The life stages and associated habitats for those species with EFH in the survey area are described in Table 4.

Two EFH areas located ~150 km northeast of the proposed survey area, the Lydonia and Oceanographer canyons, were previously protected from fishing. Bottom trawling was prohibited in these areas because of the presence of *Loligo* squid eggs, under the Fisheries Management Plan for Atlantic mackerel, butterfish, and *Illex* and *Loligo* squid. This protection was valid as of 31 July 2008 for up to three years, after which it was to be subject to review for the possibility of extension (NOAA 2008).

(3) Habitat Areas of Particular Concern

Habitat Areas of Particular Concern (HAPC) are subsets of EFH that provide important ecological functions and/or are especially vulnerable to degradation, and are designated by Fishery Management Councils. All four life stages of summer flounder have EFH within the proposed survey area, whereas HAPC have only been designated for the juvenile and adult EFH: demersal waters over the continental shelf, from the coast to the limits of the EEZ, from the Gulf of Maine to Cape Hatteras, North Carolina (NOAA 2012c). Specifically, the HAPC include "all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile EFH. If native species of submerged aquatic vegetation are eliminated then exotic species should be protected because of functional value, however, all efforts should be made to restore native species" (NOAA 2012c). No other HAPC have been designated for those species with EFH within the proposed survey area.

TABLE 4. Marine species with Essential Fish Habitat (EFH) overlapping the proposed survey area.

	Life stage[1] and habitat[2]				
Species	E	L/N	J	A	SA
Atlantic cod *Gadus morhua*				B	B
Atlantic haddock *Melanogrammus aeglefinus*		P	B		
Pollock *Pollachius virens*				B	
Black sea bass *Centropristis striata*	P	P	D	D	D
Bluefish *Pomatomus saltatrix*	P	P	P	P	P
Butterfish *Peprilus triacanthus*	P	P	P	P	P
Atlantic herring *Clupea harengus*			P	P	B
Atlantic mackerel *Scomber scombrus*	P	P	P	P	P
Red hake *Urophycis chuss*	P	P	B		
Silver hake *Merluccius bilinearis*	P	P	B		
Scup *Stenotomus chrysops*			D	D	
Monkfish *Lophius americanus*	P	P	B	B	B
Ocean pout *Macrozoarces americanus*	B	B	B	B	B
Summer flounder *Paralichthys dentatus*	P	P	B	B	B
Windowpane flounder *Scophthalmus acquosus*	P	P		B	B
Winter flounder *Pleuronectes americanus*	B	D/P	B	B	B
Witch flounder *Glyptocephalus cynoglossus*	P	P			B
Yellowtail flounder *Limanda ferruginea*	P				
Albacore tuna *Thunnus alalunga*			P		
Bigeye tuna *Thunnus obesus*				P	
Bluefin tuna *Thunnus thynnus*			P		
Skipjack tuna *Katsuwonus pelamis*				P	
Yellowfin tuna *Thunnus albacres*			P		
Swordfish *Xiphias gladius*			P		
Little skate *Leucoraja erinacea*			B	B	
Winter skate *Leucoraja ocellata*			B		
Basking shark *Cetorhinus maximus*			P	P	
Blue shark *Prionace glauca*		P	P	P	
Dusky shark *Carcharhinus obscurus*		P	P	P	
Common thresher shark *Alopias vulpinus*		P	P	P	
Porbeagle shark *Lamna nasus*				P	
Sandbar shark *Carcharhinus plumbeus*		B	B	B	
Scalloped hammerhead shark *Sphyrna lewini*			P	P	
Shortfin mako shark *Isurus oxyrinchus*		P	P	P	
Smooth (spiny) dogfish *Squalus acanthias*		P	P	P	
Sand tiger shark *Carcharias taurus*		P	P		
Tiger shark *Galeocerdo cuvier*			P	P	
White shark *Carcharodon carcharias*		P	P	P	
Atlantic sea scallop *Placopecten magellanicus*	B	P	B	B	B
Atlantic surfclam *Spisula solidissima*	P	P	B	B	B
Ocean quahog *Arctica islandica*	P	P	B	B	B
Northern shortfin squid *Illex illecebrosus*	P	P	D/P	D/P	D/P
Longfin inshore squid *Loligo pealeii*	B	P	D/P	D/P	D/P

Source: NOAA 2012c

[1] E = eggs; L/N = larvae for bony fish and invertebrates, neonate for sharks; J = juvenile; A = adult; SA = spawning adult

[2] P = pelagic; D = demersal; B = benthic

Fisheries

Commercial and recreational fisheries data are collected by NMFS, including species, gear type and landings mass and value, all of which are reported by state of landing (NOAA 2013e). Fisheries data from 2008 to 2013 were used in the analysis of New Jersey's commercial and recreational fisheries near the proposed survey area. To sample fishing vessel traffic during the proposed survey period off New Jersey, we requested historical National Automated Identification System (NAIS)[5] data from the USCG Navigation Center for June and July 2013 and 2014. The number of fishing vessels equipped with AIS was 21–27 per month, with only 4–6 of those spending more than a few hours in the proposed survey area. Some, but not all, small recreational fishing vessels would be included, as the use of AIS systems is voluntary for small vessels.

(1) Commercial Fisheries

The average annual catch weights and values, fishing season, and gear types for major commercial species are summarized in Table 5. In the waters off New Jersey, commercial fishery catches are dominated by menhaden, various shellfish, and squid. Menhaden accounted for 33% of the catch weight, followed by Atlantic surf clam (17%), ocean quahog (9%), sea scallop (7%), northern shortfin squid (6%), shellfish (5%), and blue crab (4%). Numerous other fish and invertebrate species accounted for the remaining proportion of catch weight. In 2010 (the only such dataset available in NOAA 2013g), most finfish by weight (68.8%) were caught within 5.6 km from shore; that catch was almost all (98.1%) accounted for by menhaden. Fish dominating the offshore (5.6–370 km from shore) finfish catch by weight were American mackerel (20.1% of total finfish weight), American herring (17.7%), skates (12.8%), and summer flounder (8.8%). Most finfish by value (73.3%) were caught between 5.6 and 370 km from shore; dominant fish by value were summer flounder (25.7% of total finfish value), goosefish/anglerfish (15.2%), yellowfin tuna (6.8%), and bigeye tuna (6.4%). Most shellfish and squid were captured between 5.6 and 370 km from shore, both by weight (73.6% of total shellfish and squid catch) and value (89.1%).

During 2002–2006 (the last year reported), commercial catch in the EEZ along the U.S east coast has only been landed by U.S. and Canadian vessels, with the vast majority of the catch (>99%) taken by U.S. vessels (Sea Around Us Project 2011). Typical commercial fishing vessels in the New Jersey area include trawlers, gill netters, lobster/crab boats, dredgers, longliners, and purse seiners.

(2) Recreational Fisheries

In 2013, marine recreational fishers caught over 5 million fish for harvest or bait, and >17.8 million fish in catch and release programs in New Jersey waters. These catches were taken by over 900,000 recreational fishers during more than 4 million trips. The majority of the trips (87%) occurred within 5.6 km from shore. The periods with the most boat-based trips (including charter, party, and private/rental boats) were July–August (1.03 million trips or 44% of total), followed by 1.03 million trips or 44%), and September–October (445,923 or 19%). Most shore-based trips (from beaches, marshes, docks, and/or piers; DoN 2005) occurred in July–August (600,400 or 32%), then September–October (442,464 or 23%), and May–June (370,832 or 20%).

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[5] Using the NAIS, detailed information on marine vessel traffic is collected, consolidated, and disseminated to the Coast Guard and other government agencies; the information includes vessel type, name, and other information that allows the data to be sorted by activities, e.g., fishing, diving, sailing, recreational, and cargo. Because AIS-equipped vessels transmit at regular intervals, it is possible to discriminate between vessels that are in the area for a period of time and those that are passing through.

TABLE 5. Commercial fishery catches for major marine species for New Jersey waters by weight, value, season, and gear type, averaged from 2008 to 2013.

Species	Average annual landings (mt)	% total	Average annual landings (1000$)	% total	Fishing season (peak season)	Gear Type: Fixed	Gear Type: Mobile
Menhaden	24,056	34	5,328	3	Year-round (May–Oct)	Gill nets, pots, traps, pound nets	Dip nets, trawls, dredge, purse seines, tongs, grabs
Atlantic surf clam	12,324	18	16,745	10	Year-round	N/A	Dredge, tongs, grabs
Ocean quahog	6,697	10	9,245	6	Year-round (spring–fall)	N/A	Dredge
Sea scallop	5,524	8	101,497	63	Year-round (Mar–Oct)	Gill nets, long lines, pots, traps, pound nets	Dredge, trawls
Northern shortfin squid	4,593	7	3,424	2	Year-round (Jun–Oct)	N/A	Dredge, trawls
Shellfish	3,607	5	1,464	1	Year-round (May–Oct)	Gill nets, long lines, pots, traps, pound nets, weirs	Trawls, cast nets, dip nets, diving, dredge, fyke net, hand lines, Scottish seine
Blue crab	2,768	4	7,718	5	Year-round (May–Oct)	Lines trot with bait, pots, traps	Dredge, hand lines, trawls
Atlantic herring	2,284	3	574	<1	Year-round (Jan–Feb)	Gill nets, pound nets	Trawls, fyke net
Atlantic mackerel	2,007	3	769	<1	Fall–spring (Jan–Apr)	Gill nets, pound nets	Dredge, trawls
Longfin squid	1,533	2	3,278	2	Year-round (Jan–Mar; Jul–Nov)	Gill nets, pound nets	Dredge, trawls
Monkfish (Goosefish)	1,144	2	3,199	2	Year-round (Oct–Mar; May–Jun)	Gill nets, long lines, pots, traps, pound nets	Dredge, trawls
Skate	1,036	1	667	<1	Year-round (Nov–Jan; May–Jun)	Gill nets, pots, traps, pound nets	Dredge, trawls
Summer flounder	953	1	4,527	3	Year-round	Gill nets, pots, traps, pound nets	Dredge, hand lines, trawls, rod and reel
Scup	669	1	831	1	Year-round (Jan–Apr)	Gill nets, pots, traps, pound nets	Dredge, trawls, hand lines
Spiny dogfish shark	554	1	247	<1	Fall–spring (Nov–Jan; May)	Gill nets, long lines, pots, traps, pound nets	Dredge, trawls, hand lines
Bluefish	422	1	452	<1	Year-round (Apr–Nov)	Gill nets, pots, traps, pound nets	Dredge, hand lines, trawls
Total	70,172	100	159,964	100			

Source: NOAA 2013e

In 2004, there were eight recreational fishing tournaments around New Jersey between May and November, all of which were within 150 km (~80 nm) from shore (DoN 2005). Of the 'hotspots' (popular fishing sites commonly visited by recreational anglers) mapped by DoN (2005), most are to the north or south of the proposed survey area; however, there are several hotspots located within or very near the northwestern corner of the survey area. As of May 2015, 20 tournaments were scheduled in 2015 for central New Jersey ports of call (Table 6). No detailed information about locations is given in the sources cited.

In 2013, at least 75 species of fish were targeted by recreational fishers off New Jersey. Species with 2013 recreational catch numbers exceeding one million include summer flounder (33% of total catch), black sea bass (12%), Atlantic croaker (7%), bluefish (7%), striped searobin (7%), striped bass (6%), and spot (5%). Other notable species or species groups representing at least 1% each of the total catch included unidentified sea robin, tautog, smooth dogfish, Atlantic menhaden, little skate, spiny

TABLE 6. Fishing tournaments off New Jersey, June–mid August 2014.

Dates	Tournament name	Port/ waters	Marine species/groups targeted	Source
1 Apr–30 Nov	Jersey Shore Beach N Boat Fishing Tournament	Beach Haven/ all saltwater out to 20 n.mi.	Striper; fluke; bluefish; black drum; weakfish; northern kingfish; sea bass; tautog (blackfish)	1
1 Apr–31 Dec	Beach Haven MTC Annual Fishing Contest	Beach Haven	Marlin; roundscale spearfish; swordfish; pelagic sharks; bluefin/bigeye/ albacore/yellowfin/skipjack tuna	2
1 May–30 Nov	Manasquan River MTC Monthly & Mako Tournament	Brielle	Pelagic sharks; bigeye/albacore/ yellowfin tuna	2
5 Jun–31 Jul	Manasquan River Marlin & Tuna Club Bluefin Tournament	Manasquan/ Atlantic Ocean	Bluefin tuna	1, 3
5–8 Jun	Manasquan River Marlin & Tuna Club Spring Striped Bass Tournament	Manasquan	Striped bass	3
5–7 Jun	11th Annual Brielle Family Fishing Tournament	Brielle	Fluke; striped bass; bluefish	4
6 Jun	28th Greater Atlantic Bluefish Tournament	Sheltered Cove Kammerman's Seaview Harbour	Bluefish	5
12–13 Jun	Warriors for Warriors Charity Shark Tournament	Point Pleasant	Pelagic sharks	2
12–13 Jun	Brett T Bailey Mako Rodeo	Brielle	Pelagic sharks	2, 4
13 June	Atlantic City ASAC Just For Kids Youth Fish Tournament	Atlantic City	Unlisted	6
19–20 Jun	Beach Haven MTC Mako & Tuna Tournament	Beach Haven	Pelagic sharks; bluefin/bigeye/albacore/yellowfin tuna	2
26 Jun–5 Jul	Manasquan River Marlin & Tuna Club Jack Meyer Memorial Trolling Tournament	Manasquan	Marlins; tunas	3
26–28 Jun	Jersey Coast Shark Anglers 37th Annual Shark Tournament	Brielle	Pelagic sharks	4
27–28 Jun	Mako Mania	Point Pleasant	Pelagic sharks	2
1 Jul–30 Sep	Manasquan River MTC Super Monthly Marlin	Brielle	Blue/white marlin	2
4 Jul	World Cup Blue Marlin Championship	Statewide/ offshore	Blue marlin	1
11–12 Jul	Manasquan River Marlin & Tuna Club Ladies and Juniors Tournament	Manasquan	Unlisted	3
17–18 Jul	Beach Haven MTC 1st Offshore Tournament	Beach Haven	Blue/white marlin; roundscale spearfish; swordfish; bluefin/bigeye/albacore/ yellowfin tuna	2
18 Jul	Ladies Catch of the Day Tournament	Forked River Tuna Club	Bluefish; fluke (likely summer/winter fluke); crab	5
30 Jul–1 Aug	Beach Haven MTC White Marlin Invitational	Beach Haven	Blue/white marlin; roundscale spearfish; bluefin/bigeye/albacore/ yellowfin tuna	2

Sources: 1: American Fishing Contests (2015); 2: NOAA (2015); 3: MRMTC (2015); 4: Hoffman's Marina (2015); 5: SBT (2015); 6: ASAC (2015).

dogfish, clearnose skate, tilefish, scup, cunner, red hake, unidentified skate, northern searobin, and weakfish. Most of these species/species groups were predominantly caught within 5.6 km from shore (on average 90% of total catch); summer flounder, skates/rays, and cunner were caught roughly equally within and beyond 5.6 km from shore, and red hake were mainly taken beyond 5.6 km from shore (80%).

A part of the proposed survey area is known as "The Fingers", a recognized productive and historical fishing area under the New Jersey Department of Environmental Protection (NJDEP)'s Prime Fisheries Area Mapping. The Fingers is 1 of 371 identified sport ocean fishing grounds in New Jersey; at 10,282 ha in area, it comprises ~0.9% of New Jersey's sport ocean fishing grounds (NJDEP 2003).

Recreational SCUBA Diving

Wreck diving is a popular form of recreation in the waters off New Jersey. A search for shipwrecks in New Jersey waters was made using NOAA's automated wreck and obstruction information system (NOAA 2014a). Results of the search are plotted in Figure 2 together with the survey lines. There are over 900 shipwrecks/obstructions in New Jersey waters, most (58%) of which are listed by NOAA (2014b) as unidentified. Only one shipwreck, a known dive site, is in or near the survey area (Fig. 2): the *Lillian* (Galiano 2009; Fisherman's Headquarters 2014; NOAA 2014a). Although it was noted during the public comment period for the Draft Amended EA that there might be other undocumented dive sites within the vicinity of the survey site, no specific dive site locations were identified.

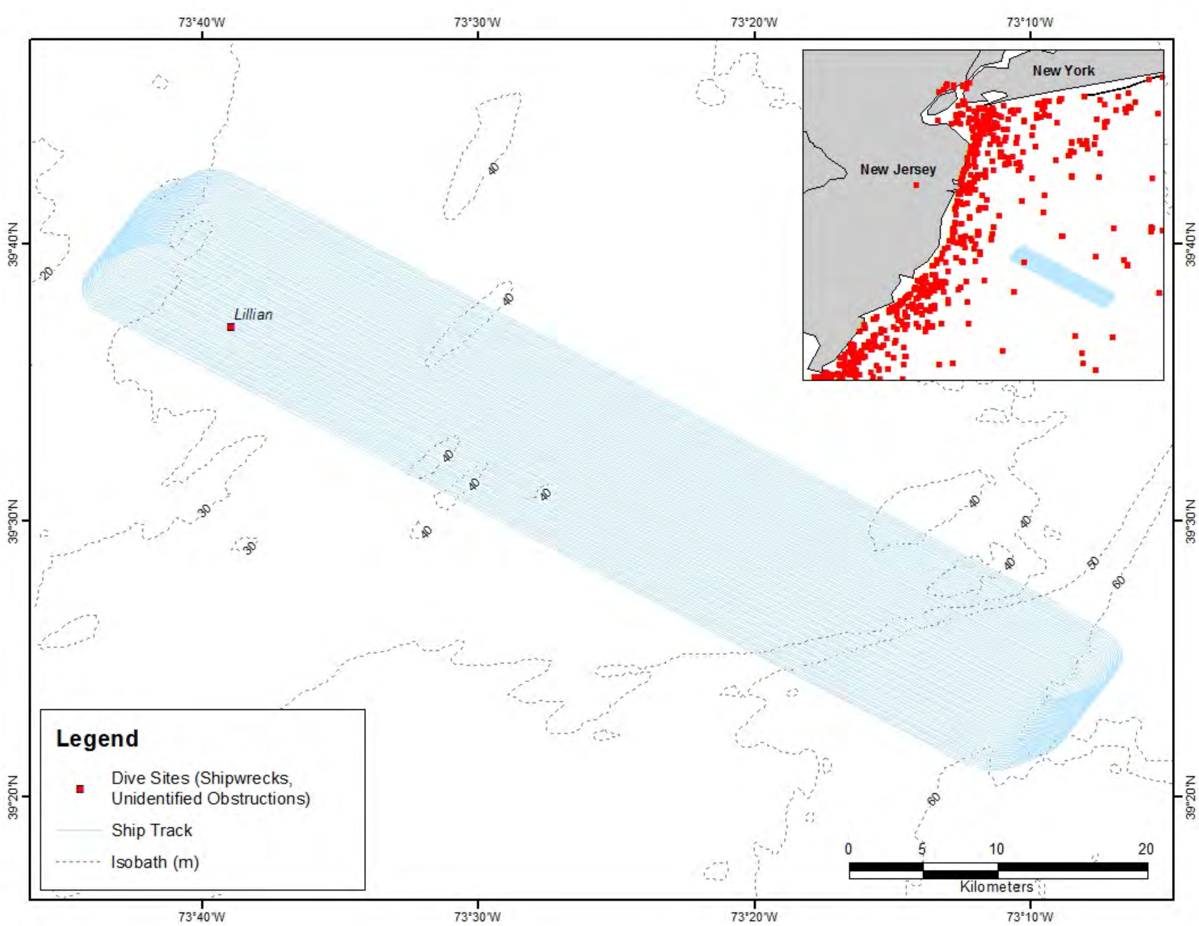

FIGURE 2. Potential dive sites (shipwrecks or unidentified obstructions) in New Jersey waters. Source: NOAA (2014b).

To sample diving activity during the proposed rescheduled survey period off New Jersey, historical NAIS data for both diving boats and pleasure craft in June and July 2013 and 2014 were requested and evaluated. There was only one AIS-identified dive boat in the survey area, apparently moving through the area in June 2013 and June 2014. In 2015, one dive operator had scheduled summer dives on the *Lillian*, on 11 July and 23 August (Deep Expeditions 2015). As of 1 May 2015, no other operators were found that have scheduled dives on the *Lillian* during the summer of 2015.

IV. ENVIRONMENTAL CONSEQUENCES

Proposed Action

The PEIS presented analyses of potential impacts from acoustic sources in general terms and for specific analysis areas. The proposed rescheduled survey and effects analysis differ from those in the NW Atlantic DAA presented in the PEIS in that different sources were used, the survey areas covered a different range of depths, and different modeling methods were used. The following section includes site-specific details of the proposed survey, summary effects information from the PEIS, and updates to the effects information from recent literature. Analysis conducted for the proposed 2015 survey remains the same as described in the 2014 Final EA for the 2014 survey, except for the smaller size of the airgun array. Seismic effects literature is updated in this Final Amended EA, and additional effects literature given in the 2015 NMFS EA (Appendix E) is incorporated into this Final Amended EA by reference as if fully set forth herein. In the conclusions of this section, we also refer to conclusions of the Final EAs, FONSIs, IHAs, and Biological Opinions issued by NMFS for the New Jersey survey in 2014 and 2015, and to observations made during the brief survey conducted in 2014. The effects are fully consistent with those set forth in the 2014 NSF Final EA and FONSI, and 2015 NMFS Final EA, FONSI, IHA, Biological Opinion, and EFH concurrence letter, and which are incorporated herein by reference.

(1) Direct Effects on Marine Mammals and Sea Turtles and Their Significance

The material in this section includes a brief summary of the expected potential effects (or lack thereof) of airgun sounds on marine mammals and sea turtles, and reference to recent literature that has become available since the PEIS was released in 2011. A more comprehensive review of the relevant background information, as well as information on the hearing abilities of marine mammals and sea turtles, appears in § 3.4.4.3, § 3.6.4.3, § 3.7.4.3, and Appendix E of the PEIS.

Estimates of the numbers of marine mammals that could be affected by the proposed seismic survey scheduled to occur during June–August 2015 are provided in (e) below, along with a description of the rationale for NSF's estimates of the numbers of individuals exposed to received sound levels ≥160 dB re 1 μPa_{rms}. Although the PEIS included modeling for the NW Atlantic DAA, it was done for a different energy source level and survey parameters (e.g., survey water depths and source tow depth), and modeling methods were different from those used by L-DEO (see PEIS, Appendix B, for further modeling details regarding the NW Atlantic DAA). Acoustic modeling for the proposed action was conducted by L-DEO, consistent with past EAs and determined to be acceptable by NMFS to use in the calculation of estimated takes under the MMPA (e.g., NMFS 2013d,e), including for the 2014 survey.

(a) Summary of Potential Effects of Airgun Sounds

As noted in the PEIS (§ 3.4.4.3, § 3.6.4.3, and § 3.7.4.3), the effects of sounds from airguns could include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, and at least in theory, temporary or permanent hearing impairment, or non-auditory physical or physiological effects (Richardson et al. 1995; Gordon et al. 2004; Nowacek et al. 2007; Southall et al. 2007). Permanent hearing impairment (PTS), in the unlikely event that it occurred, would constitute injury, but temporary threshold shift (TTS) is not considered an injury (Southall et al. 2007; Le Prell 2012). Rather, the onset of TTS has been considered an indicator that, if the animal is exposed to higher levels of that sound, physical damage is ultimately a possibility. Recent research has shown that sound exposure can cause cochlear neural degeneration, even when threshold shifts and hair cell damage are reversible (Liberman 2013). These findings have raised some doubts as to whether TTS should continue to be considered a non-injurious effect. Although the possibility cannot be entirely excluded, it is unlikely that the proposed survey would result in any cases of temporary or permanent hearing impairment, or any significant non-auditory physical or physiological effects. If marine mammals encounter the survey while it is underway, some behavioral disturbance could result, but this would be localized and short-term.

***Tolerance*.—**Numerous studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers (e.g., Nieukirk et al. 2012). Several studies have shown that marine mammals at distances more than a few kilometers from operating seismic vessels often show no apparent response. That is often true even in cases when the pulsed sounds must be readily audible to the animals based on measured received levels and the hearing sensitivity of that mammal group. Although various baleen whales and toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to airgun pulses under some conditions, at other times mammals of all three types have shown no overt reactions. The relative responsiveness of baleen and toothed whales are quite variable.

***Masking*.—**Masking effects of pulsed sounds (even from large arrays of airguns) on marine mammal calls and other natural sounds are expected to be limited, although there are very few specific data on this. Because of the intermittent nature and low duty cycle of seismic pulses, animals can emit and receive sounds in the relatively quiet intervals between pulses. However, in exceptional situations, reverberation occurs for much or all of the interval between pulses (e.g., Simard et al. 2005; Clark and Gagnon 2006), which could mask calls. Situations with prolonged strong reverberation are infrequent. However, it is common for reverberation to cause some lesser degree of elevation of the background level between airgun pulses (e.g., Gedamke 2011; Guerra et al. 2011, 2013; Klinck et al. 2012), and this weaker reverberation presumably reduces the detection range of calls and other natural sounds to some degree. Guerra et al. (2013) reported that ambient noise levels between seismic pulses were elevated because of reverberation at ranges of 50 km from the seismic source. Based on measurements in deep water of the Southern Ocean, Gedamke (2011) estimated that the slight elevation of background levels during intervals between pulses reduced blue and fin whale communication space by as much as 36–51% when a seismic survey was operating 450–2800 km away. Based on preliminary modeling, Wittekind et al. (2013) reported that airgun sounds could reduce the communication range of blue and fin whales 2000 km from the seismic source. Nieukirk et al. (2012) and Blackwell et al. (2013) noted the potential for masking effects from seismic surveys on large whales.

Some baleen and toothed whales are known to continue calling in the presence of seismic pulses, and their calls usually can be heard between the seismic pulses (e.g., Nieukirk et al. 2012; Broker et al. 2013). Cerchio et al. (2014) suggested that the breeding display of humpback whales off Angola could be disrupted by seismic sounds, as singing activity declined with increasing received levels. In addition, some cetaceans are known to change their calling rates, shift their peak frequencies, or otherwise modify their vocal behavior in response to airgun sounds (e.g., Di Iorio and Clark 2010; Castellote et al. 2012; Blackwell et al. 2013). The hearing systems of baleen whales are undoubtedly more sensitive to low-frequency sounds than are the ears of the small odontocetes that have been studied directly (e.g., MacGillivray et al. 2014). The sounds important to small odontocetes are predominantly at much higher frequencies than are the dominant components of airgun sounds, thus limiting the potential for masking. In general, masking effects of seismic pulses are expected to be minor, given the normally intermittent nature of seismic pulses. We are not aware of any information concerning masking of hearing in sea turtles.

Disturbance Reactions.—Disturbance includes a variety of effects, including subtle to conspicuous changes in behavior, movement, and displacement. Based on NMFS (2001, p. 9293), NRC (2005), and Southall et al. (2007), we believe that simple exposure to sound, or brief reactions that do not disrupt behavioral patterns in a potentially significant manner, do not constitute harassment or "taking". By potentially significant, we mean, 'in a manner that might have deleterious effects to the well-being of individual marine mammals or their populations'.

Reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, and many other factors (Richardson et al. 1995; Wartzok et al. 2004; Southall et al. 2007; Weilgart 2007; Ellison et al. 2012). If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or population (e.g., New et al. 2013). However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and populations could be significant (e.g., Lusseau and Bejder 2007; Weilgart 2007). Given the many uncertainties in predicting the quantity and types of impacts of noise on marine mammals, it is common practice to estimate how many marine mammals would be present within a particular distance of industrial activities and/or exposed to a particular level of industrial sound. In most cases, this approach likely overestimates the numbers of marine mammals that would be affected in some biologically important manner.

The sound criteria used to estimate how many marine mammals could be disturbed to some biologically important degree by a seismic program are based primarily on behavioral observations of a few species. Detailed studies have been done on humpbacks, gray whales, bowheads, and sperm whales. Less detailed data are available for some other species of baleen whales and small toothed whales, but for many species, there are no data on responses to marine seismic surveys.

Baleen Whales

Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable. Whales are often reported to show no overt reactions to pulses from large arrays of airguns at distances beyond a few kilometers, even though the airgun pulses remain well above ambient noise levels out to much longer distances. However, baleen whales exposed to strong noise pulses from airguns often react by deviating from their normal migration route and/or interrupting their feeding and moving away. In the cases of migrating gray and bowhead whales, the observed changes in behavior appeared to be of little or no biological consequence to the animals. They simply avoided the sound source by displacing their migration route to varying degrees, but within the natural boundaries of the migration corridors (Malme et al. 1984; Malme and Miles 1985; Richardson et al. 1995).

Responses of *humpback whales* to seismic surveys have been studied during migration, on summer feeding grounds, and on Angolan winter breeding grounds; there has also been discussion of effects on the Brazilian wintering grounds. Off Western Australia, avoidance reactions began at 5–8 km from the array, and those reactions kept most pods ~3–4 km from the operating seismic boat; there was localized displacement during migration of 4–5 km by traveling pods and 7–12 km by more sensitive resting pods of cow-calf pairs (McCauley et al. 1998, 2000). However, some individual humpback whales, especially males, approached within distances of 100–400 m. Studies examining the behavioral responses of humpback whales to airguns are currently underway off eastern Australia (Cato et al. 2011, 2012, 2013).

In the Northwest Atlantic, sighting rates were significantly greater during non-seismic periods compared with periods when a full array was operating, and humpback whales were more likely to swim away and less likely to swim towards a vessel during seismic vs. non-seismic periods (Moulton and Holst 2010). On their summer feeding grounds in southeast Alaska, there was no clear evidence of avoidance, despite the possibility of subtle effects, at received levels up to 172 re 1 μPa on an approximate rms basis (Malme et al. 1985). It has been suggested that South Atlantic humpback whales wintering off Brazil may be displaced or even strand upon exposure to seismic surveys (Engel et al. 2004), but data from subsequent years indicated that there was no observable direct correlation between strandings and seismic surveys (IWC 2007).

There are no data on reactions of *right whales* to seismic surveys. However, Rolland et al. (2012) suggested that ship noise causes increased stress in right whales; they showed that baseline levels of stress-related fecal hormone metabolites decreased in North Atlantic right whales with a 6-dB decrease in underwater noise from vessels. Wright et al. (2011) also reported that sound could be a potential source of stress for marine mammals.

Results from *bowhead whales* show that their responsiveness can be quite variable depending on their activity (migrating vs. feeding). Bowhead whales migrating west across the Alaskan Beaufort Sea in autumn, in particular, are unusually responsive, with substantial avoidance occurring out to distances of 20–30 km from a medium-sized airgun source (Miller et al. 1999; Richardson et al. 1999). More recent research on bowhead whales corroborates earlier evidence that, during the summer feeding season, bowheads are not as sensitive to seismic sources (e.g., Miller et al. 2005; Robertson et al. 2013). Subtle but statistically significant changes in surfacing–respiration–dive cycles were shown by traveling and socializing bowheads exposed to airgun sounds in the Beaufort Sea, including shorter surfacing intervals, shorter dives, and decreased number of blows per surface interval (Robertson et al. 2013).

Bowhead whale calls detected in the presence and absence of airgun sounds have been studied extensively in the Beaufort Sea. Bowheads continue to produce calls of the usual types when exposed to airgun sounds on their summering grounds, although numbers of calls detected are significantly lower in the presence than in the absence of airgun pulses; Blackwell et al. (2013) reported that calling rates in 2007 declined significantly where received SPLs from airgun sounds were 116–129 dB re 1 µPa. Therefore, bowhead whales in the Beaufort Sea apparently decreased their calling rates in response to seismic operations, although movement out of the area could also have contributed to the lower call detection rate (Blackwell et al. 2013).

A multivariate analysis of factors affecting the distribution of calling bowhead whales during their fall migration in 2009 noted that the southern edge of the distribution of calling whales was significantly closer to shore with increasing levels of airgun sound from a seismic survey a few hundred kilometers to the east of the study area (i.e., behind the westward-migrating whales; McDonald et al. 2010, 2011). It was not known whether this statistical effect represented a stronger tendency for quieting of the whales farther offshore in deeper water upon exposure to airgun sound, or an actual inshore displacement of whales.

Reactions of migrating and feeding (but not wintering) *gray whales* to seismic surveys have been studied. Off St. Lawrence Island in the northern Bering Sea, it was estimated, based on small sample sizes, that 50% of feeding gray whales stopped feeding at an average received pressure level of 173 dB re 1 μPa on an (approximate) rms basis, and that 10% of feeding whales interrupted feeding at received levels of 163 dB re 1 μPa_{rms} (Malme et al. 1986, 1988). Those findings were generally consistent with the results of experiments conducted on larger numbers of gray whales that were migrating along the California coast (Malme et al. 1984; Malme and Miles 1985), and western Pacific gray whales feeding off Sakhalin Island, Russia (e.g., Gailey et al. 2007; Johnson et al. 2007; Yazvenko et al. 2007a,b).

Various species of *Balaenoptera* (blue, sei, fin, and minke whales) have occasionally been seen in areas ensonified by airgun pulses; sightings by observers on seismic vessels off the U.K. from 1997 to 2000 suggest that, during times of good sightability, sighting rates for mysticetes (mainly fin and sei whales) were similar when large arrays of airguns were shooting vs. silent, although there was localized avoidance (Stone and Tasker 2006). Singing fin whales in the Mediterranean moved away from an operating airgun array, and their song notes had lower bandwidths during periods with vs. without airgun sounds (Castellote et al. 2012).

During seismic surveys in the Northwest Atlantic, baleen whales as a group showed localized avoidance of the operating array (Moulton and Holst 2010). Sighting rates were significantly lower during seismic operations compared with non-seismic periods. Baleen whales were seen on average 200 m farther from the vessel during airgun activities vs. non-seismic periods, and these whales more often swam away from the vessel when seismic operations were underway compared with periods when no airguns were operating (Moulton and Holst 2010). Blue whales were seen significantly farther from the vessel during single airgun operations, ramp up, and all other airgun operations compared with non-seismic periods (Moulton and Holst 2010). Similarly, fin whales were seen at significantly farther distances during ramp up than during periods without airgun operations; there was also a trend for fin whales to be sighted farther from the vessel during other airgun operations, but the difference was not significant (Moulton and Holst 2010). Minke whales were seen significantly farther from the vessel during periods with than without seismic operations (Moulton and Holst 2010). Minke whales were also more likely to swim away and less likely to approach during seismic operations compared to periods when airguns were not operating (Moulton and Holst 2010).

Data on short-term reactions by cetaceans to impulsive noises are not necessarily indicative of long-term or biologically significant effects. It is not known whether impulsive sounds affect reproductive rate or distribution and habitat use in subsequent days or years. However, gray whales have continued to migrate annually along the west coast of North America with substantial increases in the population over recent years, despite intermittent seismic exploration (and much ship traffic) in that area for decades. The western Pacific gray whale population did not seem affected by a seismic survey in its feeding ground during a previous year, and bowhead whales have continued to travel to the eastern Beaufort Sea each summer, and their numbers have increased notably, despite seismic exploration in their summer and autumn range for many years.

Toothed Whales

Little systematic information is available about reactions of toothed whales to sound pulses. However, there are recent systematic studies on sperm whales, and there is an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies. Seismic operators and marine mammal observers on seismic vessels regularly see dolphins and other small toothed whales near operating airgun arrays, but in general there is a tendency for most delphinids to show some avoidance of operating seismic vessels (e.g., Stone and Tasker 2006; Moulton and Holst 2010; Barry et al. 2012; Wole and Myade 2014). In most cases, the avoidance radii for delphinids appear to be small, on the order of 1 km or less, and some individuals show no apparent avoidance.

During seismic surveys in the Northwest Atlantic, delphinids as a group showed some localized avoidance of the operating array (Moulton and Holst 2010). The mean initial detection distance was significantly farther (by ~200 m) during seismic operations compared with periods when the seismic source was not active; however, there was no significant difference between sighting rates (Moulton and Holst 2010). The same results were evident when only long-finned pilot whales were considered.

Preliminary findings of a monitoring study of *narwhals* (*Monodon monoceros*) in Melville Bay, Greenland (summer and fall 2012) showed no short-term effects of seismic survey activity on narwhal distribution, abundance, migration timing, and feeding habits (Heide-Jørgensen et al. 2013a). In addition, there were no reported effects on narwhal hunting. These findings do not seemingly support a suggestion by Heide-Jørgensen et al. (2013b) that seismic surveys in Baffin Bay may have delayed the migration timing of narwhals, thereby increasing the risk of narwhals to ice entrapment.

The *beluga*, however, is a species that (at least at times) shows long-distance (10s of km) avoidance of seismic vessels (e.g., Miller et al. 2005). Captive bottlenose dolphins and beluga whales exhibited changes in behavior when exposed to strong pulsed sounds similar in duration to those typically used in seismic surveys, but the animals tolerated high received levels of sound before exhibiting aversive behaviors (e.g., Finneran et al. 2000, 2002, 2005).

Most studies of *sperm whales* exposed to airgun sounds indicate that the sperm whale shows considerable tolerance of airgun pulses; in most cases the whales do not show strong avoidance (e.g., Stone and Tasker 2006; Moulton and Holst 2010), but foraging behavior can be altered upon exposure to airgun sound (e.g., Miller et al. 2009). There are almost no specific data on the behavioral reactions of *beaked whales* to seismic surveys. Most beaked whales tend to avoid approaching vessels of other types (e.g., Würsig et al. 1998) and/or change their behavior in response to sounds from vessels (e.g., Pirotta et al. 2012). However, some northern bottlenose whales remained in the general area and continued to produce high-frequency clicks when exposed to sound pulses from distant seismic surveys (e.g., Simard et al. 2005). In any event, it is likely that most beaked whales would also show strong avoidance of an approaching seismic vessel, although this has not been documented explicitly.

The limited available data suggest that *harbor porpoises* show stronger avoidance of seismic operations than do Dall's porpoises. Thompson et al. (2013) reported decreased densities and reduced acoustic detections of harbor porpoise in response to a seismic survey in Moray Firth, Scotland, at ranges of 5–10 km (SPLs of 165–172 dB re 1 μPa, SELs of 145–151 dB $\mu Pa^2 \cdot s$). For the same survey, Pirotta et al. (2014) reported that the probability of recording a porpoise buzz decreased by 15% in the ensonified area, and that the probability was positively related to the distance from the seismic ship; the decreased buzzing occurrence could indicate reduced foraging efficiency. Nonetheless, animals returned to the area within a few hours (Thompson et al. 2013). Kastelein et al. (2013a) reported that a harbor porpoise showed no response to an impulse sound with an SEL below 65 dB, but there was a 50% brief response rate at an SEL of 92 dB and an SPL of 122 dB re 1 $\mu Pa_{0\text{-peak.}}$ The apparent tendency for greater responsiveness in the harbor porpoise is consistent with its relative responsiveness to boat traffic and some other acoustic sources (Richardson et al. 1995; Southall et al. 2007).

Odontocete reactions to large arrays of airguns are variable and, at least for delphinids, seem to be confined to a smaller radius than has been observed for the more responsive of the mysticetes and some other odontocetes. A ≥170 dB disturbance criterion (rather than ≥160 dB) is considered appropriate for delphinids, which tend to be less responsive than the more responsive cetaceans.

Sea Turtles

Several recent papers discuss the morphology of the turtle ear (e.g., Christensen-Dalsgaard et al. 2012; Willis et al. 2013) and the hearing ability of sea turtles (e.g., Martin et al. 2012; Piniak et al. 2012a,b; Lavender et al. 2014). The limited available data indicate that sea turtles will hear airgun sounds and sometimes exhibit localized avoidance (see PEIS, § 3.4.4.3).

DeRuiter and Doukara (2012) observed that immediately following an airgun pulse, small numbers of basking loggerhead turtles (6 of 86 turtles observed) exhibited an apparent startle response (sudden raising of the head and splashing of flippers, occasionally accompanied by blowing bubbles from the beak and nostrils, followed by a short dive). Diving turtles (49 of 86 individuals) were observed at distances from the center of the airgun array ranging from 50 to 839 m. The estimated sound level at the median distance of 130 m was 191 dB re 1 μPa_{peak}. These observations were made during ~150 h of vessel-based monitoring from a seismic vessel operating an airgun array (13 airguns, 2440 in^3) off Algeria; there was no corresponding observation effort during periods when the airgun array was inactive (DeRuiter and Doukara 2012).

Based on available data, it is likely that sea turtles will exhibit behavioral changes and/or avoidance within an area of unknown size near a seismic vessel. To the extent that there are any impacts on sea turtles, seismic operations in or near areas where turtles concentrate would likely have the greatest impact; concentration areas are not known to occur in the proposed survey area. There are no specific data that demonstrate the consequences to sea turtles if seismic operations with large or small arrays of airguns occur in important areas at biologically important times of the year.

***Hearing Impairment and Other Physical Effects.*—**Temporary or permanent hearing impairment is a possibility when marine mammals are exposed to very strong sounds. TTS has been demonstrated and studied in certain captive odontocetes and pinnipeds exposed to strong sounds. However, there has been no specific documentation of TTS let alone permanent hearing damage, i.e., PTS, in free-ranging marine mammals exposed to sequences of airgun pulses during realistic field conditions.

Additional data are needed to determine the received sound levels at which small odontocetes would start to incur TTS upon exposure to repeated, low-frequency pulses of airgun sound with variable received levels. To determine how close an airgun array would need to approach in order to elicit TTS, one would (as a minimum) need to allow for the sequence of distances at which airgun pulses would occur, and for the dependence of received SEL on distance in the region of the seismic operation (e.g., Breitzke and Bohlen 2010; Laws 2012). At the present state of knowledge, it is also necessary to assume that the effect is directly related to total received energy (SEL); however, this assumption is likely an over-simplification (Finneran 2012). There is recent evidence that auditory effects in a given animal are not a simple function of received acoustic energy. Frequency, duration of the exposure and occurrence of gaps within the exposure can also influence the auditory effect (Finneran and Schlundt 2010, 2011, 2013; Finneran et al. 2010a,b; Popov et al. 2011, 2013a; Finneran 2012; Kastelein et al. 2012a,b; 2013a,b,c, 2014; Ketten 2012).

Recent data have shown that the SEL required for TTS onset to occur increases with intermittent exposures, with some auditory recovery during silent periods between signals (Finneran et al. 2010b; Finneran and Schlundt 2011). Schlundt et al. (2013) reported that the potential for seismic surveys using airguns to cause auditory effects on dolphins could be lower than previously thought. Based on behavioral tests, Finneran et al. (2011) and Schlundt et al. (2013) reported no measurable TTS in bottlenose dolphins after exposure to 10 impulses from a seismic airgun with a cumulative SEL of ~195 dB re 1 $\mu Pa^2 \cdot s$; results from auditory evoked potential measurements were more variable (Schlundt et al. 2013).

Recent studies have also shown that the SEL necessary to elicit TTS can depend substantially on frequency, with susceptibility to TTS increasing with increasing frequency above 3 kHz (Finneran and Schlundt 2010, 2011; Finneran 2012). When beluga whales were exposed to fatiguing noise with sound levels of 165 dB re 1 µPa for durations of 1–30 min at frequencies of 11.2–90 kHz, the highest TTS with the longest recovery time was produced by the lower frequencies (11.2 and 22.5 kHz); TTS effects also gradually increased with prolonged exposure time (Popov et al. 2013a).

Additionally, Popov et al. (2013b) also reported that TTS produced by exposure to a fatiguing noise was larger during the first session (or naïve subject state) with a beluga whale than TTS that resulted from the same sound in subsequent sessions (experienced subject state). Similarly, several other studies have shown that some marine mammals (e.g., bottlenose dolphins, false killer whales) can decrease their hearing sensitivity in order to mitigate the impacts of exposure to loud sounds (e.g., Nachtigall and Supin 2013, 2014, 2015)

Previous information on TTS for odontocetes was primarily derived from studies on the bottlenose dolphin and beluga, and that for pinnipeds has mostly been obtained from California sea lions and elephant seals (see § 3.4.4.3, § 3.6.4.3, § 3.7.4.3, and Appendix E of the PEIS). Therefore, it is inappropriate to assume that onset of TTS occurs at similar received levels in all cetaceans or pinnipeds (*cf.* Southall et al. 2007). Some cetaceans or pinnipeds could incur TTS at lower sound exposures than are necessary to elicit TTS in the beluga and bottlenose dolphin or California sea lion and elephant seal, respectively.

Several studies on TTS in porpoises (e.g., Lucke et al. 2009; Popov et al. 2011; Kastelein et al. 2012a, 2013a, 2014) indicate that received levels that elicit onset of TTS are lower in porpoises than in other odontocetes. Kastelein et al. (2012a) exposed a harbor porpoise to octave band noise centered at 4 kHz for extended periods. A 6-dB TTS occurred with SELs of 163 dB and 172 dB for low-intensity sound and medium-intensity sound, respectively; high-intensity sound caused a 9-dB TTS at a SEL of 175 dB (Kastelein et al. 2012a). Kastelein et al. (2013a) exposed a harbor porpoise to a long, continuous 1.5-kHz tone, which induced a 14-dB TTS with a total SEL of 190 dB. Popov et al. (2011) examined the effects of fatiguing noise on the hearing threshold of Yangtze finless porpoises when exposed to frequencies of 32–128 kHz at 140–160 dB re 1 μPa for 1–30 min. They found that an exposure of higher level and shorter duration produced a higher TTS than an exposure of equal SEL but of lower level and longer duration. Popov et al. (2011) reported a TTS of 25 dB for a Yangtze finless porpoise that was exposed to high levels of 3-min pulses of half-octave band noise centered at 45 kHz with an SEL of 163 dB.

Initial evidence from prolonged (non-pulse and pulse) exposures has also suggested that some pinnipeds (harbor seals in particular) incur TTS at somewhat lower received levels than do small odontocetes exposed for similar durations (Kastak et al. 1999, 2005, 2008; Ketten et al. 2001; Kastelein et al. 2013c). Kastelein et al. (2012b) exposed two harbor seals to octave-band white noise centered at 4 kHz at three mean received SPLs of 124, 136, and 148 dB re 1 µPa; TTS >2.5 dB was induced at an SEL of 170 dB (136 dB SPL for 60 min), and the maximum TTS of 10 dB occurred after a 120-min exposure to 148 dB re 1 µPa or an SEL of 187 dB. Kastelein et al. (2013c) reported that a harbor seal unintentionally exposed to the same sound source with a mean received SPL of 163 dB re 1 µPa for 1 hr induced a 44 dB TTS. For a harbor seal exposed to octave-band white noise centered at 4 kHz for 60 min with mean SPLs of 124–148 re 1 µPa, the onset of PTS would require a level of at least 22 dB above the TTS onset (Kastelein et al. 2013c).

Based on the best available information at the time, Southall et al. (2007) recommended a TTS threshold for exposure to single or multiple pulses of 183 dB re 1 $\mu Pa^2 \cdot s$ for all cetaceans and 173 dB re 1 $\mu Pa^2 \cdot s$ for pinnipeds in water. Tougaard et al. (2015) suggested that SELs that induce TTS in porpoises are 100–110 dB above the pure tone hearing threshold at a specific frequency; they also suggested an exposure limit of $L_{eq\text{-}fast}$ (rms average over the duration of the pulse) of 45 dB above the hearing threshold for behavioral responses (i.e., negative phonotaxis). In addition, M-weighting, as used by Southall et al. (2007), might not be appropriate for the harbor porpoise (Wensveen et al. 2014; Tougaard et al. 2015); therefore, Wensveen et al. (2014) developed six auditory weighting functions for the harbor porpoise that could be useful in predicting TTS onset. Gedamke et al. (2011), based on preliminary simulation modeling that attempted to allow for various uncertainties in assumptions and variability around population means, suggested that some baleen whales whose closest point of approach to a seismic vessel is 1 km or more could experience TTS.

It is unlikely that a marine mammal would remain close enough to a large airgun array for sufficiently long to incur TTS, let alone PTS. There is no specific evidence that exposure to pulses of airgun sound can cause PTS in any marine mammal, even with large arrays of airguns. However, given the possibility that some mammals close to an airgun array might incur at least mild TTS, there has been further speculation about the possibility that some individuals occurring very close to airguns might incur PTS (e.g., Richardson et al. 1995, p. 372*ff*; Gedamke et al. 2011). In terrestrial animals, exposure to sounds sufficiently strong to elicit a large TTS induces physiological and structural changes in the inner ear, and at some high level of sound exposure, these phenomena become non-recoverable (Le Prell 2012). At this level of sound exposure, TTS grades into PTS. Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage, but repeated or (in some cases) single exposures to a level well above that causing TTS onset might elicit PTS (e.g., Kastak and Reichmuth 2007; Kastak et al. 2008).

Current NMFS policy regarding exposure of marine mammals to high-level sounds is that cetaceans and pinnipeds should not be exposed to impulsive sounds with received levels ≥180 dB and 190 dB re 1 μPa_{rms}, respectively (NMFS 2000). These criteria have been used in establishing the exclusion (shut-down) zones planned for the proposed seismic survey. However, those criteria were established before there was any information about minimum received levels of sounds necessary to cause auditory impairment in marine mammals.

Recommendations for science-based noise exposure criteria for marine mammals, frequency-weighting procedures, and related matters were published by Southall et al. (2007). Those recommendations were never formally adopted by NMFS for use in regulatory processes and during mitigation programs associated with seismic surveys, although some aspects of the recommendations have been taken into account in certain environmental impact statements and small-take authorizations. In December 2013, NOAA made available for public comment new draft guidance for assessing the effects of anthropogenic sound on marine mammals (NOAA 2013a), taking at least some of the Southall et al. recommendations into account. The new acoustic guidance and procedures could account for the now-available scientific data on marine mammal TTS, the expected offset between the TTS and PTS thresholds, differences in the acoustic frequencies to which different marine mammal groups are sensitive (e.g., M-weighting or generalized frequency weightings for various groups of marine mammals, allowing for their functional bandwidths), and other relevant factors. At the time of preparation of this Final Amended EA, the date of release of the final guidelines and how they would be implemented are unknown.

Nowacek et al. (2013) concluded that current scientific data indicate that seismic airguns have a low probability of directly harming marine life, except at close range. Several aspects of the planned monitoring and mitigation measures for this project are designed to detect marine mammals occurring near the airgun array, and to avoid exposing them to sound pulses that might, at least in theory, cause hearing impairment (see § II and § IV[2], below). Also, many marine mammals and (to a limited degree) sea turtles show some avoidance of the area where received levels of airgun sound are high enough such that hearing impairment could potentially occur. In those cases, the avoidance responses of the animals themselves would reduce or (most likely) avoid any possibility of hearing impairment.

Non-auditory physical effects could also occur in marine mammals exposed to strong underwater pulsed sound. Possible types of non-auditory physiological effects or injuries that might (in theory) occur in mammals close to a strong sound source include stress, neurological effects, bubble formation, and other types of organ or tissue damage. It is possible that some marine mammal species (i.e., beaked whales) are especially susceptible to injury and/or stranding when exposed to strong transient sounds.

There is no definitive evidence that any of these effects occur even for marine mammals in close proximity to large arrays of airguns. However, Gray and Van Waerebeek (2011) suggested a cause-effect relationship between a seismic survey off Liberia in 2009 and the erratic movement, postural instability, and akinesia in a pantropical spotted dolphin based on spatially and temporally close association with the airgun array. Additionally, a few cases of strandings in the general area where a seismic survey was ongoing have led to speculation concerning a possible link between seismic surveys and strandings (e.g., Castellote and Llorens 2013).

Non-auditory effects, if they occur at all, would presumably be limited to short distances and to activities that extend over a prolonged period. Marine mammals that show behavioral avoidance of seismic vessels, including most baleen whales, some odontocetes, and some pinnipeds, are especially unlikely to incur non-auditory physical effects. The brief duration of exposure of any given mammal and the planned monitoring and mitigation measures would further reduce the probability of exposure of marine mammals to sounds strong enough to induce non-auditory physical effects.

Sea Turtles

There is substantial overlap in the frequencies that sea turtles detect vs. the frequencies in airgun pulses. We are not aware of measurements of the absolute hearing thresholds of any sea turtle to waterborne sounds similar to airgun pulses. In the absence of relevant absolute threshold data, we cannot estimate how far away an airgun array might be audible. Moein et al. (1994) and Lenhardt (2002) reported TTS for loggerhead turtles exposed to many airgun pulses (see PEIS). This suggests that sounds from an airgun array might cause temporary hearing impairment in sea turtles if they do not avoid the (unknown) radius where TTS occurs. However, exposure duration during the proposed survey would be much less than during the aforementioned studies. Also, recent monitoring studies show that some sea turtles do show localized movement away from approaching airguns. At short distances from the source, received sound level diminishes rapidly with increasing distance. In that situation, even a small-scale avoidance response could result in a significant reduction in sound exposure.

Although it is possible that exposure to airgun sounds could cause mortality or mortal injuries in sea turtles close to the source, this has not been demonstrated and seems highly unlikely (Popper et al. 2014), especially because sea turtles appear to be highly resistant to explosives (Ketten et al. 2005 *in* Popper et al. 2014). Nonetheless, Popper et al. (2014) proposed sea turtle mortality/mortal injury criteria of 210 dB SEL or >207 dB_{peak} for sounds from seismic airguns.

The PSOs stationed on the *Langseth* would also watch for sea turtles, and airgun operations would be shut down if a turtle enters the designated EZ.

(b) Possible Effects of Other Acoustic Sources

The Kongsberg EM 122 MBES and Knudsen Chirp 3260 SBP would be operated from the source vessel during the proposed survey, but not during transits. Information about this equipment was provided in § 2.2.3.1 of the PEIS. A review of the expected potential effects (or lack thereof) of MBESs, SBPs, and pingers on marine mammals and sea turtles appears in § 3.4.4.3, § 3.6.4.3, § 3.7.4.3, and Appendix E of the PEIS.

There has been some recent attention given to the effects of MBES on marine mammals, as a result of a report issued in September 2013 by an International Whaling Commission (IWC) independent scientific review panel (ISRP) linking the operation of an MBES to a mass stranding of melon-headed whales (*Peponocephala electra*; Southall et al. 2013) off Madagascar. During May–June 2008, ~100 melon-headed whales entered and stranded in the Loza Lagoon system in northwest Madagascar at the same time that a 12-kHz MBES survey was being conducted ~65 km away off the coast. In conducting a retrospective review of available information on the event, an independent scientific review panel concluded that the Kongsberg EM 120 MBES was the most plausible behavioral trigger for the animals initially entering the lagoon system and eventually stranding. The independent scientific review panel, however, identified that an unequivocal conclusion on causality of the event was not possible because of the lack of information about the event and a number of potentially contributing factors. Additionally, the independent review panel report indicated that this incident was likely the result of a complicated confluence of environmental, social, and other factors that have a very low probability of occurring again in the future, but recommended that the potential be considered in environmental planning. The proposed survey design and environmental context of the proposed survey are quite different from the mass melon-headed whale stranding described by the ISRP. It should be noted that this event is the first known marine mammal mass stranding closely associated with the operation of an MBES. It is noted that leading scientific experts knowledgeable about MBES have expressed concerns about the independent scientific review panel analyses and findings (Bernstein 2013).

There is no available information on marine mammal behavioral response to MBES sounds (Southall et al. 2013) or sea turtle responses to MBES systems. Much of the literature on marine mammal response to sonars relates to the types of sonars used in naval operations, including Low-Frequency Active (LFA) sonars (e.g., Miller et al. 2012; Sivle et al. 2012) and Mid-Frequency Active (MFA) sonars (e.g., Tyack et al. 2011; Melcón et al. 2012; Miller et al. 2012; DeRuiter et al. 2013a,b; Goldbogen et al. 2013; Baird et al. 2014). However, the MBES sounds are quite different from naval sonars. Ping duration of the MBES is very short relative to naval sonars. Also, at any given location, an individual marine mammal would be in the beam of the MBES for much less time given the generally downward orientation of the beam and its narrow fore-aft beamwidth; naval sonars often use near-horizontally-directed sound. In addition, naval sonars have higher duty cycles. These factors would all reduce the sound energy received from the MBES relative to that from naval sonars.

Risch et al. (2012) found a reduction in humpback whale song in the Stellwagen Bank National Marine Sanctuary during Ocean Acoustic Waveguide Remote Sensing (OAWRS) activities that were carried out approximately 200 km away. The OAWRS used three frequency-modulated (FM) pulses centered at frequencies of 415, 734, and 949 Hz with received levels in the sanctuary 88–110 dB re 1 µPa. Deng et al (2014) measured the spectral properties of pulses transmitted by three 200-kHz echo sounders, and found that they generated weaker sounds at frequencies below the center frequency (90–130 kHz). These sounds are within the hearing range of some marine mammals, and the authors suggested that they could be strong enough to elicit behavioural responses within close proximity to the sources, although they would be well below potentially harmful levels. Hastie et al. (2014) reported behavioral responses by grey seals to echosounders with frequencies of 200 and 375 kHz.

Despite the aforementioned information that has recently become available, this Final Amended EA is in agreement with the assessment presented in § 3.4.7, 3.6.7, 3.7.7, and 3.8.7 of the PEIS that operation of MBESs, SBPs, and pingers is not likely to impact marine mammals, and is not expected to affect sea turtles, (1) given the lower acoustic exposures relative to airguns and (2) because the intermittent and/or narrow downward-directed nature of these sounds would result in no more than one or two brief ping exposures of any individual marine mammal or sea turtle given the movement and speed of the vessel. Also, for sea turtles, the associated frequency ranges are above their known hearing range.

(c) Other Possible Effects of Seismic Surveys

Other possible effects of seismic surveys on marine mammals and/or sea turtles include masking by vessel noise, disturbance by vessel presence or noise, and injury or mortality from collisions with vessels or entanglement in seismic gear.

Vessel noise from the *Langseth* could affect marine animals in the proposed survey area. Sounds produced by large vessels generally dominate ambient noise at frequencies from 20 to 300 Hz (Richardson et al. 1995). Ship noise, through masking, can reduce the effective communication distance of a marine mammal if the frequency of the sound source is close to that used by the animal, and if the sound is present for a significant fraction of time (e.g., Richardson et al. 1995; Clark et al. 2009; Jensen et al. 2009; Hatch et al. 2012). In order to compensate for increased ambient noise, some cetaceans are known to increase the source levels of their calls in the presence of elevated noise levels from shipping, shift their peak frequencies, or otherwise change their vocal behavior (e.g., Parks et al. 2011; 2012; Castellote et al. 2012; Melcón et al. 2012; Tyack and Janik 2013).

Baleen whales are thought to be more sensitive to sound at these low frequencies than are toothed whales (e.g., MacGillivray et al. 2014), possibly causing localized avoidance of a survey area during seismic operations. Reactions of gray and humpback whales to vessels have been studied, and there is limited information available about the reactions of right whales and rorquals (fin, blue, and minke whales). Reactions of humpback whales to boats are variable, ranging from approach to avoidance (Payne 1978; Salden 1993). Baker et al. (1982, 1983) and Baker and Herman (1989) found humpbacks often move away when vessels are within several kilometers. Humpbacks seem less likely to react overtly when actively feeding than when resting or engaged in other activities (Krieger and Wing 1984, 1986).

Many odontocetes show considerable tolerance of vessel traffic, although they sometimes react at long distances if confined by ice or shallow water, if previously harassed by vessels, or have had little or no recent exposure to ships (Richardson et al. 1995). Dolphins of many species tolerate and sometimes approach vessels. Some dolphin species approach moving vessels to ride the bow or stern waves (Williams et al. 1992). There are few data on the behavioral reactions of beaked whales to vessel noise, though they seem to avoid approaching vessels (e.g., Würsig et al. 1998) or dive for an extended period when approached by a vessel (e.g., Kasuya 1986). Based on a single observation, Aguilar-Soto et al. (2006) suggest foraging efficiency of Cuvier's beaked whales may be reduced by close approach of vessels.

The PEIS concluded that project vessel sounds would not be at levels expected to cause anything more than possible localized and temporary behavioral changes in marine mammals or sea turtles, and would not be expected to result in significant negative effects on individuals or at the population level. In addition, in all oceans of the world, large vessel traffic is currently so prevalent that it is commonly considered a usual source of ambient sound.

Another concern with vessel traffic is the potential for striking marine mammals or sea turtles. Information on vessel strikes is reviewed in § 3.4.4.4 and § 3.6.4.4 of the PEIS. The PEIS concluded that the risk of collision of seismic vessels or towed/deployed equipment with marine mammals or sea turtles exists but is extremely unlikely, because of the relatively slow operating speed (typically 7–9 km/h) of the vessel during seismic operations, and the generally straight-line movement of the seismic vessel. There has been no history of marine mammal vessel strikes with the *Langseth*, or its predecessor, R/V *Maurice Ewing* over the last two decades, including those conducted off New Jersey.

Entanglement of sea turtles in seismic gear is also a concern. There have been reports of turtles being trapped and killed between the gaps in tail-buoys offshore from West Africa (Weir 2007); however, these tailbuoys are significantly different than those used on the *Langseth*. In April 2011, a dead olive ridley turtle was found in a deflector foil of the seismic gear on the *Langseth* during equipment recovery at the conclusion of a survey off Costa Rica, where sea turtles were numerous. Such incidents are possible, but this is the first case of sea turtle entanglement in seismic gear for the *Langseth*, which has been conducting seismic surveys since 2008, or for R/V *Maurice Ewing*, during 2003–2007. Towing the seismic equipment during the proposed survey is not expected to significantly interfere with sea turtle movements, including migration. Although sea turtles were observed during the 2014 survey, no such effects were detected nor were strandings reported during survey activities.

(d) Mitigation Measures

Several mitigation measures are built into the proposed seismic survey as an integral part of the planned activity. These measures include the following: ramp ups; typically two, however a minimum of one dedicated observer maintaining a visual watch during all daytime airgun operations; two observers for 30 min before and during ramp ups; PAM during the day and night to complement visual monitoring (unless the system and back-up systems are damaged during operations); and power downs (or if necessary shut downs) when mammals or turtles are detected in or about to enter designated EZ. These mitigation measures are described in § 2.4.4.1 of the PEIS and summarized earlier in this document, in § II(3). The fact that the 4-airgun subarray, because of its design, would direct the majority of the energy downward, and less energy laterally, is an inherent mitigation measure.

Previous and subsequent analysis of the potential impacts takes account of these planned mitigation measures. It would not be meaningful to analyze the effects of the planned activity without mitigation, as the mitigation (and associated monitoring) measures are a basic part of the activity, and would be implemented under the Proposed Action or Alternative Action. The same monitoring and mitigation measures proposed for the 2014 survey are proposed for the 2015 rescheduled survey.

(e) Potential Numbers of Cetaceans Exposed to Received Sound Levels ≥160 dB

All expected takes would be "takes by harassment" as described in § I, involving temporary changes in behavior. The mitigation measures to be applied would minimize the possibility of injurious takes. (However, as noted earlier and in the PEIS, there is no specific information demonstrating that injurious "takes" would occur even in the absence of the planned mitigation measures.) In the sections below, we describe methods to estimate the number of potential exposures to sound levels >160 dB re 1 μPa_{rms}, and present estimates of the numbers of marine mammals that could be affected during the proposed seismic program. The estimates are based on consideration of the number of marine mammals that could be disturbed appreciably by ~4900 km of seismic surveys off the coast of New Jersey. The main sources of distributional and numerical data used in deriving the estimates are described in the next subsection.

Basis for Estimating Exposure.—The estimates are based on a consideration of the number of marine mammals that could be within the area around the operating airgun array where the received levels (RLs) of sound >160 dB re 1 μPa_{rms} are predicted to occur (see Table 1). The estimated numbers are based on the densities (numbers per unit area) of marine mammals expected to occur in the area in the absence of a seismic survey. To the extent that marine mammals tend to move away from seismic sources before the sound level reaches the criterion level and tend not to approach an operating airgun array, these estimates are likely to overestimate the numbers actually exposed to the specified level of sounds. The overestimation is expected to be particularly large when dealing with the higher sound-level criteria, e.g., 180 dB re 1 μPa_{rms}, as animals are more likely to move away before RL reaches 180 dB than they are to move away before it reaches (for example) 160 dB re 1 μPa_{rms}. Likewise, they are less likely to approach within the ≥180 dB re 1 μPa_{rms} radius than they are to approach within the considerably larger ≥160 dB radius.

We used densities calculated from the U.S. Navy's "OPAREA Density Estimates" (NODE) database (DoN 2007). The cetacean density estimates are based on the NMFS-NEFSC aerial surveys conducted between 1998 and 2004; all surveys from New Jersey to Maine were conducted in summer (June–August). Density estimates were derived using density surface modeling of the existing line-transect data, which uses sea surface temperature, chlorophyll *a*, depth, longitude, and latitude to allow extrapolation to areas/seasons where survey data were not collected. For some species, there were not enough sightings to be able to produce a density surface, so densities were estimated using traditional line-transect analysis. The models and analyses have been incorporated into a web-based Geographic Information System (GIS) developed by Duke University's Department of Defense Strategic Environmental Research and Development Program (SERDP) team in close collaboration with the NMFS SERDP team (Read et al. 2009). We used the GIS to obtain densities in a polygon the size of the survey area for the 19 cetacean species in the model. (A new version of the SERDP GIS was released on 19 November 2013; the old version was used to calculate densities for the 2014 Final EA and Draft Amended EA, and the new version was used to calculate densities for this Final Amended EA.) The GIS provides minimum, mean, and maximum estimates for four seasons, and we have used the mean estimates for summer (June–August). Mean densities were used because the minimum and maximum estimates are for points within the polygon, whereas the mean estimate is for the entire polygon. In the new version of the SERDP GIS, minimum, mean, and maximum densities are the same for most species. Differences in species densities between this Final Amended EA and the 2014 Final EA and Draft Amended EA are attributable to the different versions of the model.

The estimated numbers of individuals potentially exposed presented below are based on the 160-dB re 1 μPa_{rms} criterion for all cetaceans. It is assumed that marine mammals exposed to airgun sounds that strong could change their behavior sufficiently to be considered "taken by harassment". Table 7 shows the density estimates calculated as described above and the estimates of the number of different individual marine mammals that potentially could be exposed to ≥160 dB re 1 μPa_{rms} during the seismic survey if no animals moved away from the survey vessel. The *Requested Take Authorization* is given in the far right column of Table 7. For species for which densities were not available but for which there were sighting records near the survey area, we have included a *Requested Take Authorization* for the mean group size for the species from Palka (2012).

It should be noted that the following estimates of exposures to various sound levels assume that the proposed survey would be completed; in fact, the ensonified areas calculated using the planned number of line-kilometers ***have been increased by 25%*** to accommodate lines that may need to be repeated, equipment testing, etc. As is typical during offshore ship surveys, inclement weather and equipment malfunctions are likely to cause delays and may limit the number of useful line-kilometers of seismic operations that can be undertaken. Also, any marine mammal sightings within or near the designated EZ would result in the shutdown of seismic operations as a mitigation measure. Therefore, the following estimates of the numbers of marine mammals potentially exposed to 160-dB re 1 μPa_{rms} sounds are precautionary and probably overestimate the actual numbers of marine mammals that could be involved. These estimates assume that there would be no weather, equipment, or mitigation delays, which is highly unlikely. For the 2014 survey, NMFS added an additional 25% to the estimated take to account for the turnover of marine mammals in the survey area. For the proposed survey, NMFS included a 25% contingency factor rather than a turnover rate in their analysis for the 2015 IHA (described further below). NSF's methodology used for estimating take has rarely resulted in underestimation of take and has traditionally not included a turnover factor in take calculations; therefore, one was not included here.

Consideration should be given to the hypothesis that delphinids are less responsive to airgun sounds than are mysticetes, as referenced in both the PEIS and "Summary of Potential Airgun Effects" of this document. The 160-dB (rms) criterion currently applied by NMFS, on which the following estimates are based, was developed based primarily on data from gray and bowhead whales. The estimates of "takes by harassment" of delphinids given below are therefore considered precautionary. As noted previously, in December 2013, NOAA made available for public comment new draft guidance for assessing the effects of anthropogenic sound on marine mammals (NOAA 2013a), although at the time of preparation of this Final Amended EA, the date of release of the final guidelines and how they would be implemented are unknown. Available data suggest that the current use of a 160-dB criterion may be improved upon, as behavioral response may not occur for some percentage of odontocetes and mysticetes exposed to received levels >160 dB, while other individuals or groups may respond in a manner considered as taken to sound levels <160 dB (NMFS 2013a). It has become evident that the context of an exposure of a marine mammal to sound can affect the animal's initial response to the sound (NMFS 2013a).

TABLE 7. Densities and estimates of the possible numbers of individuals that could be exposed to ≥160 dB re 1 μPa_{rms} during the proposed seismic survey in the northwest Atlantic off New Jersey during June–August 2015. The proposed sound source consists of an 4-airgun subarray with a total discharge volume of ~700 in^3. Species in italics are listed under the ESA as endangered. The column of numbers in boldface shows the numbers of Level B "takes" for which authorization is requested.

Species	Reported Density (#/1000 km^2) Read et al. (2009)[1]	Correction Factor[2]	Estimated Density (#/1000 km^2)	Ensonified Area (km^2)	Calculated Take[3]	% of Regional Pop'n[4]	Requested Level B Take Authorization
Mysticetes							
North Atlantic right whale	*0*		*0*	*2037*	*0*	*0*	***0***
Humpback whale	*0*		*0*	*2037*	*0*	*0.01*	***1***[5]
Minke whale	0		0	2037	0	0	**0**
Sei whale	*0.740*		*0.740*	*2037*	*2*	*0.02*	***2***
Fin whale	*0.016*		*0.016*	*2037*	*0*	*<0.01*	***1***[5]
Blue whale	*0*		*0*	*2037*	*0*	*0*	***0***
Odontocetes							
Sperm whale	*17.07*		*17.07*	*2037*	*35*	*0.26*	***35***
Pygmy/dwarf sperm whale	0.004		0.004	2037	0	0.05	**2**[5]
Beaked whales[6]	0.570		0.570	2037	1	0.02	**3**[5]
Rough-toothed dolphin	0		0	2037	0	0	**0**
Bottlenose dolphin/WNAOS[7]	234.1		234.1	2037	477	0.62	**477**
Bottlenose dolphin/NMCS[7]	34.87		34.87	2037	71	0.62	**71**
Pantropical spotted dolphin	0		0	2037	0	0	**0**
Atlantic spotted dolphin	87.30		87.30	2037	178	0.40	**178**
Spinner dolphin[8]	0		0	2037	0	0	**0**
Striped dolphin	0		0	2037	0	0.08	**46**[5]
Short-beaked common dolphin	0		0	2037	0	0.01	**18**[5]
White-beaked dolphin[8]	0		0	2037	0	0	**0**
Atlantic white-sided dolphin	0		0	2037	0	0.03	**15**[5]
Risso's dolphin	32.88		32.88	2037	67	0.37	**67**
Pygmy killer whale[8]	0		0	2037	0	N/A	**0**
False killer whale[7]	0		0	2037	0	N/A	**0**
Killer whale [8]	0		0	2037	0	N/A	**0**
Pilot whale	0.444		0.444	2037	1	<0.01	**9**[5]
Harbor porpoise	0		0	2037	0	0	**0**

[1] Densities are the mean values for the survey area, calculated from the new version of the SERDP model of Read et al. (2009); differences in densities between this and the 2014 Final EA and Draft Amended EA are attributable to the different versions of the model

[2] No correction factors were applied for these calculations

[3] Calculated take is estimated density (reported density x correction factor) multiplied by the 160-dB ensonified area (including the 25% contingency)

[4] Requested takes expressed as percentages of the larger regional populations, where available, for species that are at least partly pelagic; where not available (most odontocetes–see Table 3), 2013 SAR population estimates were used; N/A means not available

[5] Requested take authorization was increased to group size from Palka (2012) for species for which densities were zero but that have been sighted near the proposed survey area

[6] May include Cuvier's, True's, Gervais', Sowerby's, or Blainville's beaked whales, or the northern bottlenose whale

[7] WNAOS = Western North Atlantic Offshore Stock, NMCS = Northern Migratory Coastal Stock; bottlenose dolphin density from Read et al. (2009) separated into stocks based on stock size (77,532 offshore and 11,548 coastal)

[8] Atlantic waters not included in the SERDP model of Read et al. (2009)

Potential Number of Marine Mammals Exposed.—The number of different individuals that could be exposed to airgun sounds with received levels ≥160 dB re 1 μPa_{rms} on one or more occasions can be estimated by considering the total marine area that would be within the 160-dB radius around the operating seismic source on at least one occasion, along with the expected density of animals in the area. The number of possible exposures (including repeated exposures of the same individuals) can be estimated by considering the total marine area that would be within the 160-dB radius around the operating airguns, including areas of overlap. During the proposed survey, the transect lines are closely spaced relative to the 160-dB distance. Therefore, the area including overlap is 35.5 times the area excluding overlap, so a marine mammal that stayed in the survey area during the entire survey could be exposed ~36 times, on average. However, it is unlikely that a particular animal would stay in the area during the entire survey. The numbers of different individuals potentially exposed to ≥160 dB re 1 μPa_{rms} were calculated by multiplying the expected species density times the expected area to be ensonified to that level during airgun operations excluding overlap. The area expected to be ensonified was determined by entering the planned survey lines into a MapInfo GIS, using the GIS to identify the relevant areas by "drawing" the applicable 160-dB buffer (see Table 1) around each seismic line, and then calculating the total area within the buffers.

Applying the approach described above, ~1630 km^2 (~2037 km^2 including the 25% contingency) would be within the 160-dB isopleth on one or more occasions during the proposed survey. Because this approach does not allow for turnover in the mammal populations in the area during the course of the survey, the actual number of individuals exposed may be underestimated, although the conservative (i.e., probably overestimated) line-kilometer distances used to calculate the area may offset this. Also, the approach assumes that no cetaceans would move away or toward the trackline as the *Langseth* approaches in response to increasing sound levels before the levels reach 160 dB re 1 μPa_{rms}. Another way of interpreting the estimates that follow is that they represent the number of individuals that are expected (in the absence of a seismic program) to occur in the waters that would be exposed to ≥160 dB re 1 μPa_{rms}.

The estimate of the number of individual cetaceans that could be exposed to seismic sounds with received levels ≥160 dB re 1 μPa_{rms} during the proposed survey is 832 (Table 7). That total includes 37 cetaceans listed as ***Endangered*** under the ESA: 2 sei whales (0.02% of the regional population) and 35 sperm whales (0.26% of the regional population). Most (95%) of the cetaceans potentially exposed are delphinids; the bottlenose dolphin, Atlantic spotted dolphin, and Risso's dolphin are estimated to be the most common delphinid species in the area, with estimates of 548 (0.62% of the regional population for each stock), 178 (0.40%), and 67 (0.37%) exposed to ≥160 dB re 1 μPa_{rms}, respectively.

As part of the IHA process in 2014 and 2015, NMFS reviewed the take estimates presented in Table 7 of the July 2014 Final EA, which were based on an 8-airgun subarray with a volume of ~1400 in^3, and Table 7 of this Final Amended EA, which are based on a 4-airgun subarray with a volume of ~700 in^3. As part of NMFS's analyses process, however, in 2014 they revised the take calculations for most species based on the summer or spring density information from SERDP GIS and from other sources, and most recent population estimates from the 2013 SAR. In 2015, they used only summer density information from the (new) SERDP GIS and a different source for mean group size, the Atlantic Marine Assessment Program for Protected Species (AMAPPS) surveys in 2010, 2011, and 2013. With some exceptions, for species with no density information or where the SERDP NODES summer model produced a density estimate of <1, NMFS increased the take estimates based on sighting information and mean group size from the 2010, 2011, and 2013 AMAPPS surveys. In 2015, they also introduced a new approach for calculating takes: with some exceptions, "The modeled number of instances of exposures to sound levels ≥160 dB re: 1 µPa is the product of the species density (where available), the daily ensonified area of 1,226 km^2, and the number of survey days (30 plus 25 percent contingency for a total of 38 days)". The use of the numbers of exposures, not the numbers of individuals, to calculate take authorization differs from NMFS' practice for more than a decade for NSF-funded seismic surveys. For those species, because of this different approach, authorized takes are 1.8–214 times what they were in 2014, despite the smaller airgun array being used in 2015. The IHA issued by NOAA on 7 May 2015 therefore included different estimates of the possible numbers of marine mammals exposed to sound levels ≥160 dB re 1 mPa during the proposed seismic survey than those presented in Table 7. Additionally, the 2014 and 2015 BOs used take estimation methods that differed from each other and from those in the IHAs and the NMFS EAs (for details, see Appendix C, p. 107-111). Whereas NMFS' analysis does result in an increase in take from 2014 and 2015, the number of takes for both years falls well within the range of insignificance and meets the criteria for issuing an IHA.

NMFS does not provide specific guidance or requirements for IHA Applicants or for Section 7 ESA consultation for the development of take estimates and multiple exposure analysis, therefore variation in methodologies and calculations are likely to occur. The analysis presented in this Final Amended EA and the Final EA dated 1 July 2014, however, follows a methodology that has been used successfully for past NSF seismic surveys to generate take estimates and multiple exposures for the MMPA and ESA processes. Although NSF did not, and has not historically, estimated take for sea turtles, the Biological Opinion and ITS included analysis and take estimates for sea turtles (Appendix C). NSF and LDEO would adhere to the requirements of the ITS and the IHA and associated take levels issued.

(f) Conclusions for Marine Mammals and Sea Turtles

The proposed seismic project would involve towing a 4-airgun subarray, with a total discharge volume of 700 in^3, that introduces pulsed sounds into the ocean. Routine vessel operations, other than the proposed seismic operations, are conventionally assumed not to affect marine mammals sufficiently to constitute "taking".

Cetaceans.—In § 3.6.7 and 3.7.7, the PEIS concluded that airgun operations with implementation of the proposed monitoring and mitigation measures could result in a small number of Level B behavioral effects in some mysticete and odontocete species in the NW Atlantic DAA; that Level A effects were highly unlikely; and that operations were unlikely to adversely affect ESA-listed species. The information from recent literature summarized in sections (a) to (c) above complements, and does not affect the outcome of the effects assessment as presented in the PEIS.

In this analysis, estimates of the numbers of marine mammals that could be exposed to airgun sounds during the proposed program have been presented, together with the requested "take authorization". The estimated numbers of animals potentially exposed to sound levels sufficient to cause appreciable disturbance are very low percentages of the regional population sizes (Table 7). The estimates are likely overestimates of the actual number of animals that would be exposed to and would react to the seismic sounds. The reasons for that conclusion are outlined above. The relatively short-term exposures are unlikely to result in any long-term negative consequences for the individuals or their populations. Therefore, no significant impacts on cetaceans would be expected from the proposed activity.

In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, PSOs and other crew members have seen no seismic sound-related marine mammal injuries or mortality, including during the 2014 survey. Also, actual numbers of animals potentially exposed to sound levels sufficient to cause disturbance (i.e., are considered takes) have almost always been much lower than predicted and authorized takes. For example, during an NSF-proposed, ~5000-km, 2-D seismic survey from the *Langseth* off the coast of North Carolina in September–October 2014, only 296 cetaceans were observed within the predicted 160-dB zone and potentially taken, representing <2% of the 15,498 takes authorized by NMFS (RPS 2015). During an USGS, ~2700 km, 2-D seismic survey from the *Langseth* along the U.S. east coast in August–September 2014, only 3 unidentified dolphins were observed within the predicted 160-dB zone and potentially taken, representing <0.03% of the 11,367 authorized takes (RPS 2014c).

For each of the 2014 and 2015 surveys, NMFS issued a Final EA and a FONSI. NMFS also issued IHAs on 1 July 2014 and 7 May 2015, therefore the proposed activity meets the criteria that the proposed activity "must not cause serious physical injury or death of marine mammals, must have negligible impacts on the species and stocks, must "take" no more than small numbers of those species or stocks, and must not have an unmitigable adverse impact on the availability of the species or stocks for legitimate subsistence uses." In the Biological Opinions dated 1 July 2014 and 7 May 2015, NMFS determined that the level of incidental take was not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. The issuance of the Final EAs, FONSIs, IHAs, and Biological Opinions by NMFS in July 2014 and May 2015 further verifies that significant impacts would not be expected from the proposed activity, especially given that the activity would be using the smaller 700-in^3 source, rather than the larger size source also analyzed and authorized by NMFS in 2014. Observations from the brief 2014 survey support this conclusion (RPS 2014b).

Sea Turtles.—In § 3.4.7, the PEIS concluded that with implementation of the proposed monitoring and mitigation measures, no significant impacts of airgun operations are likely to sea turtle populations in any of the analysis areas, and that any effects are likely to be limited to short-term behavioral disturbance and short-term localized avoidance of an area of unknown size near the active airguns. Five species of sea turtle—the leatherback, loggerhead, green, hawksbill, and Kemp's ridley—could be encountered in the proposed survey area. Only foraging or migrating individuals would occur. Given the proposed activity, no significant impacts on sea turtles would be expected. In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, PSOs and other crew members have seen no seismic sound-related sea turtle injuries or mortality, including during the 2014 survey. In their July 2014 and May 2015 Final EAs, FONSIs, and Biological Opinions, NMFS determined that the level of incidental take was not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. The Biological Opinions further verify that significant impacts would not be expected from the proposed activity. Observations from the brief 2014 survey support this conclusion (RPS 2014b).

(2) Direct Effects on Invertebrates, Fish, Fisheries, and EFH and Their Significance

Effects of seismic sound on marine invertebrates (crustaceans and cephalopods), marine fish, and their fisheries are discussed in § 3.2.4 and § 3.3.4 and Appendix D of the PEIS. Relevant new studies on the effects of sound on marine invertebrates, fish, and fisheries that have been published since the release of the PEIS are summarized below.

(a) Effects of Sound on Marine Invertebrates

Fewtrell and McCauley (2012) exposed captive squid (*Sepioteuthis australis*) to pulses from a single airgun; the received sound levels ranged from 120 to 184 dB re 1 dB re 1 $\mu Pa^2 \cdot s$ SEL. Increases in alarm responses were seen at SELs >147–151 dB re 1 $\mu Pa^2 \cdot s$; the squid were seen to discharge ink or change their swimming pattern or vertical position in the water column. Solé et al. (2013) exposed four cephalopod species to low-frequency (50–400 Hz) sinusoidal wave sweeps (with a 1-s sweep period for 2 h) with received levels of 157 ± 5 dB re 1 μPa, and peak levels up to 175 dB re 1 μPa. Besides exhibiting startle responses, all four species examined received damage to the statocyst, which is the organ responsible for equilibrium and movement. The animals showed stressed behavior, decreased activity, and loss of muscle tone.

When New Zealand scallop (*Pecten novaezelandiae*) larvae were exposed to recorded seismic pulses, significant developmental delays were reported, and 46% of the larvae exhibited body abnormalities; it was suggested that the malformations could be attributable to cumulative exposure (de Soto et al. 2013). Their experiment used larvae enclosed in 60-ml flasks suspended in a 2-m diameter by 1.3-m water depth tank and exposed to a playback of seismic sound at a distance of 5–10 cm. Other studies conducted in the field have shown no effects on Dungeness crab larvae or snow crab embryos (Pearson et al. 1994; DFOC 2004 *in* NSF PEIS). Moreover, a major annual scallop-spawning period occurs in the Mid-Atlantic Bight during late summer to fall (August–October), although MacDonald and Thompson (1988 in NMFS 2004) reported scallop spawning off New Jersey during September–November. The timing of the proposed survey would not coincide with the time when scallops are spawning.

Celi et al. (2013) exposed captive red swamp crayfish (*Procambarus clarkia*) to linear sweeps with a frequency range of 0.1–25 kHz and a peak amplitude of 148 dB re 1 µPa rms at 12 kHz for 30 min. They found that the noise exposure caused changes in the haemato-immunological parameters (indicating stress) and reduced agonistic behaviors.

(b) Effects of Sound on Fish

Potential impacts of exposure to airgun sound on marine fish have been reviewed by Popper (2009), Popper and Hastings (2009a,b), and Fay and Popper (2012); they include pathological, physiological, and behavioral effects. Radford et al. (2014) suggested that masking of key environmental sounds or social signals could also be a potential negative effect from sound. Popper et al. (2014) presented guidelines for seismic sound level thresholds related to potential effects on fish. The effect types discussed include mortality, mortal injury, recoverable injury, temporary threshold shift, masking, and behavioral effects. Seismic sound level thresholds were discussed in relation to fish without swim bladders, fish with swim bladders, and fish eggs and larvae.

Bui et al. (2013) examined the behavioral responses of Atlantic salmon (*Salmo salar L.*) to light, sound, and surface disturbance events. They reported that the fish showed short-term avoidance responses to the three stimuli. Salmon that were exposed to 12 Hz sounds and/or surface disturbances increased their swimming speeds.

Peña et al. (2013) used an omnidirectional fisheries sonar to determine the effects of a 3D seismic survey off Vesterålen, northern Norway, on feeding herring (*Clupea harengus*). They reported that herring schools did not react to the seismic survey; no significant changes were detected in swimming speed, swim direction, or school size when the drifting seismic vessel approached the fish from a distance of 27 km to 2 km over a 6 h period. Peña et al. (2013) attributed the lack of response to strong motivation for feeding, the slow approach of the seismic vessel, and an increased tolerance to airgun sounds.

Miller and Cripps (2013) used underwater visual census to examine the effect of a seismic survey on a shallow-water coral reef fish community in Australia. The census took place at six sites on the reef before and after the survey. When the census data collected during the seismic program were combined with historical data, the analyses showed that the seismic survey had no significant effect on the overall abundance or species richness of reef fish. This was in part attributed to the design of the seismic survey (e.g., ≥400 m buffer zone around reef), which reduced the impacts of seismic sounds on the fish communities by exposing them to relatively low SELs (<187 dB re 1 $\mu Pa^2 \cdot s$). Fewtrell and McCauley (2012) exposed pink snapper (*Pagrus auratus*) and trevally (*Pseudocaranx dentex*) to pulses from a single airgun; the received sound levels ranged from 120 to 184 dB re 1 dB re 1 $\mu Pa^2 \cdot s$ SEL. Increases in alarm responses were seen in the fish at SELs >147–151 dB re 1 μPa^2 · s; the fish swam faster and formed more cohesive groups in response to the airgun sounds.

Hastings and Miksis-Olds (2012) measured the hearing sensitivity of caged reef fish following exposure to a seismic survey in Australia. When the auditory evoked potentials (AEP) were examined for fish that had been in cages as close as 45 m from the pass of the seismic vessel and at water depth of 5 m, there was no evidence of temporary threshold shift (TTS) in any of the fish examined, even though the cumulative SELs had reached 190 dB re 1 μPa^2 · s.

Popper et al. (2013) conducted a study that examined the effects of exposure to seismic airgun sound on caged pallid sturgeon (*Scaphirhynchus albus*) and paddlefish (*Polyodon spathula*); the maximum received peak SPL in this study was 224 dB re 1 μPa. Results of the study indicated no mortality, either during or seven days after exposure, and no statistical differences in effects on body tissues between exposed and control fish.

Andrews et al. (2014) conducted functional genomic studies on the inner ear of Atlantic salmon (*Salmo salar*) that had been exposed to seismic airgun sound. The airguns had a maximum SPL of ~145 dB re 1 μPa^2/Hz and the fish were exposed to 50 discharges per trial. The results provided evidence that fish exposed to seismic sound either increased or decreased their expressions of different genes, demonstrating that seismic sound can affect fish on a genetic level.

Two spawning stocks that migrate inshore/offshore off New Jersey are the summer flounder and black sea bass. Summer flounder normally inhabit shallow coastal and estuarine waters in summer and move offshore in 60–150 m depth in fall and winter. They spawn in fall and winter (September–December) (MAFMC 1988), after the proposed seismic survey period. Black sea bass normally inhabit shallow waters in summer and move offshore and south in 75–165 m depth in fall and winter (MAFMC 1996). Spawning in the Middle Atlantic Bight population occurs primarily on the inner continental shelf from May to July during inshore migrations (NMFS 1999), largely before the survey's proposed timing. Therefore, spawning of at least two important species would not be affected to any great degree.

(c) Effects of Sound on Fisheries

Handegard et al. (2013) examined different exposure metrics to explain the disturbance of seismic surveys on fish. They applied metrics to two experiments in Norwegian waters, during which fish distribution and fisheries were affected by airguns. Even though the disturbance for one experiment was greater, the other appeared to have the stronger SEL, based on a relatively complex propagation model. Handegard et al. (2013) recommended that simple sound propagation models should be avoided and that the use of sound energy metrics like SEL to interpret disturbance effects should be done with caution. In this case, the simplest model (exposures per area) best explained the disturbance effect.

Hovem et al. (2012) used a model to predict the effects of airgun sounds on fish populations. Modeled SELs were compared with empirical data and were then compared with startle response levels for cod. This work suggested that in the future, particular acoustic-biological models could be useful in designing and planning seismic surveys to minimize disturbance to fishing. Their preliminary analyses indicated that seismic surveys should occur at a distance of 5–10 km from fishing areas, in order to minimize potential effects on fishing.

In their introduction, Løkkeborg et al. (2012) described three studies in the 1990s that showed effects on fisheries. Results of their study off Norway in 2009 indicated that fishes reacted to airgun sound based on observed changes in catch rates during seismic shooting; gillnet catches increased during the seismic shooting, likely a result of increased fish activity, whereas longline catches decreased overall (Løkkeborg et al. 2012).

(d) Conclusions for Invertebrates, Fish, and Fisheries

This newly available information does not affect the outcome of the effects assessment as presented in the PEIS. The PEIS concluded that there could be changes in behavior and other non-lethal, short-term, temporary impacts, and injurious or mortal impacts on a small number of individuals within a few meters of a high-energy acoustic source, but that there would be no significant impacts of NSF-funded marine seismic research on populations and associated EFH. The PEIS also concluded that seismic surveys could cause temporary, localized reduced fish catch to some species, but that effects on commercial and recreation fisheries were not significant.

Most commercial fish catches by weight (almost all menhaden) and most recreational fishing trips off the coast of New Jersey (87% in 2013) occurred in waters within 5.6 km from shore, although the highest-value fish (e.g., flounder and tuna) were caught farther offshore. The closest distance between the proposed survey and shore is >30 km, so interactions between the proposed survey and recreational and some commercial fisheries would be relatively limited. Also, most of the recreational fishery "hotspots" described in § III are to the north or south of the proposed survey area; however, there are several hotspots located within or very near the northwestern corner of the survey area. Two possible conflicts are the *Langseth*'s streamer entangling with fixed fishing gear and temporary displacement of fishers within the survey area, although the survey area is relatively small (12 x 50 km). Fishing activities could occur within the survey area; however, a safe distance would need to be kept from the *Langseth* and the towed seismic equipment. Conflicts would be avoided through communication with the fishing community and publication of a Notice to Mariners about operations in the area, therefore impacts would be negligible.

The number of fishing vessels equipped with AIS in June and July 2013 and 2014 was 21–27 per month, with only 4–6 of those spending more than a few hours in the proposed survey area. No fisheries activities except vessels in transit were observed in the survey area during the 13 days that the Langseth was there in July 2014.

The rescheduled survey is proposed to take place ~33–92 km off the coast of New Jersey (27–87 km from New Jersey state waters). The area of the proposed survey is relatively small, ~600 km^2. If we were to make a comparison of that survey area to blocks in New York City, it would essentially be equivalent to an area of 8 by 22 city blocks. The overall area of New Jersey marine waters from shore to the EEZ encompasses ~210,768 km^2. Therefore the proposed survey area represents less than one half percent (0.28%) of the area of waters from the New Jersey shore to the EEZ (600 km^2/210,768 km^2). The survey area plus the largest mitigation zone (8.15 km) would represent less than one percent (0.88%) of the area of waters from the New Jersey shore to the EEZ (1159 km^2/210,768 km^2). The seismic survey is proposed to take place for ~30 days within the June to August timeframe in 2015, not over the entire time that would be allowable under the IHA. As noted previously, fishing activities would not be precluded from operating in the proposed survey area. Any impacts to fish species would occur very close to the survey vessel and would be temporary. No fish kills or injuries were observed during the 2014 survey (RPS 2014b).

Given the proposed activity, no significant impacts on marine invertebrates, marine fish, their EFH, and their fisheries would be expected. In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, PSOs and other crew members have seen no seismic sound-related fish or invertebrate injuries or mortality. Furthermore, past seismic surveys in the proposed survey area (2002, 1998, 1995, 1990) did not result in noticeable effects on commercial or recreational fish catches, based on a review of multi-year NMFS fish catch data in the months when seismic surveys were undertaken. The issuance of the Final EAs, FONSIs, IHAs, and Biological Opinions by NMFS in July 2014 and May 2015 further verifies that significant impacts would not be expected from the proposed activity. Observations from the brief 2014 survey support this conclusion (RPS 2014b).

NSF consulted in 2014, and did so again in 2015, with the NMFS Greater Atlantic Regional Fisheries Office under the Magnuson-Stevens Act for EFH (see below "Coordination with Other Agencies and Processes" for further details). The NMFS Greater Atlantic Regional Fisheries Office concluded, in both 2014 (Appendix H of the 1 July 2014 Final EA) and 2015 (Appendix I of the May 2015 Final Amended EA), that the proposed activity may at some level adversely affect EFH, however, no specific conservation measures were identified for the proposed activity.

(3) Direct Effects on Seabirds and Their Significance

Effects of seismic sound and other aspects of seismic operations (collisions, entanglement, and ingestion) on seabirds are discussed in § 3.5.4 of the PEIS. The PEIS concluded that there could be transitory disturbance, but that there would be no significant impacts of NSF-funded marine seismic research on seabirds or their populations. Given the proposed activity, no significant impacts on seabirds would be expected. In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, PSOs and other crew members have seen no seismic sound-related seabird injuries or mortality. Furthermore, NSF received concurrence from USFWS in 2014 (Appendix F of the 1 July 2014 Final EA) and again in 2015 that the proposed activities "may affect" but "are not likely to adversely affect" species under their jurisdiction (Appendix H of the 2015 Final EA). Observations from the July 2014 survey support this conclusion (RPS 2014b).

(4) Indirect Effects on Marine Mammals, Sea Turtles, and Their Significance

The proposed seismic operations would not result in any permanent impact on habitats used by marine mammals or sea turtles, or to the food sources they use. The main impact issue associated with the proposed activity would be temporarily elevated noise levels and the associated direct effects on marine mammals and sea turtles, as discussed above.

During the proposed seismic survey, only a small fraction of the available habitat would be ensonified at any given time. Disturbance to fish species and invertebrates would be short-term, and fish would return to their pre-disturbance behavior once the seismic activity ceased. Therefore, the proposed survey would have little impact on the abilities of marine mammals or sea turtles to feed in the area where seismic work is planned. No other indirect effects on other species would be expected.

(5) Direct Effects on Recreational SCUBA Divers and Dive Sites and Their Significance

No significant impacts on dive sites, including shipwrecks, would be expected. Airgun sounds would have no effects on solid structures. The only potential effects could be temporary displacement of fish and invertebrates from the structures.

Significant impacts on, or conflicts with, divers or diving activities would be avoided through communication with the diving community before and during the survey and publication of a Notice to Mariners about operations in the area. In particular, dive operators with dives scheduled on the shipwreck *Lillian* during the survey would be contacted directly. That dive site represents only a very small percentage of the recreational dive sites in New Jersey waters. In June and July 2013 and 2014, there was only one AIS-identified dive boat passing through the survey area. No dive vessels were observed in the survey area during the ~13 days that the *Langseth* was there in July 2014.

The New Jersey Council of Diving Clubs (NJCDC) suggested that a 145-dB low-frequency sound limit could provide a suitable margin of safety for divers. Based on in situ measurements collected during

2014 using seismic streamer data and analyzed by Crone (2015, pers. comm.), a 145-dB level would be ~14 km (~7.5 nm) from the vessel. This 145-dB value is extrapolated from measured values; measured values at 160-dB and 180-dB distances were significantly lower, by 30–50%, than modeled values. Except for the *Lillian*, there is only one potential dive site in a 14-km buffer around the survey area, an unidentified wreck very near the outer edge of the buffer in >60 m water depth. The 14-km buffer is conservative, as it is around the entire survey area, not the vessel itself. The vessel, which would be constantly moving, would be a minimum of 14 km from a point on the edge of the buffer, but could be as far away as ~65 km from that point when it is at the far end of the survey area.

(6) Cumulative Effects

The results of the cumulative impacts analysis in the PEIS indicated that there would not be any significant cumulative effects to marine resources from the proposed NSF-funded marine seismic research. However, the PEIS also stated that, "A more detailed, cruise-specific cumulative effects analysis would be conducted at the time of the preparation of the cruise-specific EAs, allowing for the identification of other potential activities in the area of the proposed seismic survey that may result in cumulative impacts to environmental resources." Here we focus on activities that could impact animals specifically in the proposed survey area (research activities, vessel traffic, and commercial fisheries). Additionally, the 2015 NMFS EA Cumulative Effects Section on Climate Change is incorporated into this Final Amended EA by reference as if fully set forth herein.

(a) Past and future research activities in the area

As part of the IODP, the liftboat *Kayd* conducted scientific research and drilling on Expedition 313, New Jersey Shallow Shelf, at several sites off New Jersey during 30 April–17 July 2008. In the more distant past, there have been other scientific drilling activities in the vicinity. There have also been numerous prior seismic surveys, all of which were 2-D, ranging from poor quality, low resolution data collected in 1978 to the most recent, excellent quality, high resolution but shallow penetration data from 2002. These include surveys with a 6-airgun, 1350-in^3 array in 1990; with a single, 45-in^3 GI Gun in 1995 and 1998; and with two 45-in^3 GI Guns in 2002. In July 2014, the *Langseth* attempted to conduct the proposed survey, but it was not possible because of mechanical/equipment issues on the survey vessel along with weather issues (including Hurricane Arthur). The full 3-D array of equipment could not be deployed, and only ~61 h of seismic survey data were collected, with only ~43 h at full power (700 in^3) on survey tracklines. No seismic sound-related marine mammal, fish, or seabird injuries or mortality were observed by crew or scientists during any of these past seismic surveys in the proposed survey area.

In 2014, the *Langseth* also supported an NSF-proposed 2-D seismic survey off the coast of North Carolina to study the U.S. mid-Atlantic margin. That cruise lasted ~34 days and collected ~5000 km of track lines in September/October 2014. During the survey, only 296 cetaceans were observed within the predicted 160-dB zone and potentially taken, representing <2% of the 15,498 authorized takes (RPS 2015). Additionally, the *Langseth* conducted a 2-D seismic survey (~2700 km) for ~3 weeks in August/September 2014, and conducted a similar ~3 week-survey in April 2015, for the USGS in support of the delineation of the U.S. Extended Continental Shelf (ECS) along the east coast. Separate EAs were prepared for those activities, and neither project would overlap with the proposed survey area. During the 2014 USGS survey, only 3 unidentified dolphins were observed within the predicted 160-dB zone and potentially taken, representing <0.03% of the 11,367 takes issued by NMFS for the 2014 USGS survey (RPS 2014c). During the 2015 USGS survey, several visual and acoustic detections of marine mammals were made, however, only one resulted in implementation of a mitigation measure (shut down) for an unidentified dolphin (Hutchinson 2015, pers. comm.).

Other scientific research activities may be conducted in this region in the future; however, no other marine geophysical surveys are proposed at this specific site using the *Langseth* in the foreseeable future. At the present time, the proponents of the survey are not aware of other similar seismic research activities planned to occur in the proposed survey area during the June–August 2015 timeframe, but research activities planned by other entities are possible, although unlikely.

(b) Vessel traffic

Based on data available through the Automated Mutual-Assistance Vessel Rescue (AMVER) system managed by the U.S. Coast Guard, 15–49 commercial vessels per month travelled through the proposed survey area during the months of June and July from 2008 to 2013, and for each month in 2012 and 2013 (2013 data are available for January–June, the most recent data available as of May 2015). Over 50 commercial vessels per month were recorded during this time closer to shore (particularly around New York City), to the immediate west and northwest of the proposed survey area (USCG 2013).

Based on historical NAIS data requested from the USCG Navigation Center, in June 2014 vessels in the proposed survey area consisted of cargo vessels and tankers (60% of total numbers), pleasure craft/sailboats (25%), fishing vessels (9%), towing/dredging vessels (3%), other, including research vessels (2%), and military vessel (1%). During the 13 days in July 2014 that the *Langseth* was in the survey area, there was limited merchant vessel activity; most merchant traffic was lining up for "safety fairway" to the west of the survey area.

The total transit distance (~5200 km) by L-DEO's vessel *Langseth* would be minimal relative to total transit length for vessels operating in the proposed survey area during June–August 2015. Therefore, the projected increases in vessel traffic attributable to implementation of the proposed activity would constitute only a negligible portion of the total existing vessel traffic in the analysis area, and only a negligible increase in overall ship disturbance effects on marine mammals.

(c) Marine Mammal Disease

As discussed in § III, since July 2013, an unusually high number of dead or dying bottlenose dolphins have washed up on the mid-Atlantic coast from New York to Florida. NOAA noted that the triggers for disease outbreaks are unknown, but that contaminants and injuries may reduce the fitness of dolphin populations by stressing the immune system. Morbillivirus outbreaks can also be triggered by a drop in the immunity of bottlenose dolphin populations if they have not been exposed to the disease over time, and natural immunity wanes (NOAA 2013b). The last morbillivirus mortality event occurred in 1987–1988, when more than 740 bottlenose dolphins died along the mid-Atlantic coast from New Jersey to Florida (NOAA 2013b). During that UME, fungal, bacterial, and mixed bacterial and fungal pneumonias were common in the lungs of 79 dolphins that were examined, and the frequent occurrence of the fungal and bacterial infections in dolphins that also were infected by morbillivirus was consistent with morbillivirus-induced immunosuppression resulting in secondary infections (Lipscomb et al. 1994). Dr. Teri Knowles of NOAA noted that if the current outbreak evolves like the one in 1987–1988, "we're looking at mortality being higher and morbillivirus traveling southwards and continuing until May 2014." In fact, since mid 2014, the UME appears to have ended in the northern states: in the 8 months between 17 August 2014 and 15 April 2015, there were 1, 4, 2, and 1 strandings in NY, NJ, DE, and MD, respectively, as compared to pre-UME (2007–2012) annual strandings of 6, 15, 10, and 5 strandings in NY, NJ, DE, and MD, respectively (NOAA 2015a). Dr. Knowles also speculated that environmental factors, such as heavy metal pollution and sea surface temperature changes, could also play a role in the current outbreak (National Geographic Daily News 2013). It seems unlikely that the short-term behavioral disturbance that could be caused by the proposed seismic survey, especially for dolphins, would contribute to the development or continuation of a morbillivirus outbreak. Although NMFS has informed the Greater Atlantic Stranding Network coordinators and the Coordinator of the Marine Mammal Health and Stranding Program (MMHSRP) on 8 January 2015 that an IHA application for the proposed activity had been received, strandings from the proposed activity would not be expected. Therefore, the proposed activity would not be expected to increase the level of coordination necessary for stranding networks and associated budgets or impact the New Jersey Animal Health Diagnostic Laboratory budget, which has been involved with funding efforts related to the recent bottlenose dolphin morbillivirus mortality event.

(d) Fisheries

The commercial and recreational fisheries in the general area of the proposed survey are described in § III. The number of fishing vessels equipped with AIS for June and July 2013 and 2014 was 21–27 per month, with only 4–6 of those spending more than a few hours in the proposed survey area. No fisheries activities except vessels in transit were observed in the survey area during the 13 days that the Langseth was there in July 2014. The primary contributions of fishing to potential cumulative impacts on marine mammals and sea turtles involve direct removal of prey items, noise, potential entanglement (Reeves et al. 2003), and the direct and indirect removal of prey items. In U.S. waters, numerous cetaceans (mostly delphinids) and pinnipeds suffer serious injury or mortality each year from fisheries; for example, for the species assessed by Waring et al. (2013), average annual fishery-related mortality during 2006–2010 in U.S. Atlantic waters included 164 common dolphins, 212 Atlantic white-sided dolphins, 791 harbor porpoises, and 1466 harbor, gray, and harp seals. There may be some localized avoidance by marine mammals of fishing vessels near the proposed seismic survey area. L-DEO's operations in the proposed survey area are also limited (duration of ~1 month), and the combination of L-DEO's operations with the existing commercial and recreational fishing operations in the region is expected to produce only a negligible increase in overall disturbance effects on marine mammals and sea turtles.

(e) Military Activity

The proposed survey is located within the U.S. Navy's Atlantic City Range Complex (ACRC). The Boston, Narragansett Bay, and Atlantic City range complexes are collectively referred to as the Northeast Range Complexes. The types of activities that could occur in the ACRC would include the use of active sonar, gunnery events with both inert and explosive rounds, bombing events with both inert and explosive bombs, and other similar events. The ACRC includes special use airspace, Warning Area W-107. The ACRC is an active area, but there is typically relatively limited activity that occurs there. There has only been limited activity in the past, and there were no conflicts during the 2014 survey. L-DEO and NSF are coordinating, and would continue to coordinate, with the U.S. Navy to ensure there would be no conflicts in 2015.

(f) Oil and Gas Activities

Oil and gas activities are managed by BOEM. If BOEM were interested in oil and gas development activities in the survey area, BOEM would need to prepare the appropriate analyses under NEPA, followed by other consultation processes under such federal statutes as the MMPA, ESA, EFH, and CZMA. The proposed survey site is outside of the BOEM Atlantic Outer Continental Shelf Proposed Geological and Geophysical (G&G) Activities in the Mid-Atlantic and South Atlantic Planning Areas (BOEM 2014). The current BOEM mid-Atlantic and South Atlantic activities would be the preliminary surveys that are necessary for BOEM and industry to determine resource potential, and to provide siting information for renewable energy and marine minerals activities; lease sales in those areas have not yet been considered. The final BOEM Record of Decision for the proposed action was issued in July 2014.

A number of seismic surveys have been proposed within the Mid-Atlantic and South Atlantic Planning Areas. At this time, the proposals are under various federal regulatory reviews and it is unclear if and when they would be approved to move forward; it would be highly unlikely they would go forward as early as summer 2015. It is unlikely that the proposed survey would overlap in time with any of the proposed G&G seismic surveys.

Whereas it is theoretically possible that the oil and gas industry may be interested in the architecture of the passive margin area in the survey region for application to other locations (see Appendix B, page C-15, of the 1 July 2014 Final EA), there are no known interests for G&G activities, including oil and gas exploration, in or around the proposed survey site. The proposed seismic survey is not related to nor would it lead to offshore drilling; the proposed activity would evaluate sea level change as described here and in the 2014 Final EA and there are no additional activities proposed beyond those by the PIs or NSF (i.e., there are no proposed oil and gas exploration activities associated with the proposed activity).

Seismic surveys in support of research activities have occurred in the survey area in the recent past (2002, 1998, 1995, 1990). Additionally, NJDEP conducted a seismic survey (boomer/sparker source) in 1985 off the coast of New Jersey (Waldner and Hall 1991). Oil and gas activities in the proposed survey area have not resulted from these similar research seismic surveys. The proposed rescheduled seismic survey is a research activity, and is completely unrelated to oil and gas development.

Given the potential distance from any future BOEM G&G activities in the region and separation in time with the proposed activity, no cumulative effects would be expected.

(7) Unavoidable Impacts

Unavoidable impacts to the species of marine mammals, sea turtles, seabirds, fish, and invertebrates occurring in the proposed survey area would be limited to short-term, localized changes in behavior of individuals. For cetaceans, some of the changes in behavior may be sufficient to fall within the MMPA definition of “Level B Harassment” (behavioral disturbance; no serious injury or mortality). TTS, if it occurs, would be limited to a few individuals, would be a temporary phenomenon that does not involve injury, and would be unlikely to have long-term consequences for the few individuals involved. No long-term or significant impacts would be expected on any of these individual marine mammals, sea turtles, seabirds, fish, and invertebrates or on the populations to which they belong. Effects on recruitment or survival would be expected to be (at most) negligible.

(8) Public Involvement and Coordination with Other Agencies and Processes

NSF posted the Draft Amended EA on the NSF website on 19 December 2014 for a 37-day public comment period. Because the comment period overlapped with several holidays, an extra 7 days were added to the NSF standard 30-day open public comment period for Draft EAs. During the open public comment period, a 30-day extension of the public comment period on the Draft Amended EA was requested based on an assertion that the document included the addition of 126 new published data and scientific literature. NSF compared the sources cited in the 2014 Final EA for the project issued on 1 July 2014 with the Draft Amended EA. The 2014 Final EA, which was issued nearly 6 months before the Draft Amended EA, contained all but 6 of the sources identified in “Section VI Literature Cited”. Three of those sources were actually referenced in the 2014 Final EA document on page 32 but were inadvertently omitted from the Draft Amended EA. Of the remaining three additional sources, one was the 2014 Final EA for the “Seismic Reflection Scientific Research Surveys During 2014 and 2015 in Support of Mapping the US Atlantic Seaboard Extended Continental Margin and Investigating Tsunami Hazards” issued on August 21, 2014. Despite the addition of only a few sources of published data and scientific literature referenced in the Draft Amended EA, NSF decided to extend the public comment period by an additional 15 days above and beyond the 37 days it was planned to be open for comment. The public comment period was opened on 19 December 2014 and closed on 9 February 2015 11:59 PM Eastern Standard Time.

During the Draft Amended EA public comment period, nine comments were received from individuals and entities requesting an extension to the public comment period. At the close of the comment period, eight additional comments on the proposed activity were submitted from individuals and entities, one of which represented multiple organizations and individuals. After the close of the public comment period, one comment was resubmitted to add an additional signatory. Comments received related to a range of topics including, but not limited to, scuba diving safety, survey monitoring and mitigation, socioeconomic impacts, impacts on marine life and habitat, regulatory processes, take estimates and modeling, evaluation of alternatives, and general support and opposition to the proposed survey. The public comments received during the open comment period on the Draft Amended EA can be found in Appendix F and responses to the comments can be found in a response-comment matrix in Appendix G. After consideration of comments received during the public comment period and discussions during MMPA and ESA consultations with NMFS, refinements and additions to the information in the Draft Amended EA were made and included in this Final Amended EA; recent scientific literature was also incorporated since the Draft Amended EA was issued in December 2014. These changes are noted in this Final Amended EA where appropriate, and changes made in response to public comments are also identified in the response-comment matrix (Appendix G). The changes in the Final Amended EA include the addition of

- recommended diving distances from the actively operating seismic vessel;
- GPS coordinates of the proposed survey area in degrees and decimal minutes;
- NAIS data on vessel activity in the proposed survey area during June and July 2013 and 2014;
- proposed changes to North Atlantic right whale Critical Habitat;
- the current status of oil and gas related seismic surveys;
- clarification on potential impacts on marine-related local business;
- identification of a recognized productive and historical fishing area overlapping the proposed survey area;
- identification of PSO monitoring and mitigation roles with respect to fish;
- incorporation of information on sea turtle sightings off New Jersey;
- updated information on consultation processes;
- discussion of the difference in approach for calculating take estimates between the Draft Amended EA and the IHA/NMFS EA and BO/ITS (2014 and 2015); and
- changes to mitigation measures (shot interval for mitigation source and shutdowns for groups of large whales.

The new information included in this Final Amended EA, however, did not alter the overall conclusions of the Draft Amended EA and remained consistent with the PEIS and the 2014 Final EA.

This Final Amended EA was prepared by LGL on behalf of L-DEO and NSF pursuant to NEPA. Potential impacts to endangered species and critical habitat were also assessed in the document; therefore, it was used to coordinate and support other consultations with federal agencies as required and noted below.

(a) Endangered Species Act (ESA)

For 2014 and 2015 survey activity, NSF engaged in formal consultation with NMFS and informal consultation with USFWS pursuant to Section 7 of the ESA. As in 2014, NSF received confirmation on 14 January 2015 from USFWS that the proposed rescheduling of the survey from 2014 to 2015 would not change the effect of the action on the species under their jurisdiction and their concurrence on the action remained the same as in 2014. In 2014, USFWS concluded that, "the proposed 3-D activity "may affect" but "are not likely to adversely affect" the roseate tern or piping plover." (Appendix H). Mitigation measures would include power-downs/ shutdowns for foraging endangered or threatened seabirds.

NMFS issued a Biological Opinion and an Incidental Take Statement (Appendix C of the 1 July 2014 Final EA) on 1 July 2014 for the 2014 survey and consultation was concluded. Because of the proposed rescheduling of the survey, NSF submitted a formal consultation request on 19 December 2014. On 7 May 2015, NMFS issued a Biological Opinion and an Incidental Take Statement (Appendix C) for the proposed activity. In the 2014 and 2015 Biological Opinions, NMFS concluded that the proposed seismic survey was not likely to jeopardize the continued existence of endangered species and would have no effect on their critical habitat. In 2014, NMFS determined that for operational purposes and coordination with monitoring and mitigation measures required under the IHA, the Exclusion Zone for cetaceans, sea turtles, and foraging seabirds would be expanded to the 177-db isopleth. For the proposed 2015 activity, however, based on analysis conducted by Crone et al. (2014) and Crone (2015, pers. comm.), NMFS determined that this mitigation measure was unnecessary and not required. Other differences between the 2014 and 2015 Biological Opinion and between the 2015 Biological Opinion and the NSF Final Amended EA have been noted throughout the Final Amended EA where appropriate.

(b) Marine Mammal Protection Act (MMPA)

As noted previously, although an IHA had been issued (Appendix D of the 1 July 2014 Final EA) and the survey commenced in 2014, NMFS required a new IHA to conduct the same survey during a rescheduled time in 2015. L-DEO, on behalf of LDEO, Rutgers, and NSF, submitted to NMFS an IHA application pursuant to the MMPA on 23 December 2014. On 17 March 2015, NMFS issued in the Federal Register a notice of intent to issue an IHA for the survey and 30-day public comment period. NMFS prepared a separate EA for its federal action of issuing an IHA; NMFS' EA (Appendix E) is incorporated by reference in this NSF Final Amended EA as appropriate and where indicated. NMFS issued an IHA on 7 May 2015 (Appendix D) for the proposed activity. As part of the IHA process, NMFS received public comments, which are summarized in their EA and will be made available on their website at http://www.nmfs.noaa.gov/pr/permits/incidental/research.htm#nj2015. Many of the comments received during the IHA process were similar to those received during the open comment period for NSF's Draft Amended EA.

The Draft Amended EA identified where there were slight differences between the 2014 Final EA and the 2014 IHA and 2014 NMFS EA issued for the 2014 survey; similarly, differences between the IHA and NMFS EA issued for the 2015 survey and the Final Amended EA have been noted throughout the Final Amended EA where appropriate. As noted above, in 2014, NMFS determined that for operational purposes and coordination with monitoring and mitigation measures required under the IHA, the Exclusion Zone for sea turtles and foraging seabirds would be expanded to the 177-db isopleth. For the proposed 2015 activity, however, based on analysis conducted by Crone et al. (2014) and Crone (2015, pers. comm.), NMFS determined that this mitigation measure was unnecessary and not required. Differences between the IHA issued for the 2015 survey and the Draft Amended EA included, but were not limited to, a 1.25 turnover rate for animals in the take estimate calculation, a one-minute shot interval for the 40-in^3 mitigation airgun, and power downs for groups (6 or more) of large whales. NSF, Rutgers, and LDEO would adhere to the IHA requirements for the proposed action.

(c) NMFS Marine Mammal Stranding Program

Although marine mammal strandings were not expected as a result of the 2015 survey activity, NMFS Protected Resources Division informed the Greater Atlantic Stranding Network coordinators and the Coordinator for the Marine Mammal Health and Stranding Program (MMHSRP) on 8 January 2015 that an IHA application for the proposed activity had been received. Per the IHA, should any marine mammal strandings occur during the survey, NMFS and the NMFS Greater Atlantic Regional Fisheries Office Marine Mammal Response Coordinator would be contacted. No marine mammal strandings attributable to the 2014 survey were reported to NSF.

(d) Magnuson-Stevens Act—Essential Fish Habitat (EFH)

The Magnuson-Stevens Act requires that a federal action agency consult with NMFS for actions that "may adversely affect" EFH. On 22 December 2014, NSF contacted the EFH Regional Coordinator of the NOAA Greater Atlantic Regional Fisheries Office regarding consultation for the proposed activity. The EFH Regional Coordinator concluded in a letter dated 11 February 2015 that some level of adverse effects to EFH might occur as a result of the proposed activity (Appendix I). Additional research and monitoring to gain a better understanding of the potential effects that seismic surveys may have on EFH, federal managed species, their prey, and other NOAA trust resources was recommended for future NSF activities. NSF has provided federal funding in part for the "Fourth International Conference on Effects of Noise on Aquatic Life" (AN2016), and for previous such international meetings held in Nyborg, Denmark (2007), Cork, Ireland (2010), and Budapest, Hungary (2013). The major goal of AN2016 will be to define the current state of knowledge on the impact of underwater noise and, in particular, explore the progress made in this field in the three years since the previous conference. The meeting will bring together researchers, regulators/policy makers, and industry with an interest in different animal groups, including marine mammals, turtles, fish, and invertebrates. No project-specific EFH conservation recommendations, however, were provided for the proposed survey, and consultation was concluded. NSF also consulted for EFH for the 2014 survey, which resulted in the same consultation conclusion as for the 2015 proposed survey.

(e) Coastal Zone Management Act (CZMA)

***New Jersey.*—**Per the requirements of the CZMA, NSF reviewed the New Jersey Coastal Management Program (CMP) Federal Consistency Listings and determined that the proposed activity was unlisted. The following formal letters and documents are included as Appendix J. On 8 October 2014, NSF contacted NJDEP about NSF's interest in rescheduling the proposed survey for June/July/August 2015. On 15 October 2014, NSF and NJDEP held a teleconference during which the proposed survey was discussed and NJDEP's interest in reviewing the proposed survey under the CZMA was confirmed. Per CFR 15 930.34, NSF requested that NJDEP identify relevant enforceable policies applicable to the project, but none were identified. Although no enforceable policies were identified, on 22 December 2014, NSF submitted to NJDEP, "NSF Coastal Zone Management Act (CZMA) Consistency Determination" (CD), with the Draft Amended EA appended as Attachment 1. On 6 March 2015, after requesting a 15-day extension of time to respond, NJDEP provided its response to NSF's CD, which concluded that, contrary to NSF's determination, the proposed survey was inconsistent with three enforceable policies of New Jersey's federally approved CMP.

On 6 April 2015, NSF received a request from NJDEP for informal mediation facilitated by OCM pursuant to 15 CFR Part 930.111; NSF agreed to informal mediation on 9 April 2015. On April 21, 2015, NJDEP sent a request to NOAA's Office for Coastal Management (OCM) to initiate and facilitate informal mediation between NJDEP and NSF. On 27 April 2015, NSF received a letter from NJDEP also dated 21 April 2015, submitted to OCM, Rutgers, L-DEO, and NSF notifying the letter recipients of their position that the proposed survey required consistency review under 15 C.F.R. Part 930, subparts D and F. At no time prior to 21 April 2015, however, did NJDEP notify Rutgers, L-DEO, or NSF of its position. On 30 April 2015, OCM sent a letter to NJDEP denying the request to review the proposed activity under Subparts D and F (Appendix J). OCM noted that, as NJDEP had acknowledged in their letter, "...the CZMA regulations make clear that a project cannot be treated as *both* a federal agency activity under Subpart C and also an activity under Subpart D or F. Here, the Department [NJDEP] performed its review of the Project under Subpart C and having completed that review, additional, parallel, or redundant reviews under other Subparts of the regulations are now precluded." In its letter, OCM also indicated, "...that even if the reviews the Department is requesting were not otherwise precluded, it is not clear the request would meet the technical requirements set forth in the CZMA rules for reviews under Subpart D or F, including timeliness, proper notice, etc." On 1 May 2015, NSF sent a letter to OCM concurring with OCM's findings and providing additional comments for OCM's consideration regarding NJDEP's request (Appendix J). On 5 and 11 May, Rutgers University and L-DEO, respectively, sent letters to OCM concurring with OCM's findings and the additional comments provided in NSF's letter to OCM dated 1 May 2015. Despite NJDEP's inconsistent finding, NSF has determined that the proposed activity is consistent to the maximum extent practicable with New Jersey's CMP; this determination is set forth in the document titled "Final Determination of Federal Consistency by the National Science Foundation for the Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015 (Appendix J). Mediation efforts by NSF and NJDEP are ongoing, and NSF remains hopeful that an agreement will ultimately be reached.

New York.—Per the requirements of the CZMA, NSF reviewed the New York CMP Federal Consistency Listings and determined that the proposed activity was unlisted. On 1 August 2014, New York Department of State (NYDOS) submitted a letter to NSF stating that the survey area was within their off shore planning area of interest and requested review of all current and future proposed actions so that NYDOS could review them for federal consistency. Because of the substantial distance of the survey site from New York state waters, no effects would be expected on New York coastal uses or resources. Although under the CZMA unlisted review requests are required to go through OCM, in light of NYDOS' 1 August 2014 letter, NSF contacted NYDOS on 30 October 2014 to confirm the State's interest in reviewing the unlisted activity. On 9 January 2015, NYDOS confirmed interest in reviewing the project. Per CFR 15 930.34, NSF, both in October 2014 and in subsequent contacts, requested that NYDOS identify relevant enforceable policies applicable to the project, but none were identified.

On 16 January 2015, NSF submitted to NYDOS, "NSF Coastal Zone Management Act (CZMA) Consistency Determination" (CD), with the Draft Amended EA appended as Attachment 1 (Appendix K). The following correspondence is also included in Appendix K. On 17 February 2015, NSF received from NYDOS a letter (dated 3 February 2015) that acknowledged receipt of the CD, informed of the initiation of the State's review process, and included a request for additional data and information. On 19 February 2015, NSF responded to NYDOS's data request, providing the requested data. On 13 March 2015, NYDOS requested a 15-day extension of time to review the CD and NSF acknowledged NYDOS's request the same day. NYDOS provided its response to NSF's CD on 31 March 2015, which concurred with NSF's CD that the proposed survey was consistent with the enforceable policies of New York's federally approved CMP. NYDOS included, however, several recommendations to modify the proposed activity to reduce the likelihood of reasonably foreseeable effects on New York's coastal resources and uses. NYDOS's concurrence with NSF's CD was not conditional on NSF adhering to these recommendations.

One recommendation suggested by NYDOS was that because of the location of the survey and potential overlap with New York's commercial fishing use, the survey should avoid overlap to the maximum extent practicable. NYDOS suggested this could be achieved through consultation with the New York fishing industry to identify when and where commercial fishers would be in the area to avoid entangling fishing gear or displacing them. As noted in Chapter IV, based on past experience at the survey site and evaluation of NAIS data, few fishing vessels would be expected at the survey site during the proposed survey time. Regardless, L-DEO would issue Notice to Mariners to avoid space-use conflicts with fishing vessels in the survey area. Fishing activities could occur within the survey area; however, a safe distance would need to be kept from the *Langseth* and the towed seismic equipment. A second recommendation suggested by NYDOS was that the proposed activity be confined to operation during the fall months to reduce the likelihood of reasonably foreseeable effects on fish stocks commercially important to New York. The supporting exemplary graphics provided were for fall and spring; graphics for summer, the proposed survey timing, however, were not provided. Based on the supporting information provided, it would appear that conducting the survey in spring or fall would make little difference based on seasonal presence of some species. NYDOS suggested that some species would be migrating through the survey area during the proposed survey period, but again, supporting graphics for summer were not provided.

Alternative Action: Alternative Survey Timing

An alternative to issuing the IHA for the period requested, and to conducting the Project then, is to issue the IHA for another time, and to conduct the project at that alternative time. The proposed dates for the cruise (~34 days in June–August) are the dates when the personnel and equipment essential to meet the overall project objectives are available; if the date of the cruise were changed, for example to late spring or early fall, it is likely that the scientific personnel (lead PI and collaborating PIs) and *Langseth* would not be available and, therefore, the purpose and need of the proposed activities could not be met. A recommendation was made during the public comment period on the Draft Amended EA that the survey be conducted in September–October 2015, or September–October of a future year, to reduce the impact to fisheries and marine mammals. In the comment, it was suggested that the geologic formations at the target depths of interest are static and not likely to change if the proposed activity were rescheduled to September– October in a future year in which the personnel and equipment essential to meet the overall project objectives were available. This suggestion, however, does not take into account that the research was proposed by researchers and students whose professional and academic careers depend upon the timely collection of these data and successful completion of the survey. In other words, there is a timeliness factor involved with the Proposed Activity, as well as a desire to have the scientific results incorporated into the broader scientific community in the near term. If the IHA were issued for another period, it could result in significant delay and disruption not only of this cruise, but also of additional studies that are planned on the *Langseth* for 2015 and beyond.

The weather in the mid-Atlantic Ocean was also taken into consideration when planning the proposed activity. The mid-Atlantic Ocean off New Jersey can be challenging to operate during certain times of year, precluding the ability to safely tow seismic gear. Whereas conducting the survey at an alternative time is a viable alternative if the *Langseth*, personnel, and essential equipment are available, because of the weather conditions, it would not be viable to conduct a seismic survey in winter months off the coast of New Jersey. Whereas hurricanes can occur in the summer, peak hurricane season starts in mid August and extends until mid October (http://climate.rutgers.edu/stateclim/?section=menu&%20 target=nj_hurricane_history); some of New Jersey's deadliest recorded storms have occurred during September/October. The most recent deadly hurricane that hit the New Jersey shoreline was Hurricane Sandy, which impacted the state from 26 October 2012 to 8 November 2012. It was declared a major disaster on October 30, 2012 (http://www.fema.gov/disaster/4086). Hurricane Sandy was responsible for 73 deaths in the United States and cost billions of dollars in assistance (http://www.fema.gov/sandy-recovery-office). The rough weather encountered by the *Langseth* during the 2014 survey demonstrates the challenges of conducting oceanographic research even during optimal weather periods (summer), and similarly, highlights the potential safety hazards of operating during suboptimal weather periods.

Marine mammals and sea turtles are expected to be found throughout the proposed survey area and throughout the time during which the project would occur. Some marine mammal species are expected to occur in the area year-round, so altering the timing of the proposed project likely would result in no net benefits for those species. Some migratory species are expected to be farther north at the time of the survey, so the survey timing is beneficial for those species (see § III, above). In particular, migration of the North Atlantic right whale occurs mostly between November and April, and the survey is timed to avoid those months. Accordingly, the alternative action would likely result in either a failure to meet the purpose and need of the proposed activity or it would raise the risk of causing impacts to species such as the North Atlantic right whale.

No Action Alternative

An alternative to conducting the proposed activity is the "No Action" alternative, i.e. do not issue an IHA and do not conduct the operations. If the research were not conducted, the "No Action" alternative would result in no disturbance to marine mammals or sea turtles attributable to the proposed activities; however, valuable data about the marine environment would be lost. Research that would contribute to the understanding of the response of nearshore environments to changes in elevation of global sea level would be lost and greater understanding of Earth processes would not be gained. The "No Action" alternative could also, in some circumstances, result in significant delay of other studies that would be planned on the *Langseth* for 2015 and beyond, depending on the timing of the decision. Not conducting this cruise (no action) would result in less data and support for the academic institutions involved. Data collection would be an essential first step for a much greater effort to analyze and report information for the significant topics indicated. The field effort would provide material for years of analyses involving multiple professors, students, and technicians. The lost opportunity to collect valuable scientific information would be compounded by lost opportunities for support of research infrastructure, training, and professional career growth. The research goals and objectives cannot be achieved using existing scientific data. Existing seismic profiles occur at intervals too coarse to achieve the proposed scientific goals of this project. Both the larger spacing and the limitations inherent in processing 2-D seismic data preclude identification of key features of the past margin such as river or delta channels and shoreline adjustments. Only dense and 3-D seismic acquisition and processing can provide continuity of imaging to enable confident identification of these features, whose distributions are expected to evolve throughout the time period recorded in the sediments targeted. Dense 3-D data have not been collected previously at the survey site, which is why it was proposed by the PI and collaborators. The "No Action" Alternative would not meet the purpose and need for the proposed activities, but was carried through for analysis as required under CEQ regulations (40 C.F.R. 1502.14[d]).

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Appendix A

Acoustic Modelling of Seismic Sources

APPENDIX A:

ACOUSTIC MODELING OF SEISMIC ACOUSTIC SOURCES AND SCALING FACTORS FOR SHALLOW WATER[1]

For the proposed survey off New Jersey, a smaller energy source than the full airgun array available on the R/V *Langseth* would be sufficient to collect the desired geophysical data. Previously conducted calibration studies of the *Langseth*'s airgun arrays, however, can still inform the modeling process used to develop mitigation radii for the currently proposed survey.

Acoustic Source Description

This 3-D seismic data acquisition project would use two airgun subarrays that would be fired alternately as the ship progresses along track (one subarray would be towed on the port side and the other on the starboard side). Each airgun subarray would consist of four airguns (total volume 700 in^3). The subarrays would use subsets of the linear arrays or "strings" composed of Bolt 1500LL and Bolt 1900LLX airguns that are carried by the R/V *Langseth* (Figure A1): four airguns in one string would be fired simultaneously, and the other six airguns on the string would be inactive. The subarray tow depth would be either 4.5 m (desired tow depth) or 6 m (in case of weather degradation). The subarray would be fired roughly every 5.4 s. At each shot, a brief (~0.1 s) pulse of sound would be emitted, with silence in the intervening periods. This signal attenuates as it moves away from the source, decreasing in amplitude and increasing in signal duration.

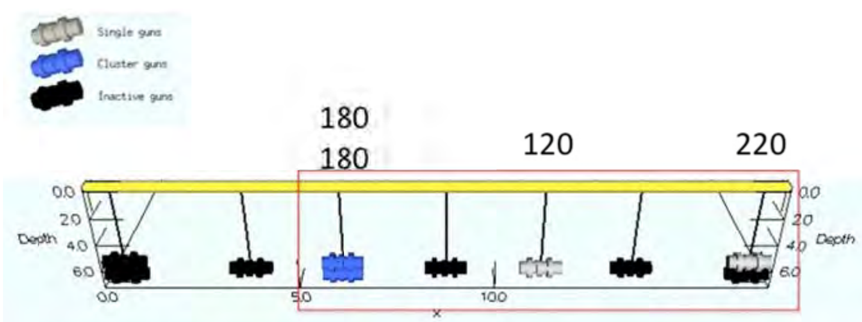

FIGURE A1. Four-airgun subset of one string that would be used as a 700-in^3 subarray for the proposed survey (individual volumes are indicated).

Four-Airgun Subarray Specifications

Energy Source	1950-psi Bolt airguns with volumes 120–220 in^3, arranged in one string of four operating airguns
Towing depth of energy source	4.5 m or 6 m
Source output (downward), 4.5 m	0-pk is 240.4 dB re 1 µPa · m; pk-pk is 246.3 dB re 1 µPa · m
Source output (downward), 6 m	0-pk is 240.4 dB re 1 µPa · m; pk-pk is 246.7 dB re 1 µPa · m
Air discharge volume	~700 in^3
Dominant frequency components	0–188 Hz

Because the actual source originates from 4 airguns rather than a single point source, the highest sound levels measurable at any location in the water is less than the nominal source level. In addition, the effective source level for sound propagating in near-horizontal directions would be substantially lower

[1] Helene Carton, Ph.D., L-DEO.

than the nominal source level applicable to downward propagation because of the directional nature of the sound from the airgun array.

Modeling and Scaling Factors

Propagation measurements were obtained in shallow water for the *Langseth*'s 18-gun, 3300-in^3 (2-string) array towed at 6 m depth, in both crossline (athwartship) and inline (fore and aft) directions. Results were presented in Diebold et al. (2010), and part of their Figures 5 and 8 are reproduced here (Figure A2). The crossline measurements, which were obtained at ranges ~2 km to ~14.5 km, are shown along with the 95th percentile fit (Figure A1, top panel). This allows extrapolation for ranges <2 km and >14.5 km, providing 150 dB SEL, 170 dB SEL and 180 dB SEL distances of 15.28 km, 1097 m, and 294 m, respectively. Note that the short ranges were better sampled in inline direction including by the 6-km long MCS streamer (Figure A2, bottom panel). The measured 170-dB SEL level is at 370-m distance in inline direction, well under the extrapolated value of 1097 m in crossline direction, and the measured 180-dB SEL level is at 140-m distance in inline direction, also less than the extrapolated value of 294 m in crossline direction. Overall, received levels are ~5 dB lower inline than they are crossline, which results from the directivity of the array (the 2-string array being spatially more extended in fore and aft than athwartship directions). Mitigation radii based on the crossline measurements are thus the more conservative ones and are therefore proposed to be used as the basis for the mitigation zone for the proposed activity.

The empirically derived crossline measurements obtained for the 18-gun, 3300-in^3 array in shallow water in the Gulf of Mexico, described above, are used to derive the mitigation radii for the proposed New Jersey margin 3-D survey that would take place in June–August 2015 (Figure A3). The entire survey area would be located in shallow water (<100 m). The source for this survey would be a 4-gun, 700-in^3 subset of 1 string at 4.5- or 6-m tow depth. The differences in array volumes, airgun configuration and tow depth are accounted for by scaling factors calculated based on the deep-water L-DEO model results (shown in Figures A4 to A6).

The scaling procedure uses radii obtained from L-DEO models. Specifically, from L-DEO modeling, 150-, 170-, and 180-dB SEL isopleths for the 18-gun, 3300-in^3 array towed at 6-m depth have radii of 4500, 450, and 142 m, respectively, in deep water (Figure A3). Similarly, the 150-, 170-, and 180-dB SEL isopleths for the 4-gun, 700-in^3 subset of 2 strings array towed at 4.5 m depth have radii of 1544, 155, and 49 m, respectively, in deep water (Figure A4). Taking the ratios between both sets of deep-water radii yields scaling factors of 0.3431–0.3451. These scaling factors are then applied to the empirically derived shallow water radii for the 3300-in^3 array at 6-m tow depth, to derive radii for the suite of proposed airgun subsets. For example, when applying the scaling ratios for the 4-gun, 700-in^3 array at 4.5-m tow depth, the distances obtained are 5.24 km for 150 dB SEL (proxy for SPL 160 dB rms), 378 m for 170 dB SEL (SPL 180 dB rms), and 101 m for 180 dB SEL (SPL 190 dB rms).

The same procedure is applied for the suite of arrays:

(1) 4-gun 700 in^3 array, subset of 1 string at 4.5 m tow depth (Figure A4)

(2) 4-gun 700 in^3 array, subset of 1 string at 6 m tow depth (Figure A5)

(3) Single 40 in^3 mitigation gun at 6 m tow depth (Figure A6)

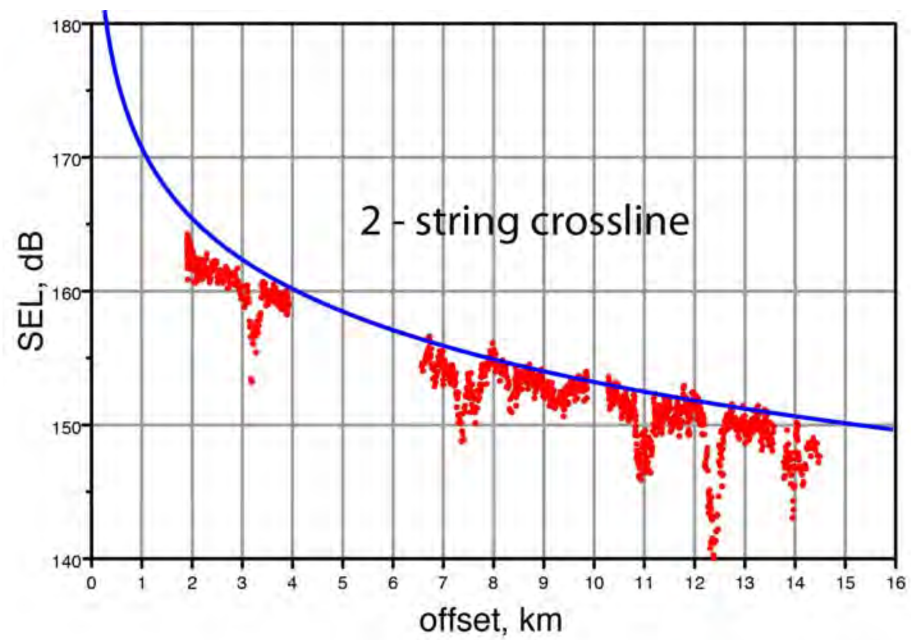

Figure 5a. Sound Exposure Levels for the crossline (side aspect) arrivals recorded along the spiral track at the shallow water calibration site, with a 95th percentile fit (using the methods described by Tolstoy et al., 2009).

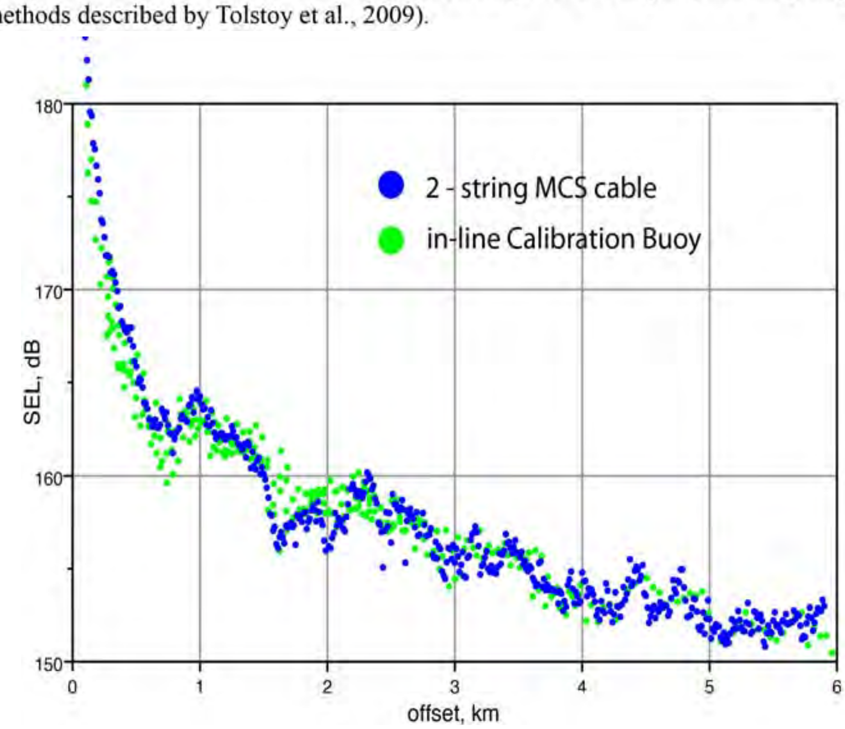

FIGURE A2. R/V *Langseth* Gulf of Mexico calibration results for the 18-gun, 3300-in^3, 2-string array at 6-m depth obtained at the shallow site (Diebold et al. 2010).

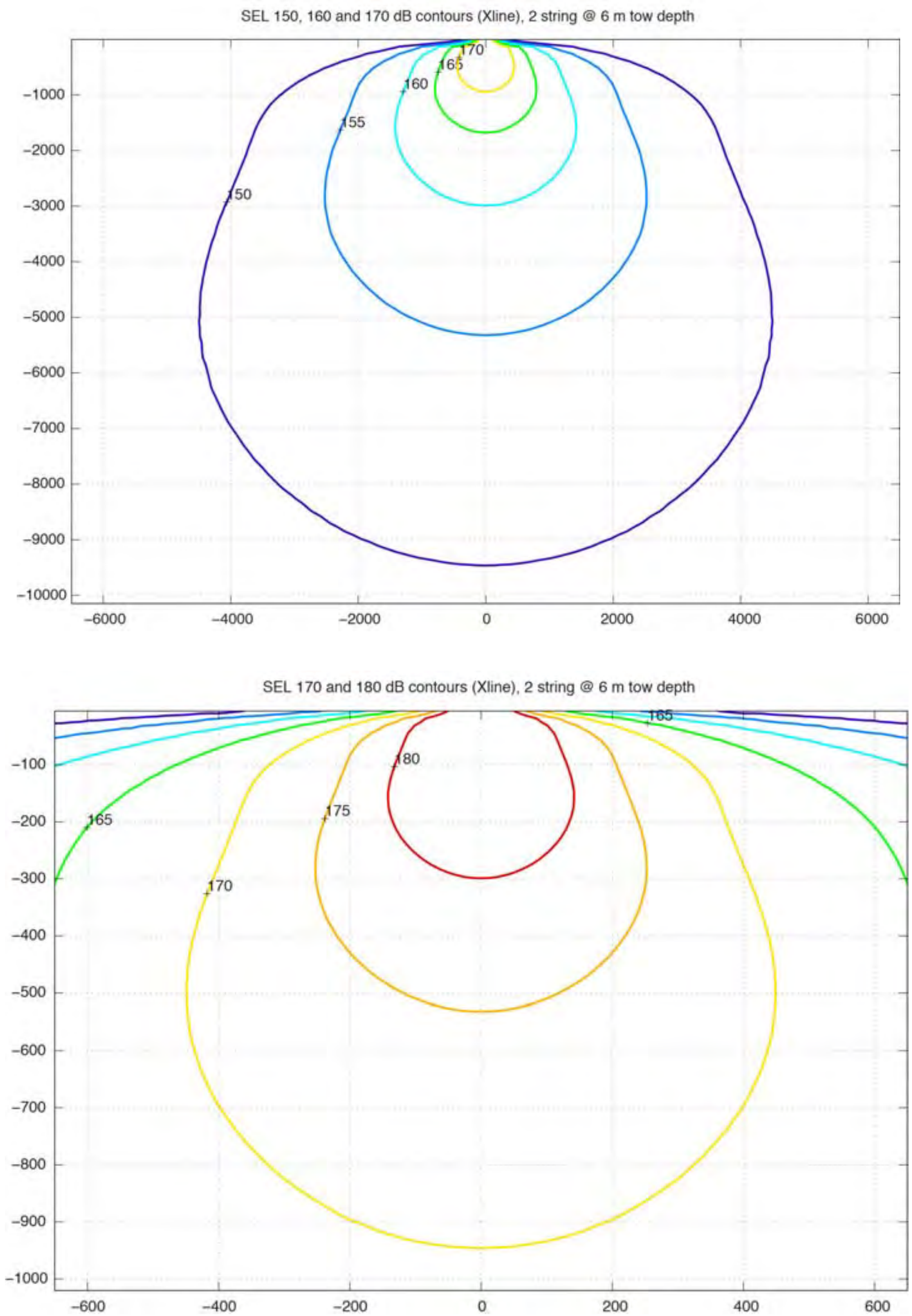

FIGURE A3. Deep-water model results for the 18-gun, 3300-in^3, 2-string array at 6-m tow depth, the configuration that was used to collect calibration measurements presented in Figure 2. The 150-dB SEL, 170-dB SEL, and 180-dB SEL (proxies for SPLs of 160, 180, and 190 dB rms[2]) distances can be read at 4500 m, 450 m, and 142 m.

[2] Sound sources are primarily described in sound pressure level (SPL) units. SPL is often referred to as rms or "root mean square" pressure, averaged over the pulse duration. Sound exposure level (SEL) is a measure of the received energy in a pulse and represents the SPL that would be measured if the pulse energy were spread evenly across a 1-s period.

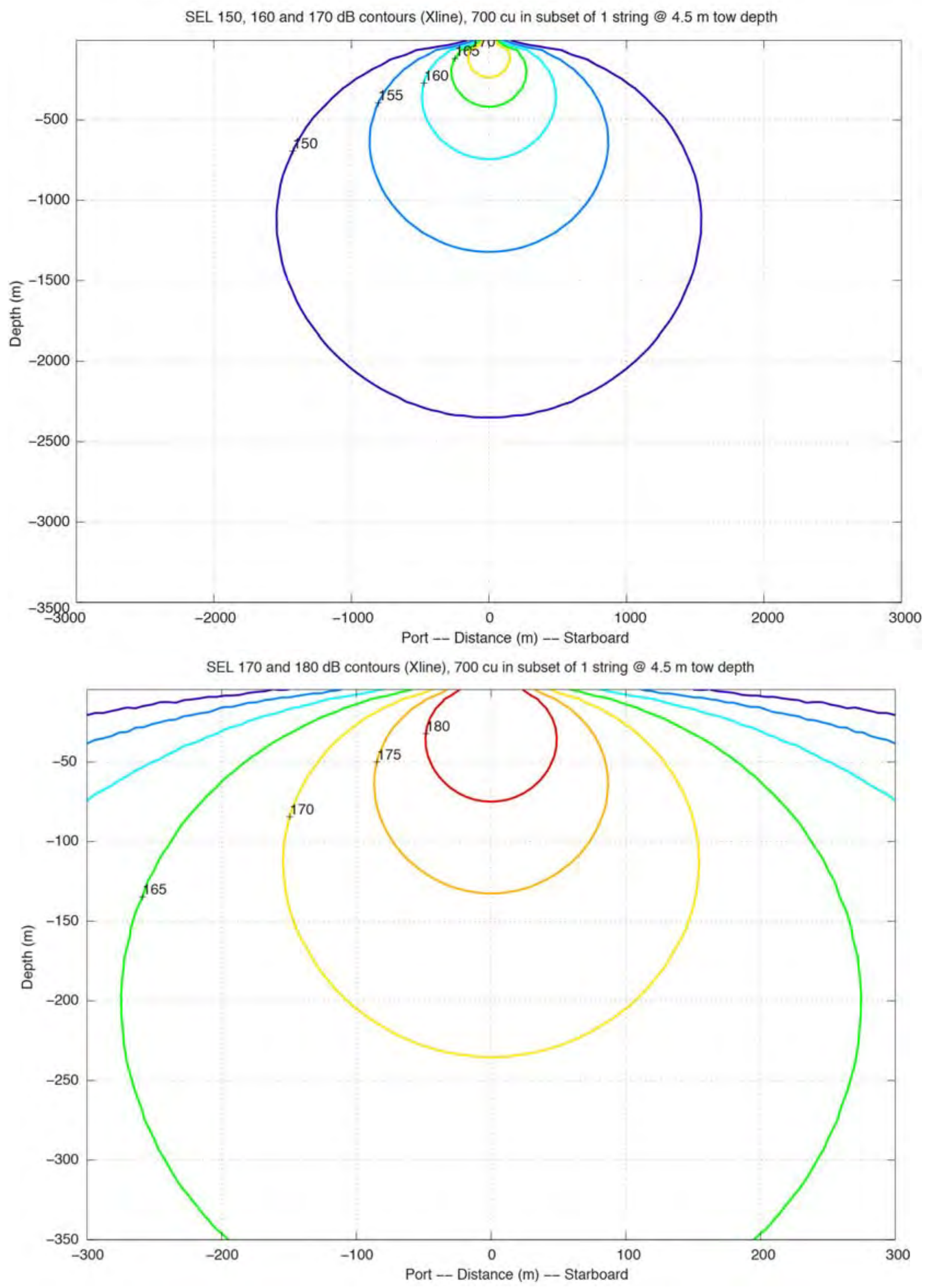

FIGURE A4. Deep-water model results for the 4-gun, 700-in^3 subset of 1-string array at 4.5-m tow depth that could be used for the NJ margin 3D survey. The 150-dB SEL, 170-dB SEL, and 180-dB SEL distances can be read at 1544 m, 155 m, and 49 m, respectively.

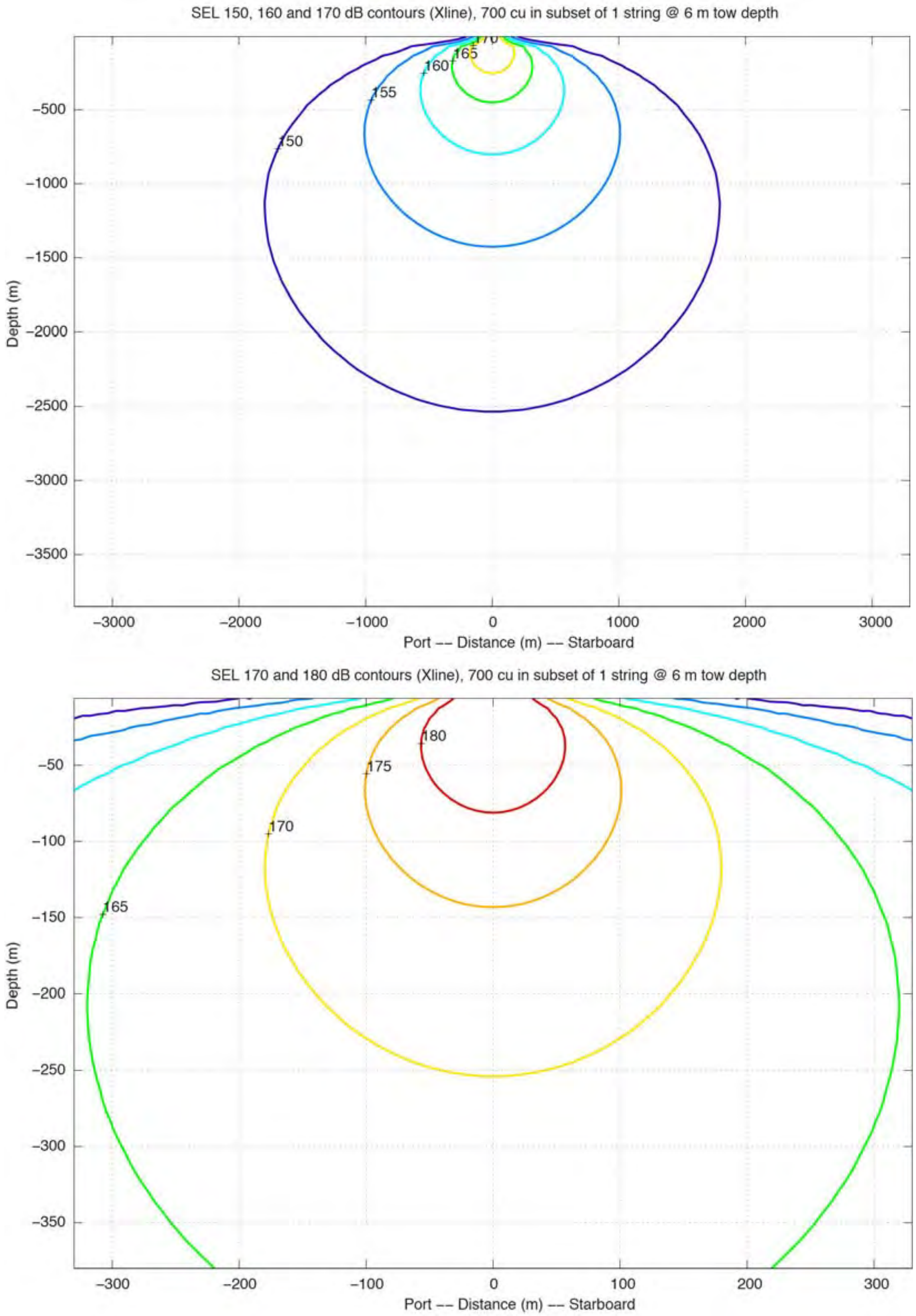

FIGURE A5. Deep-water model results for the 4-gun, 700-in^3 subset of 1-string array at 6m tow depth that could be used for the NJ margin 3-D survey. The 150-dB SEL, 170-dB SEL, and 180-dB SEL distances can be read at 1797 m, 180 m, and 57 m, respectively.

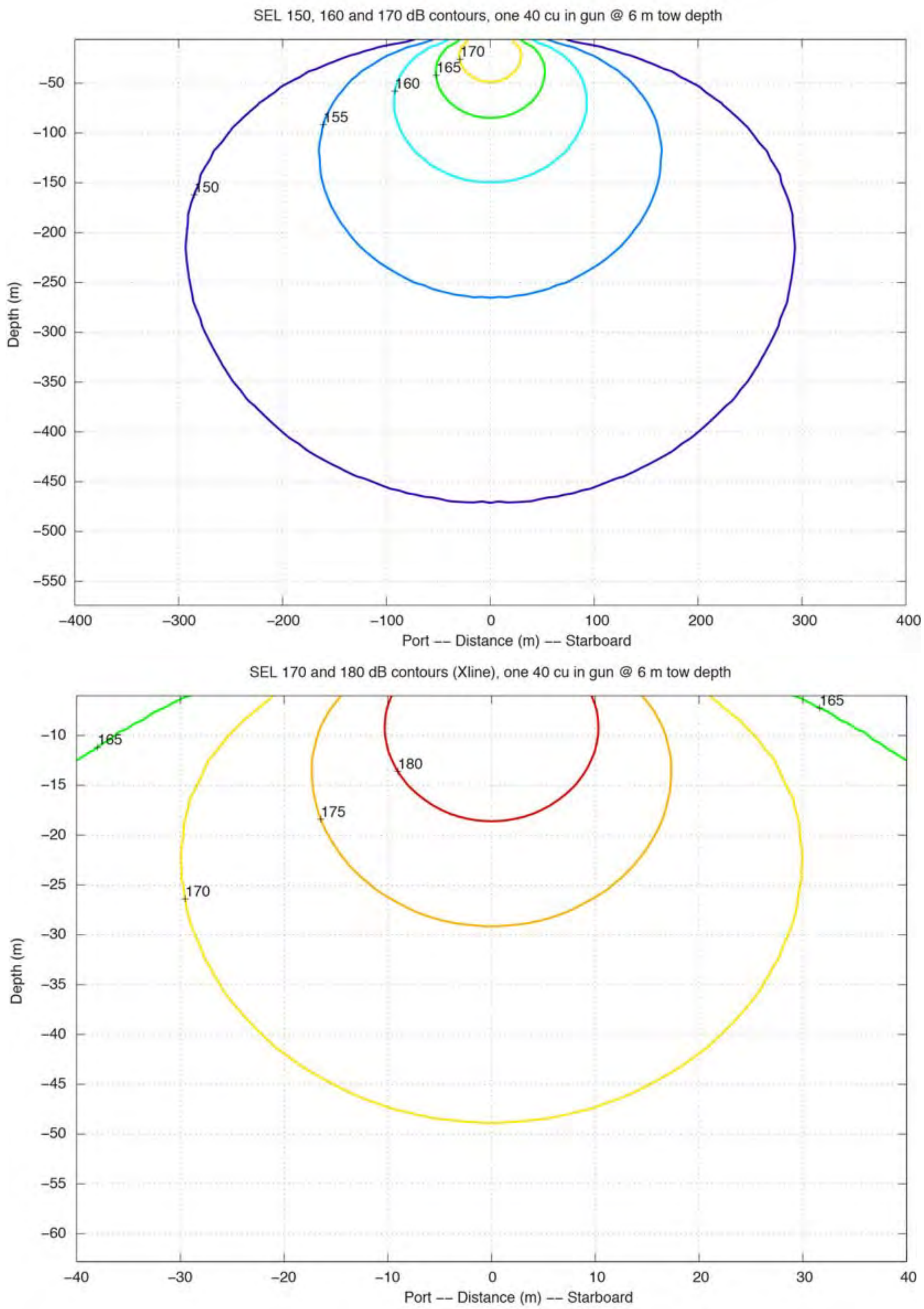

FIGURE A6. Deep-water model results for the single 40-in^3 Bolt airgun at 6-m tow depth. The 150-dB SEL, 170-dB SEL, and 180-dB SEL distances can be read at 293 m, 30 m, and 10 m, respectively.

The derived shallow water radii are presented in Table A1. The final values are reported in Table A2.

TABLE A1. Table summarizing scaling procedure applied to empirically derived shallow-water radii to derive shallow-water radii for various array subsets that could be used during the New Jersey margin 3D survey.

Calibration Study: 18-gun, 3300-in^3 @ 6-m depth	**Deep water radii (m)** (from L-DEO model results)			**Shallow Water Radii (m)** (Based on empirically-derived crossline Measurements)
	150 dB SEL:	4500		15280
	170 dB SEL:	450		1097
	180 dB SEL:	142		294
Proposed Airgun sources	**Deep water radii** (from L-DEO model results)		**Scaling factor** *[Deep-water radii for 18-gun 3300-in^3 array @ 6 m depth]*	**Shallow water radii (m)** *[Scaling factor **x** shallow water radii for 18-gun 3300 in^3 array @ 6 m depth]*
Source #1: 4-gun, 700-in^3 @ 4.5-m depth	150 dB SEL:	1544 m	0.3431	5240
	170 dB SEL:	155 m	0.3444	378
	180 dB SEL:	49 m	0.3451	101
Source #2: 4-gun, 700-in^3 @ 6-m depth	150 dB SEL:	1797 m	0.3993	6100
	170 dB SEL:	180 m	0.4000	439
	180 dB SEL:	57 m	0.4014	118
Source #3: Single 40-in^3 @ 6-m depth	150 dB SEL:	293 m	0.0651	995
	170 dB SEL:	30 m	0.0667	73
	180 dB SEL:	10 m	0.0704	21

TABLE A2. Predicted distances in meters to which sound levels ≥ 180 and 160 dB re 1 μPa$_{rms}$ would be received during the proposed 3-D survey off New Jersey, using a 4-gun, 700-in^3 subset of 1 string at 4.5- or 6-m tow depth and the 40-in^3 airgun during power-downs. Radii are based on Figures A2 to A6 and scaling described in the text and Table A1, assuming that received levels on an rms basis are, numerically, 10 dB higher than the SEL values.

		Predicted RMS Radii (m)	
Source and Volume	Water Depth	180 dB	160 dB
4-airgun subarray (700 in^3) @ 4.5 m	<100 m	378	5240
4-airgun subarray (700 in^3) @ 6 m	<100 m	439	6100
Single Bolt airgun (40 in^3) @ 6 m	<100 m	73	995

APPENDIX B

NSF COLLABORATIVE RESEARCH PROPOSAL

Corrected : 08/22/2012

COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE (if not in response to a program announcement/solicitation enter NSF 11-1) **PD 98-1620** **08/15/12**	FOR NSF USE ONLY
FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.) **OCE - MARINE GEOLOGY AND GEOPHYSICS**	NSF PROPOSAL NUMBER **1260237**

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	DUNS# (Data Universal Numbering System)	FILE LOCATION
08/15/2012	2	06040000 OCE	1620	(b) (4) [redacted]	09/04/2012 4:50pm

EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN) (b) (4) [redacted]	SHOW PREVIOUS AWARD NO. IF THIS IS ☐ A RENEWAL ☐ AN ACCOMPLISHMENT-BASED RENEWAL	IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES ☐ NO ☒ IF YES, LIST ACRONYM(S)

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE **Rutgers University New Brunswick**	ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE **Rutgers University New Brunswick** **3 Rutgers Plaza** **New Brunswick, N.J. 089018559**
AWARDEE ORGANIZATION CODE (IF KNOWN) **0026294000**	
NAME OF PRIMARY PLACE OF PERF **Department of Earth and Planetary Sciences**	ADDRESS OF PRIMARY PLACE OF PERF, INCLUDING 9 DIGIT ZIP CODE **Department of Earth and Planetary Sciences** **610 Taylor Rd.** **Piscataway ,NJ ,088548066 ,US.**

IS AWARDEE ORGANIZATION (Check All That Apply) (See GPG II.C For Definitions) ☐ SMALL BUSINESS ☐ FOR-PROFIT ORGANIZATION ☐ MINORITY BUSINESS ☐ WOMAN-OWNED BUSINESS ☐ IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE

TITLE OF PROPOSED PROJECT **Collaborative Research: Community-Based 3D Imaging That Ties Clinoform Geometry to Facies Successions and Neogene Sea-Level Change**

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE
$ 789,819	24 months	05/01/13	

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☐ VERTEBRATE ANIMALS (GPG II.D.6) IACUC App. Date ______
PHS Animal Welfare Assurance Number ______
☐ HUMAN SUBJECTS (GPG II.D.7) Human Subjects Assurance Number ______
Exemption Subsection ______ or IRB App. Date ______
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☐ HIGH RESOLUTION GRAPHICS/OTHER GRAPHICS WHERE EXACT COLOR REPRESENTATION IS REQUIRED FOR PROPER INTERPRETATION (GPG I.G.1)

PI/PD DEPARTMENT **Earth and Planetary Sciences**	PI/PD POSTAL ADDRESS **610 Taylor Rd.** **Wright Lab** **Piscataway, NJ 08854** **United States**
PI/PD FAX NUMBER **732-445-2044**	

NAMES (TYPED)	High Degree	Yr of Degree	Telephone Number	Electronic Mail Address
PI/PD NAME **Gregory S Mountain**	PhD	(b) (6) [redacted]	732-445-0817	gmtn@rci.rutgers.edu
CO-PI/PD				
CO-PI/PD				
CO-PI/PD				
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Electronic Signature

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Certification for Authorized Organizational Representative or Individual Applicant:

By signing and submitting this proposal, the Authorized Organizational Representative or Individual Applicant is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding debarment and suspension, drug-free workplace, lobbying activities (see below), responsible conduct of research, nondiscrimination, and flood hazard insurance (when applicable) as set forth in the NSF Proposal & Award Policies & Procedures Guide, Part I: the Grant Proposal Guide (GPG) (NSF 11-1). Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U. S. Code, Title 18, Section 1001).

Conflict of Interest Certification

In addition, if the applicant institution employs more than fifty persons, by electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative of the applicant institution is certifying that the institution has implemented a written and enforced conflict of interest policy that is consistent with the provisions of the NSF Proposal & Award Policies & Procedures Guide, Part II, Award & Administration Guide (AAG) Chapter IV.A; that to the best of his/her knowledge, all financial disclosures required by that conflict of interest policy have been made; and that all identified conflicts of interest will have been satisfactorily managed, reduced or eliminated prior to the institution's expenditure of any funds under the award, in accordance with the institution's conflict of interest policy. Conflicts which cannot be satisfactorily managed, reduced or eliminated must be disclosed to NSF.

Drug Free Work Place Certification

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant is providing the Drug Free Work Place Certification contained in Exhibit II-3 of the Grant Proposal Guide.

Debarment and Suspension Certification

(If answer "yes", please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency? Yes ☐ No ☒

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant is providing the Debarment and Suspension Certification contained in Exhibit II-4 of the Grant Proposal Guide.

Certification Regarding Lobbying

The following certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding $100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding $150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:
(1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.
(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Certification Regarding Nondiscrimination

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Certification Regarding Flood Hazard Insurance

Two sections of the National Flood Insurance Act of 1968 (42 USC §4012a and §4106) bar Federal agencies from giving financial assistance for acquisition or construction purposes in any area identified by the Federal Emergency Management Agency (FEMA) as having special flood hazards unless the:
(1) community in which that area is located participates in the national flood insurance program; and
(2) building (and any related equipment) is covered by adequate flood insurance.

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant located in FEMA-designated special flood hazard areas is certifying that adequate flood insurance has been or will be obtained in the following situations:
(1) for NSF grants for the construction of a building or facility, regardless of the dollar amount of the grant; and
(2) for other NSF Grants when more than $25,000 has been budgeted in the proposal for repair, alteration or improvement (construction) of a building or facility.

Certification Regarding Responsible Conduct of Research (RCR)
(This certification is not applicable to proposals for conferences, symposia, and workshops.)

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative of the applicant institution is certifying that, in accordance with the NSF Proposal & Award Policies & Procedures Guide, Part II, Award & Administration Guide (AAG) Chapter IV.B., the institution has a plan in place to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduates, graduate students and postdoctoral researchers who will be supported by NSF to conduct research.
The undersigned shall require that the language of this certification be included in any award documents for all subawards at all tiers.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE		SIGNATURE	DATE
NAME Emmeline Crowley		Electronic Signature	Aug 15 2012 10:43AM
TELEPHONE NUMBER 848-932-4027	ELECTRONIC MAIL ADDRESS Emily.Crowley@Rutgers.edu		FAX NUMBER 732-932-0162

* EAGER - EArly-concept Grants for Exploratory Research
** RAPID - Grants for Rapid Response Research

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NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE University of Texas at Austin	ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE Austin, TX 787121532 US
AWARDEE ORGANIZATION CODE (IF KNOWN) 0036582000	
NAME OF PRIMARY PLACE OF PERF University of Texas at Austin Institute for Geophysics	ADDRESS OF PRIMARY PLACE OF PERF, INCLUDING 9 DIGIT ZIP CODE University of Texas at Austin Institute for Geophysics 10100 Burnet Road, ROC/Bldg. 196 Austin ,TX ,787584445 ,US.

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PHS Animal Welfare Assurance Number ______
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______
☐ HIGH RESOLUTION GRAPHICS/OTHER GRAPHICS WHERE EXACT COLOR REPRESENTATION IS REQUIRED FOR PROPER INTERPRETATION (GPG I.G.1)

PI/PD DEPARTMENT Institute for Geophysics	PI/PD POSTAL ADDRESS 10100 Burnet Rd., ROC/Bldg. 196 J.J. Pickle Research Campus (R2200) Austin, TX 787584445 United States
PI/PD FAX NUMBER 512-471-0999	

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PI/PD NAME Craig S Fulthorpe	PhD	[redacted]	512-471-0459	craig@ig.utexas.edu
CO-PI/PD James A Austin, Jr.	PhD		512-471-0450	jamie@ig.utexas.edu
CO-PI/PD				
CO-PI/PD				
CO-PI/PD				

Electronic Signature

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Debarment and Suspension Certification

(If answer "yes", please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency? Yes ☐ No ☒

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(1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.

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AUTHORIZED ORGANIZATIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME Barbara D Reyes	Electronic Signature	Aug 13 2012 11:15AM

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512-471-6289	barbarareyes@austin.utexas.edu	512-471-6564

* EAGER - EArly-concept Grants for Exploratory Research
** RAPID - Grants for Rapid Response Research

Corrected : 08/22/2012

COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE/if not in response to a program announcement/solicitation enter NSF 11-1 PD 98-1620 08/15/12	FOR NSF USE ONLY NSF PROPOSAL NUMBER
FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.) OCE - MARINE GEOLOGY AND GEOPHYSICS	1259487

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	DUNS# (Data Universal Numbering System)	FILE LOCATION
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EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)	SHOW PREVIOUS AWARD NO. IF THIS IS	IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES ☐ NO ☒ IF YES, LIST ACRONYM(S)
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IS AWARDEE ORGANIZATION (Check All That Apply) (See GPG II.C For Definitions) ☐ SMALL BUSINESS ☐ FOR-PROFIT ORGANIZATION ☐ MINORITY BUSINESS ☐ WOMAN-OWNED BUSINESS ☐ IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE

TITLE OF PROPOSED PROJECT **Collaborative Research: Community-Based 3D Imaging That Ties Clinoform Geometry to Facies Successions and Neogene Sea-Level Change**

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE
$ 99,419	24 months	05/01/13	

CHECK APPROPRIATE BOX(ES) IF THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

☐ BEGINNING INVESTIGATOR (GPG I.G.2)
☐ DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C.1.e)
☒ PROPRIETARY & PRIVILEGED INFORMATION (GPG I.D, II.C.1.d)
☐ HISTORIC PLACES (GPG II.C.2.j)
☐ EAGER* (GPG II.D.2) ☐ RAPID** (GPG II.D.1)
☐ VERTEBRATE ANIMALS (GPG II.D.6) IACUC App. Date ______
PHS Animal Welfare Assurance Number ______
☐ HUMAN SUBJECTS (GPG II.D.7) Human Subjects Assurance Number ______
Exemption Subsection ______ or IRB App. Date ______
☐ INTERNATIONAL COOPERATIVE ACTIVITIES: COUNTRY/COUNTRIES INVOLVED (GPG II.C.2.j)
☐ HIGH RESOLUTION GRAPHICS/OTHER GRAPHICS WHERE EXACT COLOR REPRESENTATION IS REQUIRED FOR PROPER INTERPRETATION (GPG I.G.1)

PI/PD DEPARTMENT Seismology, Geology & Tectonophysics	PI/PD POSTAL ADDRESS Lamont-Doherty Earth Observatory P.O. Box 1000 Palisades, NY 109648000 United States
PI/PD FAX NUMBER 845-365-8150	

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CO-PI/PD				
CO-PI/PD				
CO-PI/PD				

Electronic Signature

CERTIFICATION PAGE

Certification for Authorized Organizational Representative or Individual Applicant:

By signing and submitting this proposal, the Authorized Organizational Representative or Individual Applicant is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding debarment and suspension, drug-free workplace, lobbying activities (see below), responsible conduct of research, nondiscrimination, and flood hazard insurance (when applicable) as set forth in the NSF Proposal & Award Policies & Procedures Guide, Part I: the Grant Proposal Guide (GPG) (NSF 11-1). Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U. S. Code, Title 18, Section 1001).

Conflict of Interest Certification

In addition, if the applicant institution employs more than fifty persons, by electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative of the applicant institution is certifying that the institution has implemented a written and enforced conflict of interest policy that is consistent with the provisions of the NSF Proposal & Award Policies & Procedures Guide, Part II, Award & Administration Guide (AAG) Chapter IV.A; that to the best of his/her knowledge, all financial disclosures required by that conflict of interest policy have been made; and that all identified conflicts of interest will have been satisfactorily managed, reduced or eliminated prior to the institution's expenditure of any funds under the award, in accordance with the institution's conflict of interest policy. Conflicts which cannot be satisfactorily managed, reduced or eliminated must be disclosed to NSF.

Drug Free Work Place Certification

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant is providing the Drug Free Work Place Certification contained in Exhibit II-3 of the Grant Proposal Guide.

Debarment and Suspension Certification

(If answer "yes", please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency? Yes ☐ No ☒

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant is providing the Debarment and Suspension Certification contained in Exhibit II-4 of the Grant Proposal Guide.

Certification Regarding Lobbying

The following certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding $100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding $150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

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AUTHORIZED ORGANIZATIONAL REPRESENTATIVE		SIGNATURE	DATE
NAME Maribel Respo		Electronic Signature	Aug 14 2012 11:46AM
TELEPHONE NUMBER 845-365-8829	ELECTRONIC MAIL ADDRESS mrespo@admin.ldeo.columbia.edu		FAX NUMBER 845-365-8112

* EAGER - EArly-concept Grants for Exploratory Research
** RAPID - Grants for Rapid Response Research

PROJECT SUMMARY

For the general benefit of a broad user community of scientists, educators and students, the Co-Principal Investigators propose to coordinate the use of R/V *Marcus Langseth* to acquire a 3D seismic volume encompassing the three IODP Expedition 313 drillsites on the inner-middle shelf of the New Jersey (NJ) continental margin. Exp313, the latest chapter in the multi-decade Mid-Atlantic Transect, represents the community's best opportunity to link excellently sampled/logged late Paleogene-Neogene prograding clinoforms to state-of- the-art 3D images. The primary goal of this proposal is to constrain the complex forcing functions tying evolution and preservation of the margin stratigraphic record to base-level changes. These processes include eustasy, climatic and paleooceanographic variations, tectonism, compaction and rates of sediment supply. Exp313 borehole data will provide lithostratigraphy, geochronology and paleobathymetry. Geomorphology revealed by coherency in horizontal (travel-time) slices within the volume (among other 3D imaging tools) will identify diagnostic features such as river systems, shorelines, delta channels, sediment failure scars, etc., none of which can be resolved in existing 2D seismic data to the degree required to map shifting shallow-water depositional settings in the vicinity of clinoform rollovers. Embracing a community-based strategy, the co-PIs will manage planning, acquisition and data processing up to the point of an interpretable 3D volume. This will entail a pre-cruise planning workshop, hands-on training for young scientists at sea, and rapid turn-around of the data by a commercial processor. Data will be made available to the engaged scientific community to use as the foundation of follow-on, PI- driven proposals that improve understanding of factors shaping the NJ margin in particular, and that imprint the sedimentary record at continental margins in general. The scientific parties of several ocean drilling expeditions and outcrop specialists of shallow-water systems are two groups certain to want to compare their research experience with the ground-truth these data will provide.

Intellectual Merit

The NJ margin has for decades been recognized as among the best siliciclastic passive margins for elucidating the timing/amplitude of eustatic change during the "Ice House" period of Earth history, when glacioeustatic changes shaped continental margin sediment sections around the world. A transect strategy adopted by the international scientific ocean drilling community has been used to study this interval at shallow-water settings offshore NJ, New Zealand and the Bahamas that were dominated by prograding clinoforms. 3D seismic imaging is now a viable tool for the research community, ready to be applied to the NJ margin to put these sampled records in a spatially accurate, stratigraphically meaningful context. Such imagery will allow researchers to map sequences around Exp313 sites with a resolution and confidence previously unattainable, and to analyze their spatial/temporal evolution. Long-awaited objectives include: 1) establishing the impact of known Ice House base-level changes on the stratigraphic record; 2) providing greater understanding of the response of nearshore environments to changes in elevation of global sea level (with special relevance to the current relentless rise), and 3) determining the amplitudes/timing of global sea-level changes during the mid-Cenozoic, which should help humanity put anthropogenic base-level change in a proper long-term context.

Broader Impacts

The community will be engaged in 3 ways. 1) A pre-cruise workshop will review the scientific payoff that 3D seismic-core-log integration can provide, and enable attendees to help shape acquisition and data processing details that optimize this goal; 2) 12 bunks aboard *Langseth* will be reserved for student/post-doc/young scientist volunteers to acquaint each with 3D acquisition and the myriad activities that comprise a research cruise; and 3) a post-cruise workshop will identify community-based avenues for analysis/interpretation of the processed 3D volume and integration with Exp313 results. The 3D images will very likely become an integral part of IODP outreach. Lamont-Doherty Earth Observatory and the University of Texas Institute for Geophysics have collaborative NSF grants to archive marine seismic data collected with NSF support. The raw field data will be delivered to the LDEO facility immediately after acquisition, and a fully processed 3D data 'volume' will be sent to the UTIG facility ~5 months after that, with the expectation that these data will become a showcase for how such sub-seafloor imaging can inform the understanding of stratigraphic evolution at continental margins.

TABLE OF CONTENTS

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*Proposers may select any numbering mechanism for the proposal. The entire proposal however, must be paginated. Complete both columns only if the proposal is numbered consecutively.

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PROJECT DESCRIPTION

Collaborative Research: Community-Based 3D Imaging that Ties Clinoform Geometry to Facies Successions and Neogene Sea-Level Change

PROLOGUE

This resubmission has benefited from constructive input by 8 mail reviewers, a panel summary, and NSF feedback (fall 2011). In response, we amplify three issues: 1) 3D imaging will detect nearshore features (e.g., meandering rivers, estuary complexes, lagoons/barrier islands, incised shelf valleys, etc.) that can be tied to IODP Exp313 sites M27-M29; mapping these features and associated facies, which developed during a time of known glacioeustatic variation, is a key both to understanding the evolution of siliciclastic systems and quantifying eustatic changes preserved in clinoformal architecture; 2) the proposed 3D survey area is 50% larger than in our initial submission, with no increase in survey time (34 days), as a result of revised estimates of in-fill shooting and downtime based on well-known histories of weather, currents, ship traffic and marine mammal activity in the proposed study region offshore New Jersey (NJ); and 3) a robust collaboration with the aligned GeoPRISMS community, including at-sea participation and pre- and post-data acquisition workshops; all activities are designed to help educators, young investigators and students understand the value of calibrating models of stratigraphic facies successions, as well as to engage them in theoretical and hands-on learning experiences with 3D seismic acquisition/processing. The goal throughout this project will be to optimize community use of the proposed product - a 3D data volume tied to continuously cored/logged/dated siliciclastic clinoforms that evolved at a stable passive margin during a time of independently measured glacioeustatic change.

INTRODUCTION

Shoreline movements and linked shifts in nearshore processes have important societal consequences. As discussion of global warming grows from speculation to more widespread acceptance (Inter-governmental Panel on Climate Change, 1995; 2001; 2007), impacts at the land-sea divide are gaining media attention. Nonetheless, journalists, policy makers, and even earth scientists often fail to grasp that while links exist among warming, melting ice and rising sea levels, actual effects on shoreline position locally vary widely. Shoreline positions are controlled by many factors, only one of which is global sea level. For example, in Scandinavia (rising due to glacial rebound) and Venice, Italy (subsiding due to sediment compaction), shorelines are moving in opposite directions despite the current rise in global sea-level of ~3mm/yr (projections point to an increase of ≥8 mm/yr by 2100; Rahmstorf et al., 2007). Other drivers include sediment supply and wave/storm-influenced sediment dispersal/compaction, plus regional influences: lithospheric cooling, isostatic/flexural loading, and dynamic topography within the asthenosphere. On old passive margins (e.g., NJ), regional effects are small and perhaps impossible to measure, but all contribute to the complexity of assessing eustatic change through geologic time.

Preserved shallow-water sediments are divided into facies successions bounded by regional unconformities (e.g., Sloss, 1963). The difficulty of mapping these "sequences" (Vail et al., 1977) in true 3D, and deconvolving factors that generate them, have long hindered all but broad interpretations regarding their relationships to eustatic change (e.g., Haq et al., 1987). Because of the importance of coarse-grained sand bodies as reservoirs, oil companies have sought ways to anticipate distributions of sequences based on seismic data alone, often without investing in costly geologic sampling. They focus on intervals/settings that offer the highest economic returns, most recently in structurally complex deep-water settings, leaving behind less productive, Neogene shelf clinoform settings. They also generally withhold their high-quality seismic data and predictive techniques from public disclosure. The international research community shares many of the same scientific interests, but relies less on high-quality seismic data and more on samples from scientific ocean drilling to link the preserved stratigraphic record with eustasy (COSOD II, 1987; Watkins and Mountain, 1990; JOIDES, 1992; Fulthorpe et al., 2008). Such efforts have focused on assembling a global compilation of co-registered analyses of paleo-water depths, sediment compaction/age, and thermal/isostatic/flexural subsidence in shallow-water basins along continental edges. Gathering these drilling-based data has been challenging, and accompanying industry-grade seismic data remain generally unavailable. Our goal here is to augment recently drilled and logged NJ shelf successions with superb 3D seismic images to provide the interested academic community an improved understanding of the factors shaping the global sedimentary record at passive margins, including the long-term history of eustatic change. Because continental margins contain the archive from which much of the world's oil and gas is extracted, and along which ~10% of humanity lives, knowledge of the interaction of this sediment record with ongoing base-level changes serves highly relevant societal interests.

BACKGROUND

The Transect Drilling Strategy

ODP/IODP-related workshops (refs. above) and more than two decades of community-based discussions have concluded that a global set of borehole transects across multiple passive margins is required to deconvolve eustatic signals from those of local processes (Christie-Blick et al., 1990; Kominz and Pekar, 2001). Only this strategy can confirm global synchroneity of sequence boundaries and document stratigraphic responses in diverse tectonic/depositional settings. To yield a reliable measure of eustatic change between two sequences, drilling must sample an intervening sequence boundary in at least three locations: 1) the youngest topset sediments of the older sequence, close to the seaward increase in gradient (the clinoform "rollover"/paleo-shelf edge); 2) the oldest bottomset sediments of the younger sequence at the seaward toe of that same clinoform; and 3) farther seaward along the same surface, where complications of reworking are diminished and age control optimal (Fulthorpe et al., 2008). Using this approach, lateral variations in facies, paleo-water depth and age can be traced along key surfaces. With proper accounting for total subsidence, reliable elevations/dimensions of sequences at their time of deposition can be estimated to distinguish local transgressive/regressive cycles (e.g., Scandinavia vs. Venice) from eustatic changes (e.g., Steckler et al, 1999).

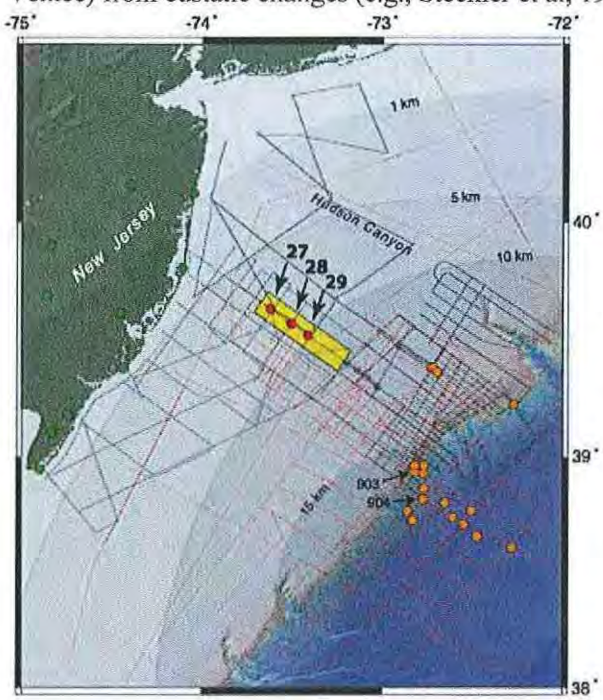

Figure 1. Proposed 12 x 50 km 3D seismic volume (yellow rectangle) encompassing Exp313 Sites 27-29 (red circles) embedded within grids of deep-penetration, reconnaissance (dashed red lines) and higher-resolution (solid gray lines) 2D MCS profiles. Previous studies have tied these grids to scientific ocean drilling wells on the outer shelf, slope and rise (orange circles). Onshore wells (green circles) provide updip equivalents to offshore stratigraphic units (see details in the text). Depths to basement are indicated (muted gray colors/contours).

IODP Expeditions 313 and 317 (NJ and offshore New Zealand, respectively) have followed this strategy, drilling dip-oriented transects imaged by grids of 2D MCS profiles (Mountain, Proust, McInroy et al., 2010; Fulthorpe, Hoyanagi, Blum et al., 2011). This proposal builds on the successful drilling of the first of these, termed the "Mid-Atlantic Transect" (MAT), by seeking to fill a critical gap in seismic correlation. Exp313 samples provide age/paleo-water depth/facies variations within and between sequences imaged by existing grids of 2D MCS data (Fig. 1). The 3D volume we propose to collect will provide accurately rendered, high-resolution "seismic geomorphology" linking depositional/erosional processes driving shoreline movements to known mid-Neogene base-level changes.

Evolution of the "Mid-Atlantic Transect" (MAT)

The NJ margin has long been recognized as a leading candidate for the study of eustatic change and its impact on the sediment record because of: 1) smooth thermal subsidence since Triassic-Early Jurassic rifting (Watts and Steckler, 1979); 2) substantial sediment supply since the mid-Oligocene (Poag, 1985), when high-latitude glaciations provide an independent measure of eustatic forcing (Miller et al., 1998;

Zachos et al., 2001; Pekar et al., 2002; Pekar and Christie-Blick, 2008); 3) optimal geochronologic control as a result of a mid-latitude setting; and 4) accessibility/wealth of supporting information (Fig. 1).

In support of the transect drilling approach, multiple 2D MCS grids have been collected since 1990 to locate potential drill sites (Fig. 1). The first was a reconnaissance grid of 120-channel, 1350 in.^{3} air-gun array profiles across shelf wells spot-cored by the U.S. Geological Survey and industry (Hathaway et al., 1976; Scholle, 1977; Libby-French, 1984). Roughly two dozen unconformity bounded, post-Eocene sequences across the shelf/upper slope were traced areally using these data. ODP Leg 150, restricted to the slope/rise, recovered sediments documenting 22 early Eocene-middle Pleistocene ("Ice House") seismic surfaces (Mountain, Miller, Blum, et al., 1994; Miller et al., 1996). In most cases, seismic sequence boundaries matched to Leg 150 boreholes showed little/no time missing across them. Coarse-grained deposits that fined upwards from the bases of many sequences were interpreted as sediments transported basinward during sea-level lowstands. The scientific community understood that Leg 150 samples were from paleo-water depths too deep to yield insight into eustatic amplitudes and their role in shaping facies successions, but shelf drilling required was not at that time deemed safe.

To attempt to remedy the need for shallow-water control, Coastal Plain drilling was begun to complement the deep-water data (Miller et al., 1994). Oligocene – mid-Miocene sequence boundaries onshore (Fig. 1) were found to correlate well with $\delta^{18}O$ increases derived from deep-ocean sampling, confirming that they formed during times of most rapid global sea-level falls (Fig. 2). Furthermore, sequence ages compared well with the Haq et al. (1987) eustatic chart (see also Miller et al., 1996, 1998).

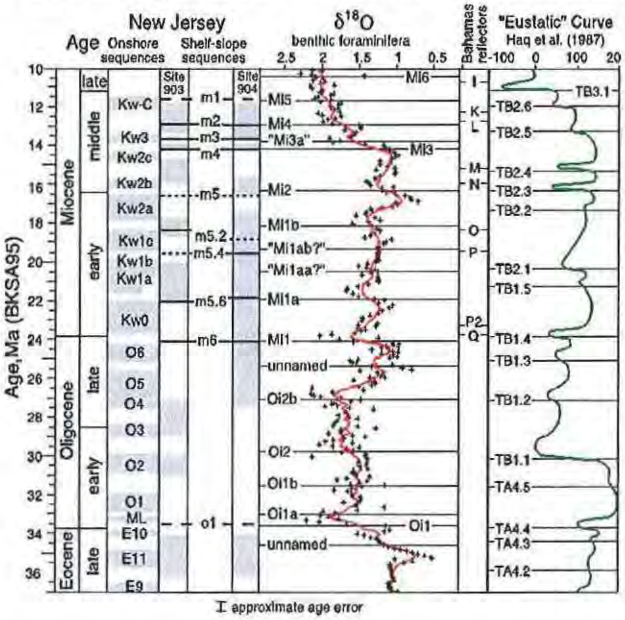

Figure 2. Correlation chart of the NJ margin, late Eocene-late middle Miocene. Onshore sequences (19 total, gray=recovered, white=hiatus) were sampled at 6 sites. Shelf sequence boundaries (10 total, o1-m1) were defined in MCS profiles (see Fig. 1) and traced to the slope. Depositional sequences at ODP slope sites 903/904 (gray=recovered, white=hiatus; Fig 1) are tied to the magnetic reversal time scale (Berggren et al, 1995) and the global $\delta^{18}O$ curve. Ice volume increases are inferred from $\delta^{18}O$-matched hiatuses in the updip/onshore record and slope sequence boundaries. A global sea level curve inferred from coastal onlap and other means (Haq et al., 1987) is at far right. While these correlations appear robust, the critical missing piece for understanding the evolution of the siliciclastic sedimentary record during a time of known eustatic change is spatial correlation of 3D seismic images (crucial for identifying/tracking shorelines and related shallow-water features) with well-sampled drillsites, such as Sites 27-29 (Fig. 1).

The Coastal Plain effort showed that: 1) sequence boundary ages could be determined to better than ±0.5 myr, thereby providing the chronologic control needed to track eustasy for the past 42 myr (Miller et al., 1996, 1998); 2) stratal surfaces are the primary cause of margin seismic reflections (Mountain, Miller, Blum, et al., 1994); 3) middle Eocene-Miocene sequence boundaries correlate with globally recognized $\delta^{18}O$ increases, linking their formation to glacioeustatic falls (Miller et al., 1996, 1998); 4) through correlation with Leg 166 (Bahamas) drilling, siliciclastic and carbonate margins yield correlatable and in some cases comparable records of inferred sea-level change (Miller et al., 1998; Eberli, Swart, and Malone, et al., 1997); and 5) several amplitude estimates of ~20-85 m for my-duration sea-level variations exist that agree with estimates based on $\delta^{18}O$ changes (Kominz et al., 1998, 2003).

Nonetheless, onshore/slope drilling on the NJ margin cannot alone constrain late Paleogene-Neogene eustasy. Onshore wells are too far updip to recover lowstand sediments and, without seismic profiles, they lack the complementary sequence architecture needed to understand facies distributions within clinoform packages. Furthermore, neither onshore nor deep-water drilling can sample paleo-shelves/clinoform rollovers that are among the most sensitive features to post-Oligocene sea-level change. The full range of known/expected "Ice House" sea-level variations cannot be addressed without drilling on the shelf.

To prepare for shelf drilling, 2D MCS profiles across the shelf/uppermost slope were collected (Fig. 1; Austin et al., 1996). These featured two aspects required for safety: high-resolution (shallowly-towed, short-offset GI gun/streamer geometry, 12.5 m shot spacing, 1 ms sampling, ~5 m vertical resolution) and dense spacing (150 m) around locations of proposed drill sites. Such data quality and density were deemed necessary to avoid drilling into pockets of shallow, pressurized gas. These data increased the resolution and number of mappable sequences (Fulthorpe et al., 1999, 2000; Fulthorpe and Austin, 2008). Unfortunately, because the *JOIDES Resolution* generally employs open-hole drilling, ODP denied all proposed sites except two that "twinned" the COST B-2 stratigraphic test well, to ensure the absence of gas (Scholle, 1977). Consequently, ODP Leg 174A drilled Sites 1071 and 1072 on the outer shelf ~.75 and 3.5 km from B-2 (Fig. 1; Austin, Christie-Blick, Malone, et al., 1998). Loose sands and drill-ship heave resulted in limited recovery to the extent that bounding surfaces could not be sampled/dated with the desired precision. Nonetheless, observed prograding clinoformal seismic sequences were confirmed as being bracketed by unconformities that formed during sea-level falls. Other contributions included: 1) water depths during late-middle Miocene-Pleistocene lowstands were close to zero ~100 km seaward of the modern shoreline; 2) inferred fluvial incisions (restricted to topsets) suggest that ambient sea-level never fell below rollovers; and 3) benthic forams indicate that maximum highstand water depths were ~50-100 m, constraining sea-level amplitudes once the effects of accumulation, compaction and loading are taken into account.

Leg 174A results also showed that a drilling platform immune to heave and a drill rig with closed-circulation were needed to provide both the flexibility in site selection and high core recovery required to meet long-standing MAT objectives. This suggested that drilling beneath the inner shelf, where ~30 m water depths permitted use of a self-propelled jack-up rig ("mission-specific platform") planted on the seafloor, was essential. To serve safety constraints, a second 2D MCS grid was completed landward of previous surveys, again with ~5 m vertical resolution and narrow line spacing (Fig. 1; Monteverde et al, 2008). Sites were selected following the transect strategy; imaging focused on early Neogene clinoforms on the inner-middle shelf.

IODP Expedition 313 – Neogene Clinoforms Continuously Cored and Logged

Exp313 drilled/logged 3 sites, (M)27-29, in 35 of water 45-65 km offshore NJ in 2009 (Figs. 1 and 3; Mountain, Proust, McInroy et al., 2010). Goals were to: 1) identify surfaces representing late Paleogene-Neogene base-level changes and compare their ages with sea-level variations implied by the $\delta^{18}O$ glacioeustatic global proxy (Fig. 2); 2) estimate corresponding amplitudes/rates/mechanisms of sea-level change during this "Icehouse" time; and 3) evaluate/improve models predicting lithofacies successions, depositional environments and seismic architecture in response to such sea-level changes and other processes that imprint the shallow-water record. Exp313 collected 1311 m of very good-excellent quality cores with 80% recovery. The deepest hole penetrated 757 mbsf to upper Eocene sediments. Slim-line logs included spectral gamma ray, resistivity, magnetic susceptibility, sonic and acoustic televiewer. Porewater chemistry profiles were generated; uncontaminated sediments were also frozen for microbiologic studies.

Downhole logs, multi-sensor track measurements of unsplit cores, and physical properties of discrete samples, aided by vertical seismic profile measurements at each site, provided core-log-seismic ties with preliminary depth uncertainties of ±5 m or less (Mountain, Proust, McInroy et al., 2010). Excellent synthetic seismograms provide support for core-log-seismic correlation within specific intervals (Mountain and Monteverde., in review). Studies by the Exp313 Scientific Party (over 2 dozen papers representing scientific results are due for submission to *Geosphere* by Aug 4, 2012) link strata to 16 seismically mapped (Figs. 1, 4) regional surfaces/unconformities. The three sites sampled topsets, foresets and toesets of multiple stacked clinoforms. Litho- and biofacies have been correlated along key seismic surfaces to yield mutually consistent depositional histories, although, as will be described, nagging

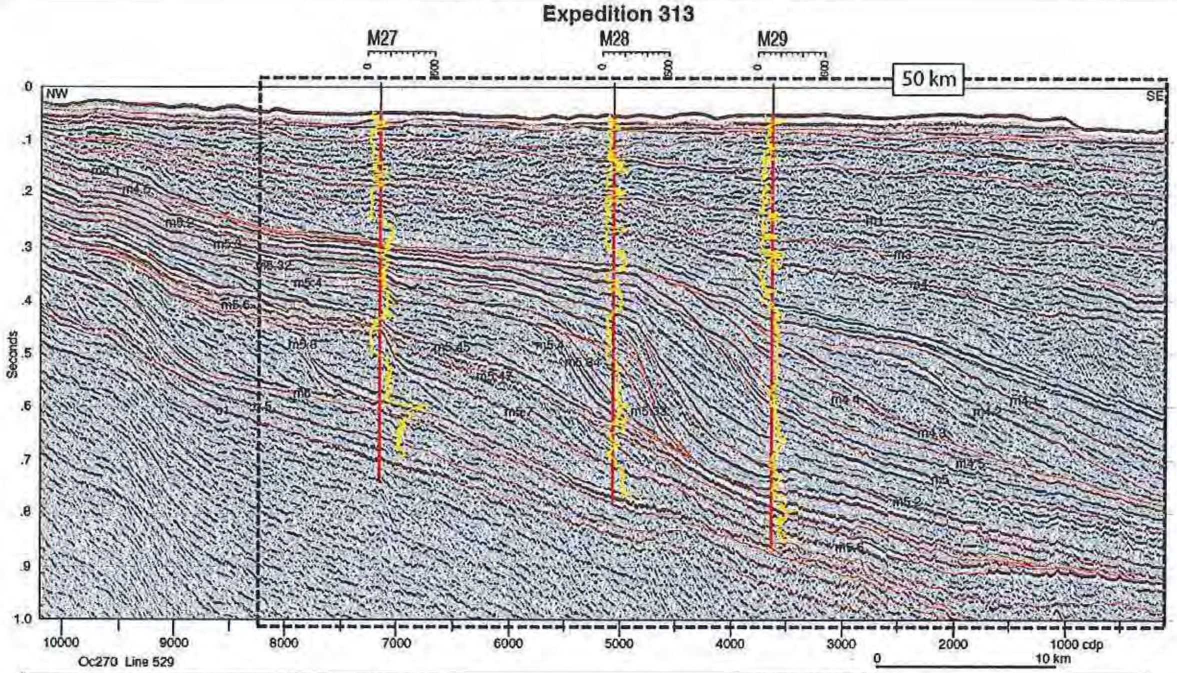

Figure 3. Oc270 line 529 through Exp313 sites M27-29 and the area we propose for a 12x50 km 3D seismic volume (dotted rectangle is the long dimension of that survey; Fig. 1). Gamma ray logs, converted to travel-time with velocities developed for Exp313, are shown in yellow. Early Oligocene - mid-Miocene sequences o1 to m4.1 have been continuously cored/logged and correlated across an existing 2D grid of seismic data on the inner shelf (Monteverde et al., 2008; Figs. 1, 4). As good as the resulting correlations appear to be, ambiguities fundamental to understanding the link between sea-level change and sequence evolution, notably the recognition of diagnostic shorelines and related shallow-water features (fluvial incisions, point bars, estuary complexes, etc.), remain and will not be fully resolved without 3D imaging encompassing these drill sites.

uncertainties remain that cannot be resolved with existing seismic coverage. Excellent paleontologic zonations (based on coccolithophores, dinocysts, diatoms and limited planktonic foraminifera), plus Sr-isotopic ages, are revealing a nearly continuous record of 0.5-2 myr sea-level cycles in the 22-12 Ma interval. Older and younger strata outside this age range have also been sampled, but were not present at all sites. Facies and benthic foram assemblages implying paleo-water depth changes of 60-80 m have been found in topset beds within transgressive-regressive cycles. Initial 2-D backstripping suggests that these paleobathymetric changes are the result of eustatic variations of ~1/2 this magnitude (Mountain and Steckler, 2011; Steckler et al, in review). Ongoing shorebased studies, involving correlation/backstripping of additional surfaces to recover original geometries, should improve eustatic amplitude estimates within the targeted time interval.

However, despite Exp313 successes, made possible by excellent core recovery with ties to logs and mapped sequences (Mountain, Proust, McInroy et al., 2010), uncertainties regarding sequence evolution and relationships with eustatic change remain: 1) If topset strata become subaerially exposed during lowstands, why are no shoreline features, and so few incised valleys, recognized on existing 2D seismic data in the Exp313 region (Fig. 4)? 2) What is the source of debris flow deposits found in Exp313 cores seaward of clinoform rollovers, during what stage(s) of the sea-level cycle are they likely to have formed, and why is there no seismic geomorphologic evidence of sediment transport from either up-dip or along-strike sources on the 2D data? 3) How are prograding Oligocene - mid-Miocene clinoforms influenced by initiation of the globally important mid-Miocene climate transition? Despite progress in sampling these clinoforms, one key element, encompassing spatial imaging, is missing. The clinoform rollover (i.e., paleo-shelf edge) is the key imaging location, because landward shoreline trajectories shift, and the growth and development of incisions in response to sea-level change can be observed seismically. Drilling calibrates those trajectories, but only spatial imaging can both recognize and document them through time.

We must know more about detailed processes and depositional environments at/near rollovers, especially volumes/timing of sediment bypass to clinoform slopes. Lateral variability along shorelines is also crucially important, so we must document changes in processes/depositional environments in both dip and strike directions, to the extent that resources allow.

In summary, the "MAT" has been a long-term effort, culminating in Exp313, involving repeated 2D seismics at a range of frequencies to carry out iterative drillsite targeting (using successive sampling technologies) to address the Neogene geologic history at an old passive margin. One crucial piece remains – to integrate calibrated shallow-water facies with 3D images of architecture/geomorphology.

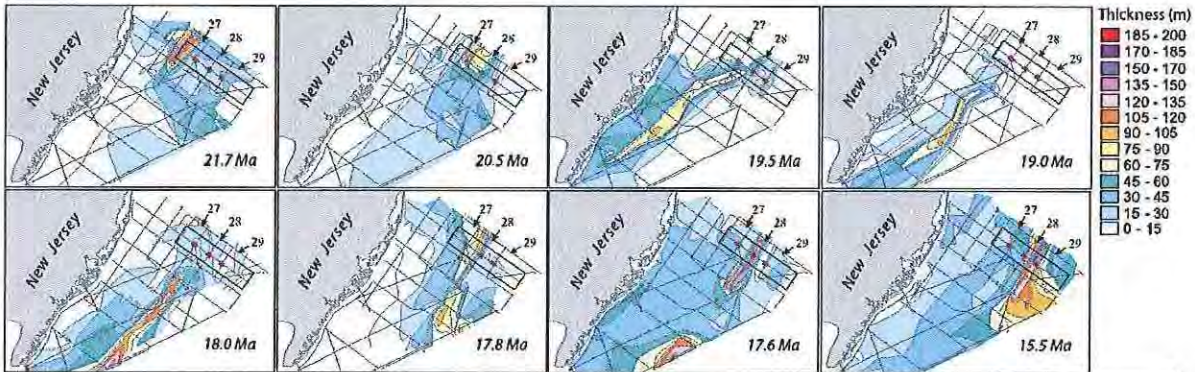

Figure 4. Isopachs of 8 early to middle Miocene sequences offshore NJ (legend at right; after Monteverde et al., 2008; basal age of sequences from Browning et al., in review). The proposed 12 x 50 km 3D MCS volume encompassing Exp313 Sites M27-M29 (red circles) is outlined in black. Seismic sequences have been identified using 2D MCS profiles (Figs. 1, 3), tied to ODP drill sites on the outer shelf and slope (see Fig. 1), and correlated to hiatuses in ODP onshore wells (Figs. 1, 2). Note seaward progradation of Miocene sediments through time, plus progression from a northern sediment buildup (21.7 Ma), followed by a southern buildup (18.0 Ma), then returning to a northern buildup (15.5 Ma) suggesting both time-varying sources of sediment and margin-parallel redistribution. This complex evolution challenges the reliability of understanding sequence development using only sparse, primarily dip-oriented 2D profiles. The proposed 3D volume will image stratal features within both the thickest parts of some sequences and along the thinner perimeters of others.

RESEARCH GOALS of the PROPOSED WORK

Provide Community Access to a Calibrated (by Exp 313 Drilling) 3D Seismic Volume

Integration of 3D images with Exp313 drilling results will couple the highest quality cores from this passive margin with unparalleled definition of seismic facies character and spatial geometry where they are needed, near rollovers/paleo-shelf edges most sensitive to changes in base-level during the Ice House. Such an integration will advance sea-level science, while providing unprecedented insights into impacts of migrating shorelines during rising sea level, such as we are experiencing today (see Broader Impacts). Future breakthroughs in the marine geosciences will rely on spatial imaging of the subsurface that can only be achieved with 3D technology. Since its appearance in the early 1970's (Walton, 1972), commercial 3D surveying has grown at such a rate that by 1999 it had eclipsed 2D profiling in terms of worldwide dollar value of acquisition (Liner, 1999). However, despite clear science advantages, its use by academia has followed slowly due to high costs of acquisition and processing.

NSF addressed this issue by convening the 2010 workshop *Challenges and Opportunities in Academic Marine Seismology* (http://www.steveholbrook.com/mlsoc/workshop_report.pdf) to encourage the academic research community to explore ways of increasing access to 3D data. A major recommendation comprised three parts: 1) generate "community" 3D surveys using the *Langseth*, the first academic 3D seismic vessel, 2) hire private companies to process 3D data to an initial interpretable volume within 6 months post-cruise, and 3) release 3D volumes for general use in follow-on, PI-driven interpretation projects. Our proposal follows this model, while being driven by MAT's enduring scientific goals.

Capitalize on the Fundamental Advantages of 3D Seismic Data

The power of 3D seismic volumes is their ability to elucidate both sedimentary processes and paleoenvironments, through assessments of "seismic geomorphology". Sedimentary basin fill is inherently 3D at all spatial scales. Traditional 2D surveys can document basin-scale (tens of km) three-dimensionality, but cannot differentiate km-scale (and less) morphologies, e.g., estuary complexes, shelf channels, upper slope canyons, etc., that are keys to defining shallow-water processes and paleoenvironments, which in turn can be used to determine shifting shoreline positions through time and hence constrain paleo-sea level changes. Individual profiles may image such features, but mapping them between profiles kilometers apart is possible only in a generalized fashion (see Fig. 4). Whereas commercial 3D data can meet academic research needs on some margins, such data are lacking off NJ.

A common misconception exists that 2D and 3D reflection data differ only in image presentation, i.e., that 2D surveying produces a cross section, while 3D surveying produces a volume. In truth, what can be extracted from 3D data far exceeds this conspicuous dimensional component. 2D images are also fundamentally hampered by "cylindrical ambiguity" and "viewpoint limitation". Cylindrical ambiguity means that 2D data lack information necessary to establish cross-profile positioning; there is no way to know true locations of reflections that "appear" to lie beneath the survey track, but which originate from somewhere to one (either) side of the profile plane. Viewpoint limitation means that only reflecting surfaces facing the profile plane can be imaged; all others, including those directly below with even modest cross-profile dips, remain invisible. Maximum reflector dips beneath the inner NJ shelf are small (<8°; Figs. 3, 4), so cross-profile mis-positioning of reflections is not as large as in geologic areas with more steeply dipping features. However, for the two-way travel time range of highest interest (0-0.8 s; Fig. 3), and the corresponding average velocity range (1.6-1.8 km/s), the expected maximum cross-profile mis-positioning of events on existing profiles is 35-100 m, which is as large or larger than incised valleys and related shoreline-related features we hope to observe. 3D acquisition and processing will virtually eliminate these problems.

Another challenge using 2D data for stratigraphic interpretations is caused by streamer cable side-drift/feathering (Renick, 1974; Levin, 1983). During 2D acquisition, cross-currents cause average feathering of ~10° (Yilmaz, 2001). As a result, 2D profiling becomes a limited-swath 3D survey to one side of profile track. Processing such marine survey data using standard 2D imaging procedures (as has been done to the present) creates spurious discontinuities/wipeouts in reflection events (Nedimovic et al., 2003). Currents offshore NJ vary in both strength and direction (Butman et al., 2003), so they must have caused 5-10° streamer feathering when existing 2D data were collected (Fig. 3); this is confirmed by records of visual sightings of tail buoys. Such feathering has detracted from reflection event continuity in all 2D profiles offshore NJ. Unfortunately, past feathering effects cannot be corrected because streamer navigation was not utilized during all of those 2D surveys.

Exploit the Unique Tools Associated with 3D Imaging

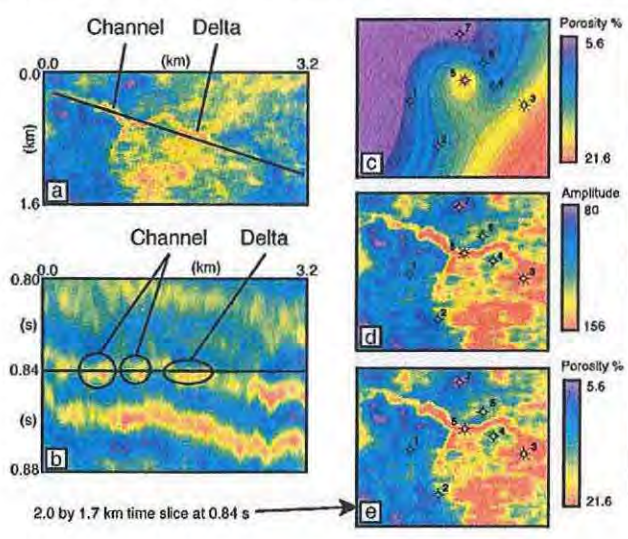

Figure 5. (a, b) Channel systems (from the Gulf of Mexico) in 2D and 3D and (c, d, e) integrating seismic and well data to extract porosity. a-b: While a map view (a) of an amplitude slice at 840 ms two-way travel-time provides a clear image of a channel and (associated) delta, little can be inferred about this system from a cross-sectional image (b) carefully chosen to cross the channel twice and the delta once. (c): Gridded porosity map at the reservoir level (840 ms, see a), based upon samples from 7 drilled holes. (d): Time slice at the same level as in (c). Note the level of detail of sratigraphic features. (e): Seismic-guided porosity map formed by integrating seismic and well data. If 3D seismic data had been collected before drilling, 5 dry holes (1, 2, 4, 6, 7) would not have been drilled. Figure adapted from Liner (1999).

The growing use of 3D seismic techniques has led to significant advances in stratigraphic studies. Small but important "process" features like incised channels, difficult to document using 2D data, stand out in maps derived using 3D data (Figs. 5, 6). However, stratigraphic interpretation benefits not only from a 3D view of the subsurface, but also from the ability to extract quantities called "seismic attributes" from 3D volumes. Both pre-stack and post-stack attributes will be needed from the proposed 3D volume to extract the maximum information for ongoing stratigraphic interpretations of the NJ margin.

Post-stack seismic attributes result from image manipulation (Liner, 1999; Fig. 5). For NJ, the most useful post-stack attributes are instantaneous amplitude, phase, frequency and Q (1/attenuation). When applied to 3D volumes, these attributes can be powerful indicators of lithologic variations, event continuity, fracturing and absorption. The most useful 2D attributes for delineating channels are coherency, edge detection, directional gradient (e.g., "curvature", Fig. 6) and shaded relief.

While 3D surveys provide more accurate and useful information than 2D seismic imaging (Fig. 5c-e), the most complete geologic information is extracted by combining 3D images with drilling/logging. Such a combined approach allows for detailed analysis of geometry, lithology, porosity, fluid saturation and anisotropy of buried sediments and associated depositional/erosional systems (e.g., complex fluvial channel systems; Fig. 6) and their geometric relationships with Neogene rollovers sampled by Exp313.

An excellent example of the value of 3D data is provided by ongoing research into the upper Oligocene-Recent clinoformal stratigraphy of the Northern Carnarvon Basin (NCB), Australian Northwest Shelf (NWS) (Liu et al., 2011; Sanchez et al., 2012a, b). Middle Miocene-Pliocene siliciclastic sediments represent a long-lived (~8 my) break in otherwise carbonate-dominated shelf sedimentation. Available commercial 3D volumes have enabled a profound new interpretation of these prograding siliciclastics as 27 shelf-/shelf-edge delta lobes (Fig. 7). Only through true 3D mapping has it been possible to correlate individual clinoform sets with these lobate, complex deltaic morphologies. Long-term (cumulative) progradation of this delta system and subsequent backstepping correlate with long-term sea-level fall and rise during the late middle-late Miocene. This observed siliciclastic influx correlates with other coeval increases in siliciclastic sediment supply worldwide, including offshore NJ and a prospective depocenter in the Gulf of Mexico (see text below).

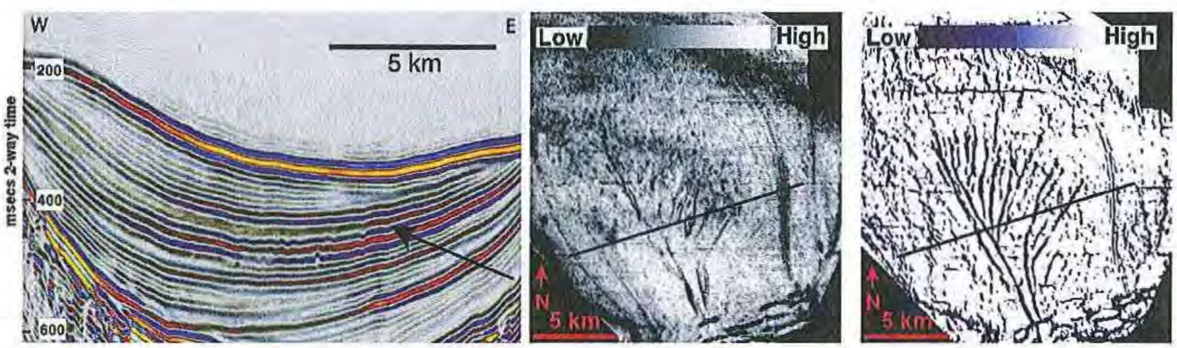

Figure 6. Visualization and interpretation of paleo-channels in 2D (left) and 3D (center, right) seismic data. Left: Strike-oriented 2D seismic reflection profile from the Gulf of Mexico showing subtle undulations in one imaged stratal horizon (indicated by the black arrow) which are produced by slope channels. However, this could not be confirmed using the 2D representation by itself. Center/right: Seismic attribute (travel-time) slices produced along the same horizon extracted from a conventional 3D volume, the center view showing "coherence" and the right view highlighting "most-negative curvature". Identifying complex channel features and tracking them spatially is straightforward using the 3D volume, but challenging if not impossible to achieve using 2D control alone, even if the 2D grid is dense, as is true for some of the grids on the NJ margin (Figs. 1, 4). From Lozano and Marfurt, 2008.

In addition, 3D mapping in the NCB has yielded important insights into the relationships between clinoformal sequence boundaries and sea-level change, particularly: 1) complex spatial acoustic evidence of karst topography (indicative of shelf exposure) along some horizons, and 2) step-like, vertical offsets up to 65 m high, downward toward the basin on the outer paleo-shelves (near rollovers) of two early-middle Miocene sequence boundaries. These have been interpreted as rarely preserved examples of wave-cut terraces or sea cliffs (Liu et al., 2011). All of these features represent direct evidence of paleo-sea level and shoreline location, which can only be interpreted with 3D data.

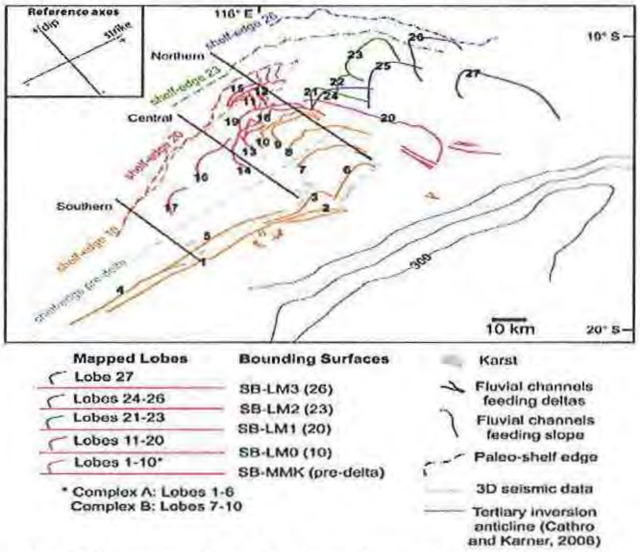

Figure 7. Delta lobes and positions of paleo-shelf edges at the ends of deltaic progradation pulses in the Northern Carnarvon Basin (NCB), Australian Northwest Shelf (NWS; Sanchez et al., 2012 a, b). The outline of each lobe corresponds to the rollover of the upper bounding unconformity of the mapped clino-form set representing that lobe. Interpreted fluvial channels within the siliciclastic interval are shown in colors correlative with their pre-sumed associated delta lobe. Interpreted karst features, indicative of paleo-shelf exposure (i.e., sea-level low stand), also underlie lobes 1-6. This interpretation of clinoform sets as a spatially complex set of prograding delta lobes was only possible through mapping within a 3D seismic volume (outline of the volume shown in the figure, thin grey line).

Tie 3D Volume to Exp 313 Results to Resolve Ambiguities of Neogene Stratigraphic Evolution

Seismic morphologies similar to those of the NWS, containing imprints of changing sea level and other factors that control shallow-water sedimentary processes, are present on the NJ margin (Fulthorpe and Austin, 1998; Nordfjord et al., 2005). The 3D MCS volume we propose to collect will focus on resolving the origin of such features critical to understanding the relationships between sea-level change and sequence development. In particular, we will focus on shallow-water features near and at paleo-shorelines: fluvial channels, point bars and estuary complexes (Nordfjord et al., 2005). MCS line 529 (Fig. 3) runs through the center of our proposed survey area and ties the three Exp313 sites. Below, we use that image to frame three working hypotheses that can be tested by combining a 3D volume with Exp313 results. These hypotheses/related goals agree with components of the Eastern North American Margin (ENAM) component of the GeoPRISMS Draft Implementation Plan (http://www.geoprisms.org/enam.html).

1) What are the spatial/temporal relationships between sea-level low stands and areas of paleo-shelf exposure adjacent to/landward of clinoform rollovers? Linked hypothesis: low stand paleo-shelf exposure has increased since the Oligocene, probably in response to increasing eustatic amplitudes (Fig. 2), resulting in an increasing number of fluvial incisions both up-section and seaward across the NJ margin.

Seismic sequences, when first defined, were classified according to the nature of their basal boundaries (Mitchum et al., 1977). While terminology has since been refined, a fundamental observation remains valid: some sequences begin with valleys cut into the top of the underlying sequence, while others have no such incisions, and begin instead with apparently conformable deposition onto beds of the preexisting shelf/uppermost slope. The former incised, "Type 1", sequence boundaries have been inferred to indicate a larger and/or more rapid fall in base-level than the latter, "Type 2", boundaries. Judging from existing 2D MCS data off NJ (Fig. 1), incised valleys appear to be scarce in paleo-shelf strata landward of rollovers, suggesting that Type 2 boundaries dominate the early Miocene within the proposed survey area (Fig. 3). Similarly, a lack of lobate low stand fans seaward of clinoform toes (Figs. 3, 4; see below) supports the hypothesis that Type 1 systems are minor to nonexistent in this lower Miocene section. Nonetheless, there is seismic evidence (at ~cdp 4000, between m5 and m4.5, Fig. 3) of a shelf-edge delta and erosional truncation of foresets, suggesting base level at m5 time was very close to, if not below, the elevation of adjacent topsets. In addition, landward of all Exp313 sites (Fig. 1), isolated incisions ~100 m wide and 5-10 m deep are observed seismically, but none can be connected with existing data coverage (Fig. 4;

Monteverde et al., 2008). Possible explanations include: 1) incised valleys are well-preserved/present, but existing 2D profiles do not cross them (unlikely); 2) such valleys were removed by ravinement during transgressions (possible, but unlikely due to the lack of core-based evidence for accompanying hiatuses between sequences in Exp313 samples); or 3) such valleys are present, but too small/widely spaced to be resolved by existing 2D coverage (very likely). This third possibility is supported by interpretations of dense, ultra-high resolution single-channel (2D/3D CHIRP geophysical profiles) of the NJ shelf 60 km to the southeast, which confirm that complex dendritic, incised fluvial systems formed during the latest Pleistocene (Davies et al., 1992; Duncan et al., 2001; Nordfjord et al., 2005). Incised valleys are crucial paleo-water depth indicators at sequence boundaries, independent of benthic foraminiferal successions. We are confident that if incised valleys exist within lower Miocene sediments around Exp313 sites, and seaward toward correlative rollovers, they will be detected using 3D images along with related morphologic enhancement techniques (Figs. 5, 6). Mapping these incisions will constrain shoreline positions through time, improve estimates of eustatic amplitudes, and enable sequence architecture/seismic geomorphologic techniques to predict facies distributions calibrated by Exp313.

While pre-middle Miocene shelf exposure near Exp313 sites is difficult to detect with existing 2D data, this is not true of younger intervals sampled by Exp313 above reflector m4.1 (Fig. 3). Spot coring at irregular surfaces corresponding to sequence boundaries m1, m3 and m4 at sites M27 and M29 recovered shallow water sands, and in several cases ~1 m of paleosol (Mountain, Proust, McInroy, et al., 2010). These surfaces can be traced seismically to clinoforms on the mid-shelf 25 km seaward of M29, but the proposed 3D imaging will not extend seaward to those younger clinoforms. Nonetheless, several hundred meters of largely discontinuous reflectors above m4.1 (Fig. 3) are virtually certain to be resolved with 3D techniques to a degree rarely seen, providing seismic expression of nearshore and coastal plain facies tied to Exp313 cores and logs.

Using the proposed 3D volume, seismic evidence for paleo-shelf exposures and proximity of fluvial sources to paleo-shelf edges/rollovers can be mapped, along with shelf/uppermost slope delta architecture (if it exists; Fig. 7), within any of the eight sequences constrained by Exp 313 results (Fig. 3). Community-based efforts can then document any enhanced fluvial contributions to observed clinoform progradation during a known time interval of long-term eustatic fall and increasing glacioeustatic amplitudes. Seismic attribute analyses, e.g., coherence displays (Fig. 6, center), offer exciting opportunities to locate/map incised valleys/canyons at sequence boundaries, to calibrate sand distribution in shallow shelf intervals/topsets, clinoform front/toe and basinal settings, and to investigate facies-dependent bedding characteristics calibrated by Exp 313. The higher fold and improved source to be used for the proposed 3D survey (see below) will also provide enhanced multiple suppression and thereby produce sharper definition of sequence boundaries (e.g., Fig. 4), a task that is especially challenging along the mid-Atlantic shelf because of highly reflective and parallel layering of interbedded muds and sands in the Neogene section (e.g., Austin, Christie-Blick et al., 1998)

2) What are the mechanisms of sediment transport seaward of clinoform rollovers, and how do they fit into the sequence stratigraphic model? Linked hypothesis: During shelf progradation, the evolution of clinoform front morphology is a complex response to changes in gradient, sediment source geometry (point- vs. line-source), and basinward redeposition by sediment gravity flows/turbidity currents.

Despite the lack of seismic evidence for inner-shelf incisions along the tops of Oligocene-middle Miocene sequences (Fig. 4), mass-transport deposits on slopes were encountered by Exp313 (Fig. 8). The classic model of siliciclastic sequence development includes submarine fans seaward of clinoform toes (Van Wagoner et al., 1988; Posamentier and Vail, 1988), presumed to represent sediment by-pass/basinward transport of mostly coarse-grained material during times of rapid sea-level fall. However, there is little evidence of such lobate depocenters in Oligocene-Miocene sections beneath the NJ shelf (Figs. 3, 4; Greenlee et al., 1992; Poulsen et al., 1998). In their place beneath the inner shelf there are well-defined deposits less than a few km seaward of rollovers that accumulated as units 10's-100's of m thick on ~2° clinoform slope gradients (Fig. 3). All pinch out landward and thin seaward, where most become seismically indistinguishable from underlying strong reflectors at slope toes. Each extends for 10's of km along-strike. These sediments have been termed "slope apron deposits"; Exp313 results have shown that they comprise glauconitic sands and mature quartz grains up to gravel size, all presumably shed from edges of adjacent clinoform tops (Fig. 8). The Exp313 team is using both litho- and seismic stratigraphic features of several of these deposits where they occur within a single sequence. The goal is to identify criteria that divide them into separate depositional units, but because they represent rapidly deposited, reworked material, such subdivisions will be difficult or impossible to establish with the existing 2D data. We will also be able to determine how slope apron deposition relates to timing of eustatic change(s), a goal at the heart of understanding clinoform evolution. A 3D volume is required to do this work.

In addition to resolving internal structures of slope aprons, the 3D volume will also detect failure scars/transport lanes that directed mass flows basinward (Fig. 8). The volume will also document spatial/temporal connections to shelf-crossing incised valleys immediately landward of rollovers. One important objective is to determine the degree to which observed incised features served as conduits for sediment originating landward of the rollover, as opposed to more local slope redistributions, such as headward erosion, gravitational creep, slumping and/or debris flow mechanisms, all of which originated seaward of rollovers. Ties between continuously sampled cores and 3D images make this possible.

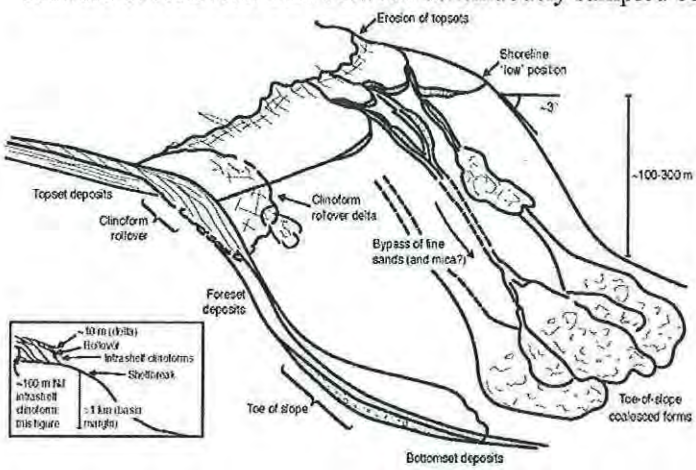

Figure 8. Conceptual model developed during Exp313 to explain regular occurrences of poorly sorted, stratified, glauconite-rich coarse sand/gravels in cores taken near the tops of clinoform slopes. Multiple channels and/or regressive shorefaces at clinoform rollovers are presumed to erode into/entrain older topset deposits. These sediments are remobilized and transported down the clinoform slope as debris flows and turbidity currents to form aprons close to the toe of slope (Mountain, Proust, McInroy et al., 2010). The 3D volume will vastly improve images of clinoform rollovers, where these sediment movements take place in response to base-level changes.

Research on sediment transport pathways using 2D data has been unable to provide definitive models of shelf/slope/basin connectivity on this or any continental margin. In the sequence stratigraphic model, fans and laterally extensive onlap depend on stable point sources of sediment (e.g., Karner and Driscoll, 1997). But even middle-late Miocene sequence boundaries that display evidence of paleo-shelf exposure are not associated with lobate lowstand accumulations basinward of clinoform toes, based on available 2D profiles (e.g., Fulthorpe et al., 2000). Perhaps such deposits were instead transported farther basinward to the continental rise and/or laterally along the margin, as probably occurred in the Miocene on Australia's NWS (Cathro et al., 2003). Lowstand fans are also absent in paleo-shelf settings of the Canterbury Basin, New Zealand, where influences of along-strike currents are unequivocal (Lu et al., 2003; Lu and Fulthorpe, 2004). Morphologic elements of paleo-slope incisions, i.e., canyons and rills, on the mid-Atlantic and other margins remain unclear with available (2D) seismic control. Pleistocene and modern canyons are large (up to 300 m deep and 2-5 km wide), closely spaced (2-10 km), and the Hudson and Delaware canyons off the east coast of the U.S. are clearly linked to river systems that have retreated westward during the Holocene sea-level rise. In contrast, middle-late Miocene canyons are both less deeply incised and less common and do not appear to be directly linked to paleo-shelf incisions, suggesting that they are not directly related to fluvial sources (Fulthorpe et al., 1999; Fulthorpe et al., 2000). Fulthorpe et al. (1999) have advanced the hypothesis that observed paleo-shelf-edge linearity results from along-strike sediment transport by waves and currents, which mutes the influence of individual fluvial point sources to form a line-source of sediment delivery to clinoform fronts (see also Fulthorpe and Austin, 2008). Individual fluvial sources apparently did not deliver sufficient sediment to overcome along-strike forcing to produce lobate depocenters (see Fig. 7), even though some fluvial incisions appear similar in width and depth to the Pleistocene Hudson and Delaware shelf channels (Fulthorpe et al., 1999). Shelf and slope incisions cannot be observed on the NCB/NWS, despite 3D imaging (Fig. 7). A lack of prominent point sources on the Miocene NJ margin (Fulthorpe et al., 1999; Pekar et al., 2003) may account for differences between NJ sequences and the standard sequence model (e.g., presence of slope aprons and absence of lobate fans). However, none of these inferences can be confirmed using only the available 2D seismic control. The only way that process-based links between sediment sources and observed/sampled NJ Oligocene-Miocene clinoforms can be established, and their relationship to sea-level cycles defined, is by 3D imaging encompassing Exp313 sites (Figs. 3-4).

Similarly, canyons cut into clinoform slopes do not appear to be linked to those incising more gently dipping surfaces basinward of clinoform toes, suggesting that different submarine erosional processes may be associated with observed changes in gradient. This may result from different "regime variables" controlling sedimentation patterns (Swift and Thorne, 1991; Fulthorpe et al., 2000). Along the modern shelf edge offshore NJ, incisions up to 140 m deep can occur even on low gradients basinward of clinoform toes, most likely due to fluid escape processes (Dugan and Flemings, 2000). 3D imaging along clinoform slopes in this project can test for this process of slope failure in the early - mid-Miocene.

3) What was the sedimentary process response to the global mid-Miocene climatic (and tectonic) transition? Linked hypothesis: Changes in the rate of sediment input to the NJ margin during the mid-Miocene, as evidenced by mapping clinoforms bracketed by sequence boundaries, are linked to globally significant changes in the relative intensity of margin erosion.

Many continental margins reveal mid-Miocene influxes of siliciclastic sediments (Molnar, 2004). In addition to NJ (Poag and Sevon, 1989; Pazzaglia and Brandon, 1996; Steckler et al., 1999), other well-constrained examples of this pattern include the Gulf of Mexico (Galloway et al., 2000; Galloway, 2008), Canterbury Basin (Lu et al., 2005), NCB (Cathro et al., 2003; Sanchez et al., 2012a, b), the Angola margin (Lavier et al., 2001), and the Maltese Islands margin (John et al., 2003). Age estimates for this influx range from 15-12 Ma. The NCB case (Fig. 7) is striking, because the observed siliciclastic increase occurred at a preexisting carbonate margin. In the Canterbury Basin, the mid-Miocene sediment increase is not linked to known tectonism in the proximal Southern Alps; the only notable increase in sedimentation rate that coincides with tectonism is much later, during a well-defined period of increasing convergence rates at the Alpine Fault (Lu et al., 2005). This global pattern of mid-Miocene sediment influxes has been linked to global cooling following the mid-Miocene $\delta^{18}O$ peak. One possible mechanism is that the post - mid-Miocene global sea-level fall may have led to increased shelf erosion everywhere. However, reconstructed paleobathymetric profiles on the NJ margin suggest that the amount of sediment required for the observed progradation, estimated as a 20-fold increase in flux, exceeds that available from paleo-shelf erosion alone (Steckler et al., 1999). Other proposed mechanisms include changes in precipitation and in the amplitude/frequency of late Cenozoic climate change (Molnar, 2001; 2004).

However, climate may not have been the only driver of mid-Miocene sediment influx. Tectonic uplift of the hinterland may also have contributed (Poag and Sevon, 1989; Pazzaglia and Brandon, 1996). Potter and Szatmari (2009) have united climatic and tectonic mechanisms for Miocene sedimentation by hypothesizing a global increase in middle-late Miocene tectonic activity driven by accelerated upwelling at two "superplumes" below the Pacific and Africa plates, which may also have produced far-field uplift of passive margins such as NJ. In their scenario, tectonic activity drove the coeval climatic transitions, through opening/closing key gateways and changing the oceanic circulation to trigger global cooling. The same Appalachian uplift that provided sediment to NJ has also been proposed as the origin of voluminous mid-Miocene sediments in the deep Gulf of Mexico (Jackson et al, 2011). These sediments were delivered by the paleo-Tennessee River, which discharged into the northeastern Gulf prior to its capture by the Mississippi (Galloway et al., 2000; Galloway, 2008). In spite of the large volumes of sandy sediment delivered to the Gulf basin, coeval updip slope canyons have not been identified, in marked contrast to the Pleistocene depositional episode (Galloway et al., 2000; Galloway, 2008). These Gulf of Mexico Miocene sediments are now targets of intensive hydrocarbon exploration, so understanding processes of middle Miocene sediment delivery from shelf to basin is economically as well as academically important.

The middle-late Miocene was a critical period in which climatic/tectonic processes combined to influence sedimentation globally. One of the long-term goals off NJ is to evaluate sedimentary response to these Miocene changes that influenced hinterland capability to provide sediment to the margin. Our proposed 3D survey will target initiation of the mid-Miocene sediment influx by imaging the transition between steep, slowly prograding Oligocene to mid-Miocene clinoforms drilled during Exp313 (Fig. 3), to more gently dipping, but more rapidly progradating features deposited later in the Miocene. Seismic geomorphology derived using the 3D volume will allow us to map temporal changes in shelf channel geometrical parameters (e.g., width, depth, sinuosity, gradient) to deduce changing sediment transport capacities from the hinterland through time, while slope morphologies, including the presence/absence of incised valley/canyons, will provide insights into processes involved in sediment bypassing to deep water (Fig. 8). In addition, correlation with the well-dated mid-Miocene sequences in the Gulf of Mexico, sourced from the same hinterland, will enable the timing of the influx in each basin to be compared.

WORK PLAN

Early-middle Miocene sequences clearly vary along-strike (Fig. 4), but a 3D volume long enough (perhaps ~100 km) to image all mapped variability is cost prohibitive. Instead, we propose to collect a 50 (dip) x 12 (strike) km volume encompassing all Exp 313 sites (Fig. 1), which has sampled ~12 sequences (Fig. 3). Some will be imaged along depocenter axes, others along peripheries, so we should image the full suite of potential shelf/slope, process-related seismic geomorphologies. Only one boundary (m5.6) will be missed. Fig. 3 shows that the volume proposed will image at least eight Miocene clinoform rollovers; these paleo-shelf edges record primary depositional processes associated with base-level change.

We have prepared a 2-year budget for acquisition/initial commercial processing of the volume (Fig.1). The data will be acquired on *Langseth*; processing will be done by a commercial company to pre-stack time-migrated (PSTM) shot gathers and 3D image volume (see quote in "Other Supplementary Documents"). The 12 km survey width optimizes turn efficiency and allows full data acquisition to be completed in two 6-km wide 'racetracks'. The 50 km dip-length enables imaging of early Miocene topsets landward of Site M27 to middle Miocene toe-of-clinoform morphologies basinward of Site M29 (Fig. 3).

We will focus on imaging the upper 1 s two-way travel time; we expect to achieve vertical resolution of 5 m or better and horizontal resolution of 15 m or better. We will record with 1 ms sampling to a travel-time depth of 4 s to image diffractions necessary for proper migration. These constraints dictate a shallow, high frequency source array and a recording design that minimizes spatial aliasing. We expect in-line dips to be <4°, and cross-line dips to be <8°, the latter along inward-facing walls of incised valleys. To reduce aliasing of diffractions that will arise from lateral discontinuities and pinchouts, we plan to collect data with a nominal bin size of 6.25 m in-line and 18.75 m cross-line. *Langseth* will tow four 3-km streamers spaced 75 m apart to provide the necessary range of source-receiver offsets required for complete imaging to a maximum estimated target depth of 5-6 km.

We estimate cruise duration based on industry acquisition standards (e.g., 30% downtime and infill) prior *Langseth* 3D projects, consultations with R. Steinhaus, Chief Sci. Officer on *Langseth*, and use of industry acquisition planning software. We anticipate leaving from/returning to Newark, NJ, a ~80 nmi transit to/from the survey area (Fig. 1). Setup/deployment/streamer ballasting should take 3 days; gear retrieval and transit at the end will be 1 day. *Langseth* will use two flip-flopping gun arrays designed for high-resolution surveying, resulting in eight CMP lines spaced at 18.75 m for each sail line. The 12 km-wide area will be covered with 80 sail lines. Total shiptime dock-to-dock is 34 days.

Data acquisition will result in 5 terabytes of field data. PGS (see quote in "Other Supplementary Documents") has responded with a detailed work plan at a competitive cost. Their approach comprises 27 processing steps leading to various 3D PSTM shot gathers and data volumes; these will provide the community with interpretable reflection results and material for follow-on data analysis proposals. The data will be processed at 2 ms sampling rate unless the records show signal above 250 Hz, in which case the processing will proceed at 1 ms. Estimated data processing time is 5 mo. Two 1-week visits to the PGS facility by two co-PIs are budgeted to participate in and oversee the data preparation. Following a post-cruise workshop for the interested community of users (see UTIG Budget and Justification), we will upload delivered results to UTIG's Academic Science Portal of the Marine Geoscience Data System, and will also upload raw data/navigation to LDEO's Seismic Reflection Data Management System.

This is a collaborative effort between PIs with decades of experience collecting, processing and analyzing marine seismic data along continental margins, and in particular NJ. M. Nedimovic (MN) has recently completed a successful 2-month cruise as a Co-PI aboard *Langseth* collecting multi-streamer 2D data. His experience planning and executing that campaign (that included 6 volunteer watch-standers onboard to gain scientific experience) is valuable for the proposed project. Post-cruise, MN will provide primary oversight of the commercial processing; he will make two 5-day trips to the processing facility in Houston. He will be joined on both trips by a second Co-PI. G.Mountain (GM) has participated in every 2D MCS acquisition survey comprising the MAT. In his role as Exp313 Co-Chief, GM is in touch with Expedition-based research that will both augment and benefit from results of the proposed 3D volume. GM, MN and N. Christie-Blick (NCB) are professors at their respective institutions with years of teaching experience that can be applied to educational aspects of pre- and post-cruise workshops and the at-sea experience of volunteer watch-standers. NCB brings lengthy experience in applying sequence stratigraphic principles at the outcrop scale, which tied to the Exp313 wells is what the proposed 3D imagery will closely rival. J. Austin (JA) and C. Fulthorpe (CF) bring decades of experience in using both 2D and 3D MCS and ultra high-resolution acoustic tools (CHIRP, boomer, swath bathymetry) to the study of sediment transport on passive margins. With ONR support, they have studied the latest Pleistocene-Holocene stratigraphic succession of the NJ shelf for 25 yrs. Furthermore, both have analyzed 3D data volumes on the NW Australian continental margin, and both have been ODP/IODP Co-Chiefs in continental shelf drilling efforts (JA: Leg 174A, CF: Exp317). All co-PIs will help run shorebased workshops pre- and post-data acquisition, and 4 will sail aboard *Langseth* and participate in the instruction of volunteer watch-standers in the theory and practice of seismic acquisition, processing and interpretation. In addition to their instructional duties, GM, JA and CF will stand 8-hr watches each day at sea; MN will oversee data QC and be on-call to troubleshoot acquisition-related problems.

The 3D, pre-stack time migrated data volume will be delivered from the processing company to JA and CF, to be loaded onto a 3D visualization workstation. The co-PIs will convene a data appraisal, first-look interpretation workshop at UTIG for the interested scientific community shortly thereafter. Research themes identified will initiate sub-groups to focus on developing important research goals. Workshop products are TBD, but the intent is clear: 1) to debut the 3D data to interested researchers, 2) to task those present with developing strategies for achieving realistic goals using the 3D volume, and 3) to rapidly link a wide community of potential researchers to the 3D data by making it publically available at the close of the workshop (see the "Data Management Plan").

INTELLECTUAL MERIT

The NJ margin is among the best siliciclastic passive margins for elucidating the timing/amplitude of eustatic change over millions of years, and for examining quantitatively the link between sea-level change and the stratigraphic record. Consequently, this margin has been a key location in all long-range plans of scientific ocean drilling since it was first identified by COSOD II (1987). While Exp313 continuously cored/logged boreholes within shallow-water facies, and has recovered complete stratigraphic information, 3D seismic imaging is needed to put that sampled record in a spatially accurate, stratigraphically meaningful context. The 29 researchers of the Exp313 scientific party are an especially valuable knowledge base of the mid-Cenozoic evolution of the NJ shelf; they and other scientists involved in research of the MAT represent a large body of experts for whom the proposed seismic geomorphology will be a tremendous asset. 3D imagery will allow them to map sequences around Exp313 sites, including shoreline positions and flanking diagnostic shallow-water features (e.g., fluvial incisions, estuary complexes, point bars). The long-term objectives remain to: 1) determine the amplitude and timing of global sea-level changes during the "Ice House" 2) establish the impact of base-level changes on the preserved stratigraphic record; and 3) improve understanding of the response of shorelines/nearshore environments to changes in global sea level, a societally relevant topic today.

BROADER IMPACTS

The team of co-PIs envisions 3 phases of robust interaction with the user community before, during and after 3D acquisition aboard *Langseth*: 1) A pre-acquisition workshop to acquaint interested participants with the project (an announcement of opportunity was placed [May 2012; see 'Other Suppl. Docs.'] on the GeoPRISMS and Consortium for Ocean Leadership [COL] websites; additional announcements will follow funding) will be held at Rutgers prior to data acquisition. The scientific value of 3D data will be displayed, the history of research on the NJ margin will be highlighted, and plans for data acquisition will be laid out. Discussions will aim at reaching a consensus concerning acquisition details and processing features of the community data volume by a commercial company. 2) Community interaction during acquisition will be primarily the hands-on participation of students/young scientists aboard *Langseth* (~12 bunks are available for volunteers [see 'Mentoring Plan']). The survey area is <40 nmi from Atlantic City, so rotation of more than one group is possible by at-sea transfer, enabling a variety of education/outreach activities with perhaps occasional live satellite feeds showing the deployment/recovery of seismic gear, etc. 3) A post-acquisition workshop at UTIG will focus on avenues for community analysis/interpretation of the processed 3D volume, once that volume is available ~5 mo post-acquisition.

The Rutgers Geology Museum has previously hosted exhibits of scientific drilling in the Coastal Plain, focusing on the K/Pg boundary core obtained at Bass River, NJ (ODP Leg 174AX; Olsson et al., 1997). We will prepare similar exhibits/talks to highlight the integration of 3D seismic with drilling. We expect that 3D images will become integral to IODP outreach, along with Exp313 results. We will showcase NJ margin results for the European Union (which funded Exp313 drilling/logging costs through IODP), for ICDP (which funded some drilling costs), the COL (responsible for logging/data management) and IODP-MI (which managed Exp313). We will provide the IODP Data Bank, and, if asked, the ECORD/ESO Drilling Operator, with 3D image data. LDEO/UTIG have an ongoing collaboration through NSF to archive marine seismic data. We will make the commercially processed 3D data available to this facility, with the expectation that they will become an enduring demonstration of how 3D imaging can improve understanding of passive margin stratigraphic evolution.

A final note about societal relevance. The proposed 3D volume, tied to cored and logged drillsites, will provide a valuable opportunity to understand better the causes of an increase in mid-Neogene deposition at many passive margins around the globe (e.g., Bartek et al., 1991.). The same Appalachian hinterland that was the source of the sedimentary record offshore NJ, and concentrated on by the MAT, fed a similar pulse of sediments into the Gulf of Mexico. Consequently, increasing knowledge of the evolution of the NJ shelf may help to improve exploration strategies in the Gulf, a proven hydrocarbon province.

RESULTS FROM PRIOR NSF SUPPORT

Gregory Mountain and **Nicholas Christie-Blick** have not received NSF support in the past 5 years.
Mladen Nedimović (w/ PIs from LDEO, WHOI + SIO; only LDEO support listed): OCE-0648303, *Collab. Res.: Seismic structure + evolu-tion of oceanic crust along the Juan de Fuca Ridge + its Flanks*, 04/01/07-03/31/10, $173,519. Resulted in 3 PhD chapters, 15 AGU abstracts, 11 peer-reviewed papers (4 in G^3, 2 in *Nature*, 2 in *EPSL*, 2 in *JGR*, and 1 in *Geology*).
Craig Fulthorpe and **James Austin**, OCE 0550004 (PIs Fulthorpe, Austin, Lavier [UTIG]), *The NW Shelf, Australia: the next step in a global approach to understanding the role of eustasy in the generation and preservation of stratigraphy*, $464,278; 2/1/06-1/31/09 + 2 no-cost extensions to 1/31/11. Commercially donated 3D+2D MCS, logs and well-completion reports were used to investigate stratal architecture of a siliciclastic-rich interval of the N. Carnarvon Basin, where late mid-Miocene siliciclastics prograded across a Paleogene carbonate ramp under wave-dominated conditions during a time of base-level fall. Thus far resulted in (Liu et al., 2011; Sanchez et al., 2012a, 2012b; 1 Ph.D. (Sanchez); aid for C. Liu to visit UTIG from China to collaborate, 2008-2010.

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SUMMARY PROPOSAL BUDGET

YEAR 1

FOR NSF USE ONLY			
PROPOSAL NO.	DURATION (months)		
	Proposed	Granted	
AWARD NO.			

ORGANIZATION
Rutgers University New Brunswick

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Gregory Mountain

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Gregory S Mountain - Professor**	(b) (4), (b) (6) [redacted]				
2.					
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)					
7. (**1**) TOTAL SENIOR PERSONNEL (1 - 6)					
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS					
2. (**0**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)					
3. (**0**) GRADUATE STUDENTS					
4. (**0**) UNDERGRADUATE STUDENTS					
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)					
6. (**0**) OTHER					
TOTAL SALARIES AND WAGES (A + B)					
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)					
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)					
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				(b) (4) [redacted]	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)					
2. FOREIGN					
F. PARTICIPANT SUPPORT COSTS (b) (4) [redacted]					
1. STIPENDS $					
2. TRAVEL					
3. SUBSISTENCE					
4. OTHER					
TOTAL NUMBER OF PARTICIPANT TOTAL PARTICIPANT COSTS				(b) (4) [redacted]	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES					
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION					
3. CONSULTANT SERVICES					
4. COMPUTER SERVICES					
5. SUBAWARDS					
6. OTHER					
TOTAL OTHER DIRECT COSTS					
H. TOTAL DIRECT COSTS (A THROUGH G)					
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) (b) (4) [redacted]					
TOTAL INDIRECT COSTS (F&A)				(b) (4) [redacted]	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)					
K. RESIDUAL FUNDS					
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**787,551**	

M. COST SHARING PROPOSED LEVEL $ **Not Shown** AGREED LEVEL IF DIFFERENT $

PI/PD NAME
Gregory Mountain

ORG. REP. NAME*
Emmeline Crowley

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

1 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

SUMMARY PROPOSAL BUDGET

YEAR 2

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
Rutgers University New Brunswick

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Gregory Mountain

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Gregory S Mountain - Professor**	0.00	0.00	0.00	**0**	
2.					
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**1**) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	0.00	0.00	**0**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**0**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	0.00	0.00	0.00	**0**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**0**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**0**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**0**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				(b) (4) [redacted]	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)					
2. FOREIGN					
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				(b) (4) [redacted]	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION					
3. CONSULTANT SERVICES					
4. COMPUTER SERVICES					
5. SUBAWARDS					
6. OTHER					
TOTAL OTHER DIRECT COSTS					
H. TOTAL DIRECT COSTS (A THROUGH G)					
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) (b) (4) [redacted]					
TOTAL INDIRECT COSTS (F&A)				(b) (4) [redacted]	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)					
K. RESIDUAL FUNDS					
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**2,268**	
M. COST SHARING PROPOSED LEVEL $ **Not Shown**	AGREED LEVEL IF DIFFERENT $				

PI/PD NAME
Gregory Mountain

ORG. REP. NAME*
Emmeline Crowley

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

2 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

1260237

SUMMARY PROPOSAL BUDGET

Cumulative

ORGANIZATION **Rutgers University New Brunswick**	**FOR NSF USE ONLY** PROPOSAL NO.	DURATION (months) Proposed | Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR **Gregory Mountain**	AWARD NO.	

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Gregory S Mountain - Professor**	(b) (4), (b) (6) [redacted]				
2.					
3.					
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)					
7. (**1**) TOTAL SENIOR PERSONNEL (1 - 6)					
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS					
2. (**0**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)					
3. (**0**) GRADUATE STUDENTS					
4. (**0**) UNDERGRADUATE STUDENTS					
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)					
6. (**0**) OTHER					
TOTAL SALARIES AND WAGES (A + B)					
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)					
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)					
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				(b) (4) [redacted]	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)					
2. FOREIGN					
F. PARTICIPANT SUPPORT COSTS 1. STIPENDS $ (b) (4) [redacted] 2. TRAVEL 3. SUBSISTENCE 4. OTHER					
TOTAL NUMBER OF PARTICIPANT — TOTAL PARTICIPANT COSTS				(b) (4) [redacted]	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				(b) (4) [redacted]	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION					
3. CONSULTANT SERVICES					
4. COMPUTER SERVICES					
5. SUBAWARDS					
6. OTHER					
TOTAL OTHER DIRECT COSTS					
H. TOTAL DIRECT COSTS (A THROUGH G)					
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				(b) (4) [redacted]	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)					
K. RESIDUAL FUNDS					
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**789,819**	

M. COST SHARING PROPOSED LEVEL $ **Not Shown** AGREED LEVEL IF DIFFERENT $

PI/PD NAME **Gregory Mountain**	**FOR NSF USE ONLY** INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME* **Emmeline Crowley**	Date Checked	Date Of Rate Sheet	Initials - ORG

C *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

RUTGERS BUDGET JUSTIFICATION

(b) (4), (b) (6)

[redacted]

(b) (4), (b) (6)

[redacted]

BUDGET SUMMARY

Collaborative Research: Community-Based 3D Imaging that Ties Clinoform Geometry to Facies Successions and Neogene Sea-Level Change

Rutgers University

(b) (4), (b) (6)

[redacted]

J. Total Costs	**$787,551**	**$2,268**	**$789,819**

SUMMARY PROPOSAL BUDGET

YEAR 1

ORGANIZATION	FOR NSF USE ONLY		
University of Texas at Austin	PROPOSAL NO.	DURATION (months)	
		Proposed	Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR	AWARD NO.		
Craig S Fulthorpe			

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months	Funds Requested By proposer	Funds granted by NSF (if different)
1. Craig S Fulthorpe - Sr. Research Scientist	(b) (4), (b) (6) [redacted]		
2. James A Austin, Jr. - Sr. Research Scientist			
3.			
4.			
5.			
6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)			
7. (2) TOTAL SENIOR PERSONNEL (1 - 6)			
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)			
1. (0) POST DOCTORAL SCHOLARS			
2. (1) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)			
3. (0) GRADUATE STUDENTS			
4. (0) UNDERGRADUATE STUDENTS			
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)			
6. (0) OTHER			
TOTAL SALARIES AND WAGES (A + B)			
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)			
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)			
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEED[redacted]			
TOTAL EQUIPMENT		(b) (4) [redacted]	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)			
2. FOREIGN			
F. PARTICIPANT SUPPORT COSTS			
1. STIPENDS $ 0			
2. TRAVEL 0			
3. SUBSISTENCE 0			
4. OTHER 0			
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS		0	
G. OTHER DIRECT COSTS			
1. MATERIALS AND SUPPLIES		(b) (4) [redacted]	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION			
3. CONSULTANT SERVICES			
4. COMPUTER SERVICES			
5. SUBAWARDS			
6. OTHER			
TOTAL OTHER DIRECT COSTS			
H. TOTAL DIRECT COSTS (A THROUGH G)			
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)			
(b) (4) [redacted]			
TOTAL INDIRECT COSTS (F&A)		(b) (4) [redacted]	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)			
K. RESIDUAL FUNDS			
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)		79,603	
M. COST SHARING PROPOSED LEVEL $ Not Shown	AGREED LEVEL IF DIFFERENT $		

PI/PD NAME	FOR NSF USE ONLY		
Craig S Fulthorpe	INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME*	Date Checked	Date Of Rate Sheet	Initials - ORG
Barbara Reyes			

1 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

SUMMARY PROPOSAL BUDGET

YEAR 2

ORGANIZATION **University of Texas at Austin**	**FOR NSF USE ONLY** PROPOSAL NO.	DURATION (months) Proposed | Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR **Craig S Fulthorpe**	AWARD NO.	

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Craig S Fulthorpe - Sr. Research Scientist**	(b) (4) [redacted]				
2. **James A Austin, Jr. - Sr. Research Scientist**					
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE					
7. (**2**) TOTAL SENIOR PERSONNEL (1 - 6)					
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS					
2. (**2**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)					
3. (**0**) GRADUATE STUDENTS					
4. (**0**) UNDERGRADUATE STUDENTS					
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)					
6. (**0**) OTHER					
TOTAL SALARIES AND WAGES (A + B)					
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)					
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)					
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				(b) (4) [redacted]	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)					
2. FOREIGN					
F. PARTICIPANT SUPPORT COSTS (b) (4) [redacted] 1. STIPENDS $ 2. TRAVEL 3. SUBSISTENCE 4. OTHER					
TOTAL NUMBER OF PARTICIPANT TOTAL PARTICIPANT COSTS				(b) (4) [redacted]	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				(b) (4) [redacted]	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION					
3. CONSULTANT SERVICES					
4. COMPUTER SERVICES					
5. SUBAWARDS					
6. OTHER					
TOTAL OTHER DIRECT COSTS					
H. TOTAL DIRECT COSTS (A THROUGH G)					
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) (b) (4) [redacted]					
TOTAL INDIRECT COSTS (F&A)				(b) (4) [redacted]	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)					
K. RESIDUAL FUNDS					
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**114,828**	

M. COST SHARING PROPOSED LEVEL $ **Not Shown** AGREED LEVEL IF DIFFERENT $

PI/PD NAME **Craig S Fulthorpe**	**FOR NSF USE ONLY** INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME* **Barbara Reyes**	Date Checked	Date Of Rate Sheet	Initials - ORG

2 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

SUMMARY PROPOSAL BUDGET

Cumulative

ORGANIZATION **University of Texas at Austin**	FOR NSF USE ONLY PROPOSAL NO. / DURATION (months): Proposed / Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR **Craig S Fulthorpe**	AWARD NO.

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Craig S Fulthorpe - Sr. Research Scientist**	(b) (4), (b) (6) [redacted]				
2. **James A Austin, Jr. - Sr. Research Scientist**					
3.					
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)					
7. (**2**) TOTAL SENIOR PERSONNEL (1 - 6)					
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS					
2. (**3**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)					
3. (**0**) GRADUATE STUDENTS					
4. (**0**) UNDERGRADUATE STUDENTS					
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)					
6. (**0**) OTHER					
TOTAL SALARIES AND WAGES (A + B)					
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)					
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)					
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				(b) (4) [redacted]	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)					
2. FOREIGN					
F. PARTICIPANT SUPPORT COSTS 1. STIPENDS $ (b) (4) [redacted] 2. TRAVEL 3. SUBSISTENCE 4. OTHER					
TOTAL NUMBER OF PARTICIPANT — TOTAL PARTICIPANT COSTS				(b) (4) [redacted]	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				(b) (4) [redacted]	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION					
3. CONSULTANT SERVICES					
4. COMPUTER SERVICES					
5. SUBAWARDS					
6. OTHER					
TOTAL OTHER DIRECT COSTS					
H. TOTAL DIRECT COSTS (A THROUGH G)					
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				(b) (4) [redacted]	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)					
K. RESIDUAL FUNDS					
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**194,431**	

M. COST SHARING PROPOSED LEVEL $ **Not Shown** AGREED LEVEL IF DIFFERENT $

PI/PD NAME **Craig S Fulthorpe**	FOR NSF USE ONLY INDIRECT COST RATE VERIFICATION
ORG. REP. NAME* **Barbara Reyes**	Date Checked / Date Of Rate Sheet / Initials - ORG

C *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

BUDGET SUMMARY

Collaborative Research: Community-Based 3D Imaging that Ties Clinoform Geometry to Facies Successions and Neogene Sea-Level Change

The University of Texas at Austin

May 1, 2013 - April 30, 2015

(b) (4), (b) (6)

[redacted]

BUDGET JUSTIFICATION

Collaborative Research: Community-Based 3D Imaging that Ties Clinoform Geometry to Facies Successions and Neogene Sea-Level Change

The University of Texas at Austin Institute for Geophysics (UTIG)

May 1, 2013 - April 30, 2015

(b) (4), (b) (6)

[redacted]

(b) (4), (b) (6)

[redacted]

SUMMARY PROPOSAL BUDGET

YEAR 1

	FOR NSF USE ONLY		
ORGANIZATION **Columbia University**	PROPOSAL NO.	DURATION (months)	
		Proposed	Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR **Nicholas Christie-Blick**	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Nicholas Christie-Blick - Professor**	(b) (4), (b) (6) [redacted]				
2. **Mladen Nedimovic - Adjunt Research Scientist**					
3. **Total Salaries**					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE					
7. (**3**) TOTAL SENIOR PERSONNEL (1 - 6)					
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS					
2. (**0**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)					
3. (**0**) GRADUATE STUDENTS					
4. (**0**) UNDERGRADUATE STUDENTS					
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)					
6. (**1**) OTHER					
TOTAL SALARIES AND WAGES (A + B)					
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)					
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)					
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				(b) (4), (b) (6) [redacted]	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)					
2. FOREIGN					
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				(b) (4) [redacted]	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION					
3. CONSULTANT SERVICES					
4. COMPUTER SERVICES					
5. SUBAWARDS					
6. OTHER					
TOTAL OTHER DIRECT COSTS					
H. TOTAL DIRECT COSTS (A THROUGH G)					
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) (b) (4) [redacted]					
TOTAL INDIRECT COSTS (F&A)				(b) (4) [redacted]	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)					
K. RESIDUAL FUNDS					
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**94,508**	

M. COST SHARING PROPOSED LEVEL $ **Not Shown** AGREED LEVEL IF DIFFERENT $

PI/PD NAME **Nicholas Christie-Blick**	FOR NSF USE ONLY INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME* **Maribel Respo**	Date Checked	Date Of Rate Sheet	Initials - ORG

1 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

SUMMARY PROPOSAL BUDGET

YEAR 2

	FOR NSF USE ONLY		
ORGANIZATION **Columbia University**	PROPOSAL NO.	DURATION (months) Proposed	Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR **Nicholas Christie-Blick**	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Nicholas Christie-Blick - Professor**	0.00	0.00	0.00	**0**	
2. **Mladen Nedimovic - Adjunt Research Scientist**	0.00	0.00	0.00	**0**	
3. **Total Salaries**	0.00	0.00	0.00	**0**	
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**3**) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	0.00	0.00	**0**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**0**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	0.00	0.00	0.00	**0**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**0**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**0**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**0**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				(b) (4) [redacted]	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)					
2. FOREIGN					

F. PARTICIPANT SUPPORT COSTS		
1. STIPENDS $	**0**	
2. TRAVEL	**0**	
3. SUBSISTENCE	**0**	
4. OTHER	**0**	
TOTAL NUMBER OF PARTICIPANTS (**0**)	TOTAL PARTICIPANT COSTS	**0**

	Funds Requested By proposer	Funds granted by NSF (if different)
G. OTHER DIRECT COSTS		
1. MATERIALS AND SUPPLIES	(b) (4) [redacted]	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION		
3. CONSULTANT SERVICES		
4. COMPUTER SERVICES		
5. SUBAWARDS		
6. OTHER		
TOTAL OTHER DIRECT COSTS		
H. TOTAL DIRECT COSTS (A THROUGH G)		
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) (b) (4) [redacted]		
TOTAL INDIRECT COSTS (F&A)	(b) (4) [redacted]	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)		
K. RESIDUAL FUNDS		
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)	**4,911**	
M. COST SHARING PROPOSED LEVEL $ **Not Shown**	AGREED LEVEL IF DIFFERENT $	

	FOR NSF USE ONLY		
PI/PD NAME **Nicholas Christie-Blick**	INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME* **Maribel Respo**	Date Checked	Date Of Rate Sheet	Initials - ORG

1259487

SUMMARY PROPOSAL BUDGET

Cumulative

ORGANIZATION	FOR NSF USE ONLY		
Columbia University	PROPOSAL NO.	DURATION (months)	
		Proposed	Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR	AWARD NO.		
Nicholas Christie-Blick			

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Nicholas Christie-Blick - Professor	(b) (4) [redacted]				
2. Mladen Nedimovic - Adjunt Research Scientist					
3. Total Salaries					
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE					
7. (3) TOTAL SENIOR PERSONNEL (1 - 6)					
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS					
2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)					
3. (0) GRADUATE STUDENTS					
4. (0) UNDERGRADUATE STUDENTS					
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)					
6. (1) OTHER					
TOTAL SALARIES AND WAGES (A + B)					
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)					
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)					
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				(b) (4) [redacted]	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)					
2. FOREIGN					
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				(b) (4) [redacted]	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION					
3. CONSULTANT SERVICES					
4. COMPUTER SERVICES					
5. SUBAWARDS					
6. OTHER					
TOTAL OTHER DIRECT COSTS					
H. TOTAL DIRECT COSTS (A THROUGH G)					
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				(b) (4) [redacted]	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)					
K. RESIDUAL FUNDS					
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				99,419	

M. COST SHARING PROPOSED LEVEL $ Not Shown AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY		
Nicholas Christie-Blick	INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME*	Date Checked	Date Of Rate Sheet	Initials - ORG
Maribel Respo			

C *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

BUDGET JUSTIFICATION

The following is confidential information that The Trustees of Columbia University requests not be released to persons outside the Government, except for purposes of review and evaluation

(b) (4), (b) (6)

[redacted]

TITLE: Collaborative Research: Community-Based 3D Imaging That Ties Clinoform Geometry
PRINCIPAL INVESTIGATOR(S): Nicholas Christie-Blick, PI; Mladen Nedimovic, Co-PI
PERIOD OF PERFORMANCE: May 1, 2013 - April 30, 2015

(b) (4), (b) (6)

[redacted]

CURRENT AND PENDING SUPPORT
8/7/12

Gregory Mountain

A Supporting Agency	B Project Title	C Award Amount	D Pd Covered Award	E Man-Mos. Acad. Sum. Cal.	F Location
A. Current Support					
(b) (4), (b) (6) [redacted]					
Dept. of Energy / subcontract from Battelle Corp.	Midwestern Regional Carbon Sequestration Partnership (MCRSP): Rutgers	$568,800	07/01/12 - 06/30/16	1/1/1/1 (all Sum.)	Rutgers
B. Pending Support					
(b) (4), (b) (6) [redacted]					

Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Craig Fulthorpe

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

(b) (4), (b) (6)

[redacted]

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

(b) (4), (b) (6)

[redacted]

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

(b) (4), (b) (6)

[redacted]

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Summ:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

 USE ADDITIONAL SHEETS AS NECESSARY

Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: James Austin, Jr.	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

(b) (4), (b) (6)

[redacted]

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

(b) (4), (b) (6)

[redacted]

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

(b) (4), (b) (6)

[redacted]

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

(b) (4), (b) (6)

[redacted]

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

(b) (4), (b) (6)

[redacted]

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

CURRENT AND PENDING SUPPORT
8/6/2012

NICHOLAS CHRISTIE-BLICK

A Supporting Agency	B Project Title	C Award Amount	D Period Covered Award	E Man-Month Acad. Sum. Cal.	F Location

A. Current Support
NONE

(b) (4), (b) (6)

[redacted]

CURRENT AND PENDING SUPPORT
8/7/2012

MLADEN NEDIMOVIC

A Supporting Agency	B Project Title	C Award Amount	D Period Covered Award	E Man-Month Acad. Sum. Cal.	F Location
A. Current Support					
NSF OCE 10-29411	COLLABORATIVE RESEARCH: EVOLUTION AND HYDRATION OF THE JUAN DE FUCA CRUST AND UPPERMOST MANTLE: A PLATE-SCALE SEISMIC INVESTIGATION FROM RIDGE TO TRENCH (CARBOTTE, S., PI; CARTON, H., NEDIMOVIC, M., CO-PI's)	223,709	3/1/12 2/28/13	NC/YR	LDEO
NSF EAR 06-07687	COLLABORATIVE RESEARCH: UPLIFT AND FAULTING AT THE TRANSITION FROM SUBDUCTION TO COLLISION- A FIELD AND MODELING STUDY OF THE CALABRIAN ARC. (STECKLER, M., PI; SEEBER, L., CO-PI; STARK, C., CO-PI; SCHAEFER, J., CO-PI; MALINVERNO, A., CO-PI; W/ NEDIMOVIC, M.; ARMBRUSTER, J.; KIM, W.Y.)	1,764,627	8/1/06 7/31/13	2/1/.5/1/NC/ NC/NC	LDEO
NSF OCE 09-26614	MEGATHRUST SEISMIC HAZARDS BY REFLECTION MAPPING (SHILLINGTON, D., PI; WEBB, S., NEDIMOVIC, M.; CO-PI'S)	713,878	1/1/10 12/31/12	NC	LDEO

(b) (4), (b) (6)

[redacted]

MLADEN NEDIMOVIC

(b) (4), (b) (6)

[redacted]

RUTGERS FACILITIES, EQUIPMENT & OTHER RESOURCES

FACILITIES:

Laboratory: 900 sq ft computer processing, visualization laboratory for students, researchers, faculty and visitors

Clinical:
N/A

Animal:
N/A

Computer: Instruction and pre-cruise data review for the first community workshop will be held in an 1800 sq ft instructional computer lab equipped with 16 HP 6200 Small Form Factor Computers. Each is at least a first generation i5 processor with 4GB of ram, and all are running Scientific Linux 6 as the default operating system. Fundamentals of 2D multichannel seismic processing will be demonstrated and participants will be able to complete training exercises on these machines using Seismic Unix. These same machines are connected via a Cisco 2948 switch which operates at 100 mb/s (FastEthernet), and bound to our department's LDAP and served home directories from our file server. The latter is an HP 380 G6, and utilizes a raid 5 disk array with 8TB of space that is backed up 3x daily. During the workshop we will also connect each of the client machines to our Virtual Desktop Infrastructure to enable 2D and 3D seismic visualization running SMT-Kingdom 64-bit licensed software on an HP xw6600 Windows 2008 R2 server with 4GB of ram and dual quadcore Intel Xeon E5420 processors and 1 TB of storage on a RAID 5 array. All of the existing public 2D seismic data and scientific results of IODP Exp313 are stored locally and available for instruction and participant exercises that will be prepared for this workshop.

Office:

MAJOR EQUIPMENT:

OTHER RESOURCES:

The PI will prepare lectures and instructional material for the participants in the pre-cruise workshop as well as at sea during the acquisition phase.

NSF Form 1363 (10/99)

FACILITIES, EQUIPMENT & OTHER RESOURCES

FACILITIES: Identify the facilities to be used at each performance site listed and, as appropriate, indicate their capacities, pertinent capabilities, relative proximity, and extent of availability to the project. Use "Other" to describe the facilities at any other performance sites listed and at sites for field studies. Use additional pages if necessary.

Laboratory:

The University of Texas at Austin Institute for Geophysics ("UTIG") has some laboratory space at the main Institute building and a larger space in another building nearby for staging preparation for field work.

Clinical:

N/A

Animal:

N/A

Computer:

UTIG is connected to the University of Texas at Austin and the internet via a 10 gigabit Ethernet connection. Internally, a switched 10/1 gigabit LAN interconnects Solaris and Linux workstations, PCs and Macintoshes. Significant computer resources include 32 64bit Linux computers with nearly 300 cores and 1.2TB of memory. Five servers participate in a 4Gb/s fiber-channel SAN with 20TB of disk. 25TB of public fast disk with tiered demand migration to 105TB of slower disk and 220TB of tape serve Unix and Windows clients; 300TB of other network disk is online. An assortment of tape drives (3480, 4mm, 8mm, DLT, LTO3/4) allow data to be staged to disk or processed directly. Plotting devices include two 42" HP inkjet plotters, several letter-to-tabloid-size color printers and many black-and-white printers. A 42" scanner is available. Software available on all systems includes program development tools, plotting tools, and both public domain and commercial data analysis packages. All PCs and Macs have common graphics tools and office productivity applications, and share files with the Unix systems.

Office:

UTIG's main office space at the University of Texas's J.J. Pickle Research Campus, 10100 Burnet Road, Bldg. 196, Austin, Texas, is available for the proposed research.

MAJOR EQUIPMENT: List the most important items available for this project and, as appropriate, identify the location and pertinent capabilities of each.

- 2 x 32 core servers 2.7GHz/64GB/100G/4gigE
- 3 x 16 core servers 2.2+GHz/32GB/3TB/4gigE
- 7 x 12 core servers 2.9+GHz/24+GB/10TB/4gigE
- 3 x 8 core servers 2.2+GHz/16GB/1-4TB/2gigE
- 17 x 4 core servers 2.2+GHz/4-10GB/140GB/2gigE
- 1 x 4 core Sun x4200 server 2.8GHz/24G/140GB/4gigE
- 1 x 4 core Sun T2000 server 1GHz/8GB/140GB/4gigE
- 3 x 2 core Sun servers 900Mhz/4Gbyte/72G/1gigE
- 4Gb/s FC SAN; 10G network; SAM-FS data migration software
- Paradigm Focus seismic processing software
- Paradigm Geodepth pre-stack migration software
- Geoquest, Landmark interpretation software
- Arc/GIS, Caris Multi-Beam, Matlab software
- Two HP 42" color plotters; 42" scanner

OTHER RESOURCES: Provide any information describing the other resources available for the project. Identify support services such as consultant, secretarial, machine shop, and electronics shop, and the extent to which they will be available for the project. Include an explanation of any consortium/contractual/sub award arrangements with other organizations.

UTIG has administrative and computer support personnel.

LDEO FACILITIES, EQUIPMENT AND OTHER RESOURCES

FACILITIES

Laboratory:
N/A

Clinical:
N/A

Animal:
N/A

Computer:
Computing resources at LDEO include an extensive network of Sun and Linux workstations, fileservers and peripherals. Site-licensed software is available for interactive MCS data manipulation, 2D and 3D imaging, waveform analysis, and graphical visualization from both Landmark and Paradigm (e.g., Promax, SeisWorks, Focus, STRATA, etc.). The multichannel seismic reflection processing facility has five linux based 3.06 GHz Intel Xeon multithread dual CPU DELL workstations each with 3 GB of RAM and 750 GB internal raid arrays, and a unix based SUN enterprise 450 server with 296 MHz dual CPU, 2 GB of RAM and 510 GB of disk space. These are all 21-inch dual monitor stations. A 16 node 32 CPU linux-box cluster connected to a NAS raid array providing 100 TB useable disk space is available. There are also a number of other SUN Ultrasparc 10 stations. The MCS facility also has two 3490E cartridge drives with stack loaders, two DLT7000 cartridge drives, and two DLT2000 cartridge drives.

Office:
Office space, heating, air conditioning, administrative support, grants management and financial services, library and other academic services to support the effort are all provided under the negotiated ICR.

MAJOR EQUIPMENT:
N/A

OTHER RESOURCES:
N. Christie-Blick (PI) and M. Nedimovic (Co-PI) will participate in the planning of the cruise, the pre-cruise workshop, the post-processing data review, and the post-cruise workshop at which community-based opportunities for analysis/interpretation of the processed 3D volume and integration with Exp313 results will be developed. M. Nedimovic (Co-PI) will also take part in the cruise, and the data processing in Houston.

Data Management Plan

This project will create ~7.5 terabytes of 120-channel, 3D seismic reflection field data integrated with navigation in standard SEG-D and UKOOA formats, respectively. Metadata related to QA/QC monitoring of MCS operations, routine to all such activities aboard the *R/V Langseth*, will be recorded as well. Additional digital data gathered from other shipboard sensors, including multibeam sonar, gravity and meteorological data, will be transmitted to the Lamont Database group that will, in turn, ensure that these data are deposited in appropriate national archives for long-term preservation. The 'raw' MCS field data will be copied to the Academic Seismic Portal at Lamont-Doherty (http://www.marine-geo.org/portals/seismic/), where it will undergo additional QA/QC in preparation for archiving purposes and for its delivery to the processing center.

The MCS field shot data described above will be copied to a robust external hard drive and delivered to the commercial processing company of choice (e.g., PGS of Houston, TX; see accompanying quote), where a prearranged flow of processing steps, overseen by the PIs, will produce a 3D 'volume' of pre-stack, time-migrated data within ~5 mos. of the end of data acquisition. Processed data will be returned to Lamont-Doherty in standard SEG-Y format, with navigation embedded in trace headers.

A copy of the processed dataset will be sent to the Univ. of Texas, Austin/Institute for Geophysics where it will be served on a network of 3D-data MCS workstations. All public data from Exp313 will be installed on this network and integrated with these seismic data for access during a community workshop at UTIG, whose purpose is to examine data quality and develop strategies for maximizing the opportunities for the ensuing stage of scientific analysis.

The processed 3D data volume will be transferred to the Academic Seismic Portal at the Univ. of Texas, Austin/Institute for Geophysics (http://www.ig.utexas.edu/sdc/) which handles processed seismic data and where it will be instantly available for public distribution without restriction. The field shot data archived at the Lamont-Doherty Academic Seismic Portal will be made available at this time as well. Like any other data set released by this national facility, rules concerning derivative products and re-distribution will apply, but any qualified user who abides by these agreements will have complete access to both the processed data and the raw field data.

Postdoctoral Researcher Mentoring Plan

We seek no funds for Post-Doctoral Researchers to conduct scientific analysis of data acquired in the proposed project. While individuals selected by the PIs through an application process will be invited to participate on the cruise, they may or may not be Post-Docs. 4-6 months pre-cruise a public call will go out for 'young researchers' (grad students / post-docs / young scientists) who are looking towards a career that requires knowledge of 3D MCS acquisition, processing and/or interpretation. Following the advice of the MG&G program of NSF, we are providing this 'qualified' mentoring plan to define clearly the manner in which Post-Doctoral researchers may benefit from the proposed project.

We are acting on recommendations of the 2010 community workshop entitled *Challenges and Opportunities in Academic Marine Seismology* (http://www.steveholbrook.com/mlsoc/workshop_report.pdf) that encouraged (1) greater community access to 3D MCS data, and (2) providing bunk space on cruises that could yield hands-on learning experiences for the upcoming generation of marine scientists. Accordingly, we ask that up to 12 berths aboard the *R/V Langseth* be reserved for these young researchers. Funds are requested to subsidize their travel to and from the ship, but we seek no other financial support for them prior to, during, or following the cruise. (Of course, the daily operational costs of the *Langseth* will absorb their 'room and board' expenses at sea.) Their exact roles and contributions to the project will depend on the skills they bring with them. We hope to have the luxury of more applicants than berths and be able to select those best qualified to benefit from this opportunity.

The goals will be to: (1) provide a 'learning by doing' experience to a broad range of participants; (2) transfer experience from the 4 on-board PIs to these young researchers in such areas as planning and running a cruise, handling gear on deck, the theory and practice of seismic processing, applications of 2 and 3D MCS, etc.; and (3) stimulate members of the group to participate in the data showcase workshop (see the Project Description) and pursue a research project using the data they helped to collect. Each of the 4 PIs who will be on the *Langseth* have lecture experience, and 2 teach marine geology and geophysics at the college and graduate level. We are all prepared to conduct lessons at sea, tailored to the backgrounds and interests of the young researchers.

APPENDIX C

NMFS BIOLOGICAL OPINION

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

Mr. Bauke (Bob) Houtman, Integrative Programs Section Head
OCE Environmental Operations
Division of Ocean Sciences
National Science Foundation
4201 Wilson Boulevard
Arlington, Virginia 22230

MAY - 7 2015

Dear Mr. Houtman:

Enclosed is the National Marine Fisheries Service's (NMFS) biological opinion on the effects on threatened and endangered species of the National Science Foundation's use of the vessel *Langseth* to conduct a seismic survey along New Jersey, pursuant to section 7(b) of the Endangered Species Act (ESA) of 1973, as amended (16 United States Code 1536). This biological opinion also considers the effects of NMFS's authorization for the National Science Foundation to take, in the form of harassment, marine mammals and sea turtles incidental to the proposed seismic activities.

The biological opinion concludes that the proposed seismic survey is not likely to jeopardize the continued existence of threatened or endangered species under NMFS's jurisdiction or destroy or adversely modify critical habitat that has been designated for those species (we do not expect critical habitat to be affected by the proposed actions). However, we expect some species of ESA-listed whales to be taken incidental to the proposed survey. Terms and conditions are included. The incidental take statement enclosed in the biological opinion allows for exemption to take under ESA section 9(a) and includes measures that must be undertaken in order for the exemption prescribed in section 7(o)(2) of the ESA to apply.

This concludes formal consultation on the use of the *Langseth* by the National Science Foundation for marine seismic survey activities along New Jersey. Reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained and if: (1) the amount or extent of taking specified in the Incidental Take Statement is exceeded; (2) new information reveals effects of these actions that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) any of the identified actions are subsequently modified in a manner that causes an effect to the listed species that was not considered in the biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by the identified action.

If you have questions regarding this biological opinion, please contact Kristine Petersen at kristine.petersen@noaa.gov 301-427-8453.

Sincerely,

PERRY GAYALDO

for Donna S. Wieting
Director
Office of Protected Resources

Enclosure

NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7 BIOLOGICAL OPINION

Action Agencies: National Science Foundation-Division of Ocean Sciences and NOAA's National Marine Fisheries Service-Office of Protected Resources-Permits and Conservation Division

Activity Considered: *1) Seismic survey by the Lamont-Doherty Earth Observatory along New Jersey, and*

2) Issuance of an Incidental Harassment Authorization pursuant to section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA)

Consultation Conducted By: Endangered Species Act Interagency Cooperation Division, Office of Protected Resources, National Marine Fisheries Service

Approved:

Perry Gayaldo

for

Donna S. Wieting
Director, Office of Protected Resources

MAY - 7 2015

Date:

Public Consultation Tracking System (PCTS) number: *FPR-2015-9109*

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LIST OF ACRONYMS

AMAPPS-Atlantic Marine Assessment Program for Protected Species

BOEM-Bureau of Ocean Energy Management

CETAP-Cetacean and Turtle Assessment Program

CFR-Code of Federal Regulations

CI-Confidence interval

CV-Coefficient of variation

dB-decibel

DDE-Dichlorodiphenyldichloroethylene

DDT-Dichlorodiphenyltrichloroethane

DPS-Distinct population segment

EEZ-Exclusive economic zone

ESA-Endangered Species Act

EZ-Exclusion zone

HCB-Hexachlorobenzene

HMS FMP-Highly migratory species fisheries management plan

Hz-Hertz

IHA-Incidental harassment authorization

IPCC-Intergovernmental Panel on Climate Change

IWC-International Whaling Commission

kHz-kilohertz

kg-kilogram

L-DEO-Lamont Doherty Earth Observatory

MMPA-Marine Mammal Protection Act

ms-millisecond

NAO-North Atlantic oscillation

NMFS-National Marine Fisheries Service

NOAA-National Oceanic and Atmospheric Administration

NSF-National Science Foundation

PAM-Passive acoustic monitoring

PCB-Polychlorinated biphenyl

PFOA-Perfluorooctanoic acid

PFOS-Perfluorooctanesulfonic acid

PSVO-Protected species visual observer

PTS-Permanent threshold shift

RMS-Root mean squared

SEL-Sound exposure level

SERDP SDSS- Strategic Environmental Research and Development Program Spatial Decision Support System

TEWG-Turtle Expert Working Group

TTS-Temporary threshold shift

U.S.-United States

U.S.C.-United States Code

USFWS-United States Fish and Wildlife Service

1 INTRODUCTION

Section 7(a)(2) of the Endangered Species Act (ESA)(16 U.S.C. 1531 et seq.) requires that each federal agency insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When the action of a federal agency "may affect" a listed species or critical habitat designated for it, that agency is required to consult with NOAA's National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service, depending upon the listed resources that may be affected. For the activities described in this document, the Federal action agencies are the National Science Foundation (NSF) and NMFS' Permits and Conservation Division.

Two federal actions are considered in this biological opinion (Opinion). The first is the NSF's proposal to allow the use of its research vessel, *Marcus G. Langseth* (*Langseth*), which is operated by the Lamont-Doherty Earth Observatory (L-DEO), to conduct a seismic survey off the coast of New Jersey from June to August of 2015, in support of an NSF-funded collaborative research project led by Rutgers University. The second is the NMFS' Permits and Conservation Division proposal to issue an incidental harassment authorization (IHA) authorizing non-lethal "takes" by Level B harassment (as defined by the Marine Mammal Protection Act (MMPA)) of marine mammals incidental to the planned seismic survey, pursuant to section 101 (a)(5)(D) of the MMPA, 16 U.S.C. § 1371 (a)(5)(D). The consulting agency is the NMFS' Office of Protected Resources, ESA Interagency Cooperation Division.

This document represents NMFS's ESA Interagency Cooperation Division's Opinion on the effects of the two proposed federal actions on threatened and endangered species, and has been prepared in accordance with section 7 of the ESA. This Opinion is based on information provided in the:

- MMPA IHA application
- draft public notice of proposed IHA
- a draft environmental assessment prepared pursuant to the National Environmental Policy Act
- monitoring reports from similar activities
- published and unpublished scientific information on endangered and threatened species and their surrogates
- scientific and commercial information such as reports from government agencies and the peer-reviewed literature
- biological opinions on similar activities, and
- other sources of information.

1.1 Consultation History

On December 19, 2014, the NMFS' ESA Interagency Cooperation Division received a request for formal consultation pursuant to section 7 of the ESA from the NSF to incidentally harass marine mammal and sea turtle species during the seismic survey; information was sufficient to initiate consultation with the NSF on this date. On the same date, the NMFS' Permits and Conservation Division received an application from the L-DEO to incidentally harass marine mammal species pursuant to the MMPA during the proposed seismic survey.

On March 17, 2015, the NMFS' Permits and Conservation Division sent the application for the proposed seismic survey out to reviewers and published a notice in the *Federal Register* soliciting public comment on their intent to issue an IHA.

On April 7, 2015, the NMFS' ESA Interagency Cooperation Division received a request for formal consultation under section 7 of the ESA from the NMFS' Permits and Conservation Division.

On April 10, 2015, the NMFS' ESA Interagency Cooperation Division met with the Permits and Conservation Division to discuss the take estimation methods used by the Permits and Conservation Division in its initiation request. The Permits and Conservation Division agreed to modify its take estimate approach based upon discussion in that meeting.

On April 17, 2015 the NMFS' ESA Interagency Cooperation Division again met with the Permits and Conservation Division to discuss the modified take estimation methods used by the Permits and Conservation Division in their incidental harassment authorization. The ESA Interagency Cooperation Division requested documentation of this approach.

On April 20, 2015, the Permits and Conservation Division provided additional support documentation for the modified analytical approach and take authorization in the Permits and Conservation Division's MMPA incidental harassment authorization. Information was sufficient to initiate consultation with the Permits and Conservation Division on this date.

On May 1, 2015, the NMFS' ESA Interagency Cooperation Division again met with the Permits and Conservation Division to discuss analytical approaches to assessing the action. It was determined that both analyses produced no jeopardy outcomes and that the take estimates of the Permits and Conservation Division are more appropriate to include in the ITS.

2 DESCRIPTION OF THE PROPOSED ACTIONS

Two federal actions were evaluated in this Opinion. The first is the NSF's proposal to allow the use of its research vessel, *Marcus G. Langseth* (*Langseth*), operated by the L-DEO, to conduct a seismic survey off the coast of New Jersey from June to August of 2015, in support of an NSF-funded collaborative research project led by Rutgers University. The second is the NMFS' Permits and Conservation Division proposal to issue an IHA authorizing non-lethal "takes" by Level B harassment pursuant to section 101 (a)(5)(D) of the MMPA.

2.1 National Science Foundation Proposed Action

The NSF proposes to allow the use of its research vessel, *Marcus G. Langseth* (*Langseth*) to conduct a seismic survey off the coast of New Jersey during an approximate 30 day period from June to August, 2015. An array of four airguns will be deployed as an energy source. In addition, a multibeam echosounder and a sub-bottom profiler will continuously operate from the *Langseth*, except during transit to the survey site. A system of three kilometer-long hydrophone streamers (up to four streamers in total) will also be deployed.

The purpose of the proposed activities is to collect data across existing Integrated Ocean Drilling Program (IODP) Expedition 313 drill sites on the inner-middle shelf of the New Jersey continental margin to reveal the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to present. Features such as river valleys cut into coastal plain sediments, now buried under younger sediment and flooded by today's ocean, cannot be identified and traced with existing 2-D seismic data, despite their existence being clearly indicated in sediment cores recovered during IODP Expedition 313. These and other erosional and depositional features will be imaged using 3-D seismic data and will enable follow-on studies to identify the magnitude, time, and impact of major changes in sea level. The proposed seismic survey will collect data in support of a research proposal that was reviewed under the NSF merit review process and identified as an NSF program priority to meet NSF's critical need to foster a better understanding of Earth processes.

2.1.1 Schedule

The NSF proposes to allow the use of the *Langseth* by L-DEO roughly 30 days of seismic operations and an additional five days of non-airgun operations. Some minor deviation from the proposed dates is possible, depending on logistics, weather conditions, and the need to repeat some survey lines if data quality is substandard. During an approximate 30-day period in June to August 2015, corresponding to an effective IHA, the *Langseth* would survey the action area (**Figure 1**). The *Langseth* would depart from and return to New York, New York. NMFS' Permits and Conservation Division proposes to issue an authorization that is effective from June 1, 2015 to August 31, 2015.

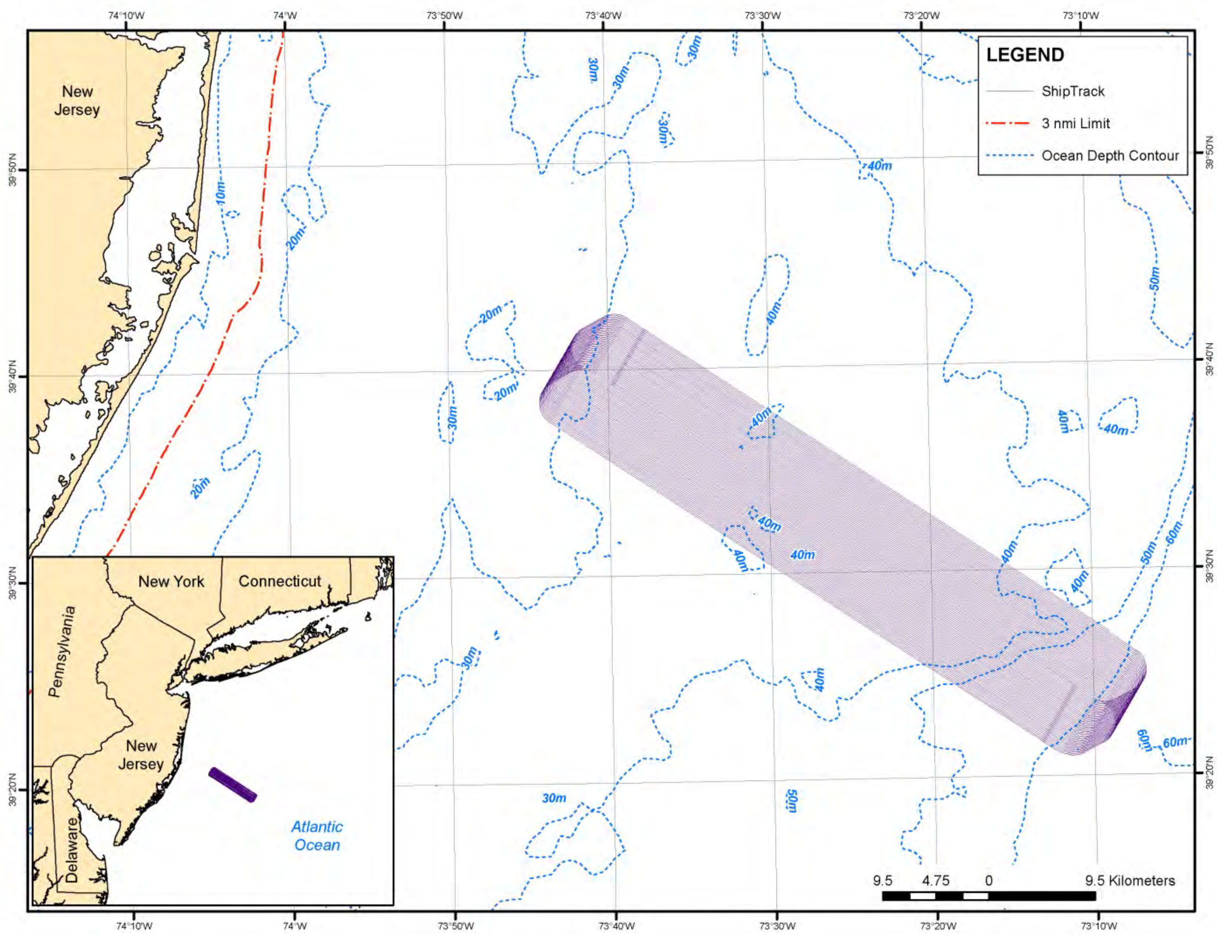

Figure 1. Proposed area for the marine seismic survey off New Jersey.

2.1.2 Source Vessel Specifications

The *Langseth* will tow a four-airgun array along predetermined lines (see Figure 1). The *Langseth's* design is that of a seismic research vessel, with a particularly quiet propulsion system to avoid interference with the seismic signals. The operating speed during seismic acquisition is typically 8.3 km/h (4.4 knots). When not towing seismic survey gear, the *Langseth* typically cruises at 18.5 km/h (10 knots).

The *Langseth* will also serve as the platform from which protected species visual observers (PSVOs) would watch for animals. Although the airgun array will operate during straight-line and early turn portions of the transects, only a mitigation gun will operate during most of the turns and entries into straight-line transects.

A chase vessel will also be used in logistical support of the project. Although the exact vessel is uncertain, it is described in the NSF's Environmental Assessment prepared under the National Environmental Policy Act, as resembling an offshore utility vessel of roughly 28 m in length, 2.6 m in draft, and twin screws of 450 horsepower each. The chase vessel will operate at roughgly the same speed as the *Langseth*.

2.1.3 **Airgun Description**

The airgun array will consist of two pairs of four airgun arrays (**Table 1**). However, only four of these airguns will be active at any given time (i.e., one pair at a time) and total discharge volume will be limited to 700 in^3. The airgun configuration includes a pair of linear arrays or "strings". Each string will have four airguns. Up to four airguns in one string would fire at any one time. The four-airgun strings will be towed approximately 150 m behind the vessel. The tow depth of the array will be 4.5 or 6 m. The airgun array will fire roughly every five to six seconds. During firing, a brief (approximately 0.1 s) pulse of sound will be emitted, but be silent during the intervening periods. This signal attenuates as it moves away from the source, decreasing in amplitude, but also increasing in signal duration. Airguns will operate continually during the survey period except for unscheduled shutdowns.

Table 1 Specifications of the four-airgun array to be used by the R/V *Langseth* during the proposed seismic activities.

Four-airgun array specifications	
Energy source	4-1,950 psi bolt airguns of 120-220 in^3 each, in four strings of nine operating airguns per string
Source our tput (downward)-4 airgun array	0-pk is 240.4 dB re 1 µPa·m; pk-pk is 246.3-246.7 dB re 1 µPa·m
Air discharge volume	~ 700 in^3
Dominant frequency components	0–188 Hz

Because the actual source originates from four airguns rather than a single point source, the highest sound levels measurable at any location in the water is less than the nominal source level. In addition, the effective source level for sound propagating in near-horizontal directions will be substantially lower than the nominal source level applicable to downward propagation because of the directional nature of the sound from the airgun array.

2.1.4 **Multibeam Echosounder and Sub-bottom Profiler**

Along with airgun operations, three additional acoustical data acquisition systems will operate during the survey from the *Langseth*. The multibeam echosounder and sub-bottom profiler systems will map the ocean floor during the survey. These sound sources will operate from the *Langseth* simultaneously with the airgun array.

The multibeam echosounder is a hull-mounted system operating at 10.5-13 kHz. The beamwidth is 1 or 2° fore–aft and 150° perpendicular to the ship's line of travel. The maximum source level is 242 dB re 1 µPa·m_{rms}. For deepwater operation, each "ping" consists of eight successive fan-shaped transmissions, each 2 to 15 ms in duration and each ensonifying a sector that extends 1° fore–aft. The eight successive transmissions span an overall cross-track angular extent of about 150°, with 2 ms gaps between the pulses for successive sectors (Maritime 2005).

The sub-bottom profiler provides information about the sedimentary features and the bottom topography that is being mapped simultaneously by the multibeam echosounder (**Table 2**). The output varies with water depth from 50 watts in shallow water to 1,000 (204 dB) watts in deep water. The pulse interval is 1 s, but a common mode of operation is to broadcast five pulses at 1-s intervals followed by a 5-s pause.

Table 2 Sub-bottom profiler specifications of the R/V *Langseth.*

***Langseth* sub-bottom profiler specifications**	
Maximum/normal source output (downward)	204 dB re 1 µPa·m; 800 watts
Dominant frequency component	3.5 kHz
Bandwidth	1.0 kHz with pulse duration 4 ms
	0.5 kHz with pulse duration 2 ms
	0.25 kHz with pulse duration 1 ms
Nominal beam width	30º
Pulse duration	1, 2, or 4 ms

2.1.5 Proposed Exclusion Zones

The NSF identifies in its EA that the L-DEO will implement exclusion zones (EZs) around the *Langseth* to minimize any potential adverse effects of airgun sound on MMPA and ESA-listed species. These zones are areas where seismic airguns would be powered down or shut down to reduce exposure of marine mammals and sea turtles to sound levels expected to produce potential fitness consequences. These EZs are based upon modeled sound levels at various distances from the *Langseth*, described below.

Predicted Sound Levels vs. Distance and Depth. The L-DEO has predicted received sound levels in deep water (free-field model), in relation to distance and direction from a four-airgun array (Figure 2 and Figure 3) as well as a 40 in^3 single 1900LLX airgun used during power-downs (Figure 4). In shallow water, empirical data concerning 180 and 160 dB re 1 μPa_{rms} distances were acquired during the acoustic calibration study of the *Langseth*'s 18-airgun 3,300 in^3 array in the Gulf of Mexico (Diebold et al. 2010). However, the array configuration and tow depth were different in the Gulf of Mexico calibration study (3,300 in^3, 6 m tow depth) than in the proposed survey (700 in^3, 4.5 or 6 m tow depth). To adapt the shallow-water measurements obtained during the calibration survey to the proposed array configuration(s) and tow depth(s), scaling factors have been applied to the distances reported by Diebold et al. (2009) for shallow waters, and this scaling is done according to the sound exposure level (SEL) contours obtained from the free-field modeling. Figures 3-5 show predicted distances of the various configurations of the airguns.

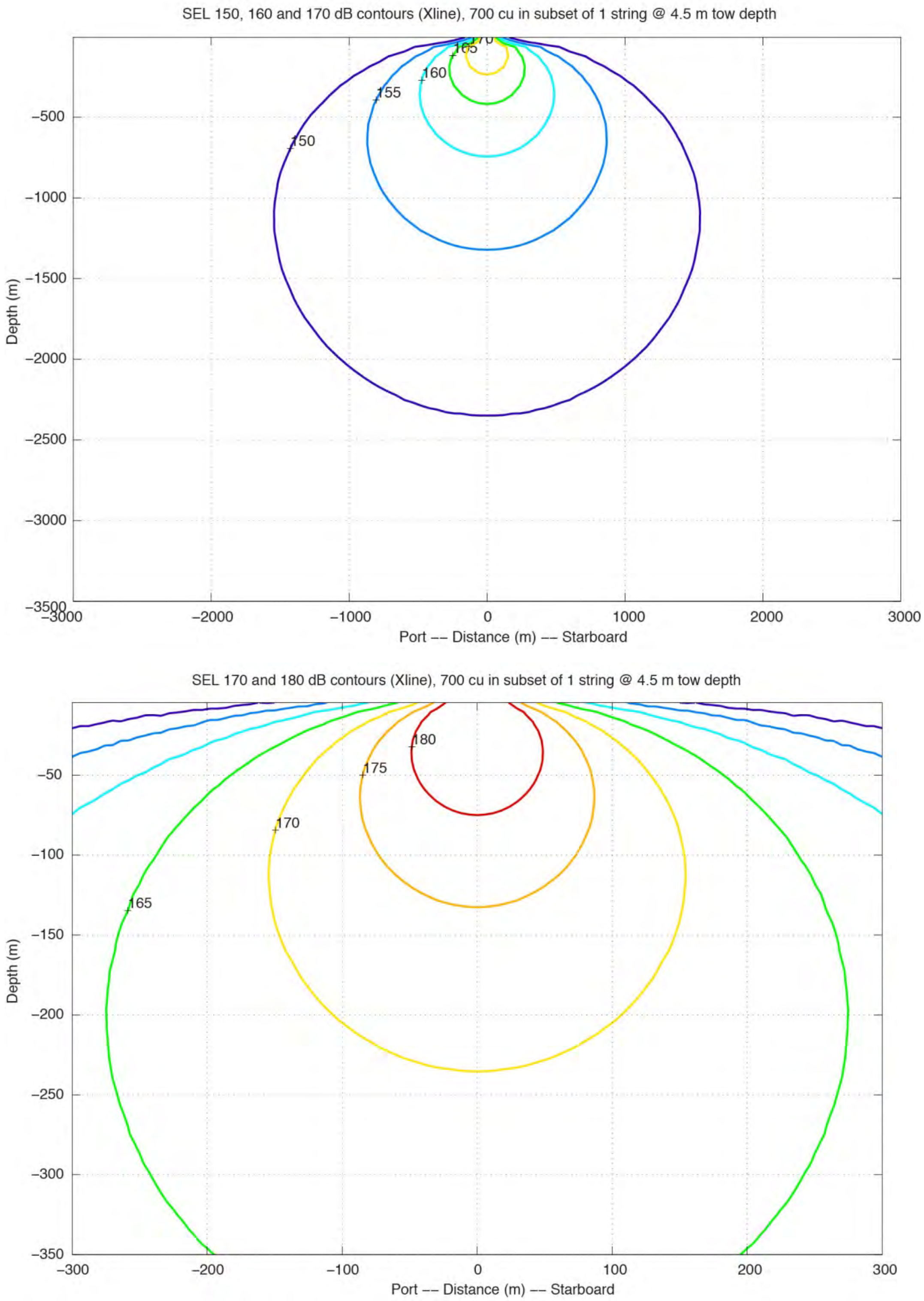

Figure 2. Modelled distances for the four-airgun array at 4.5 meter tow depth in deep water.

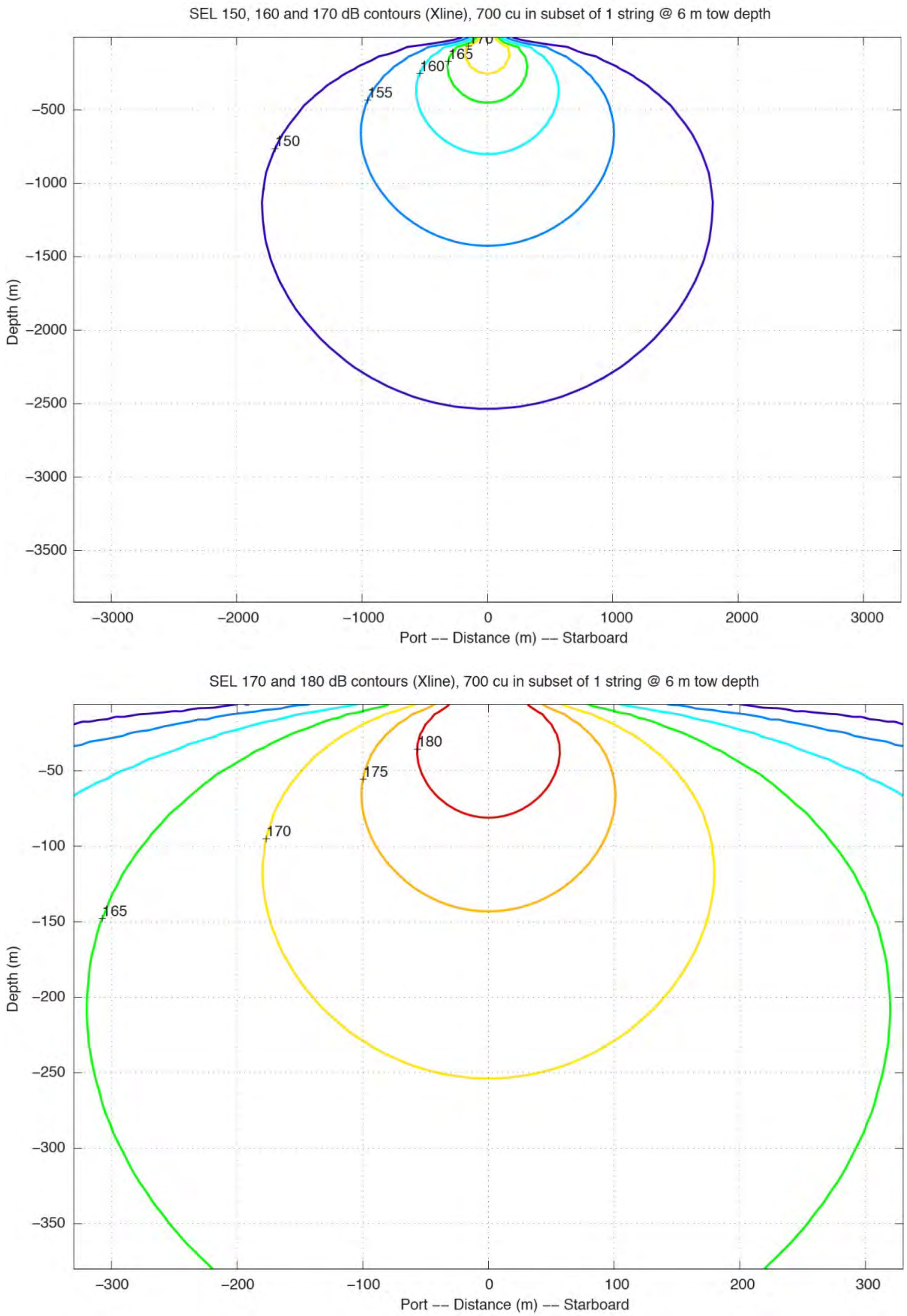

Figure 3. Modelled distances for the four-airgun array at six meter tow depth in deep water.

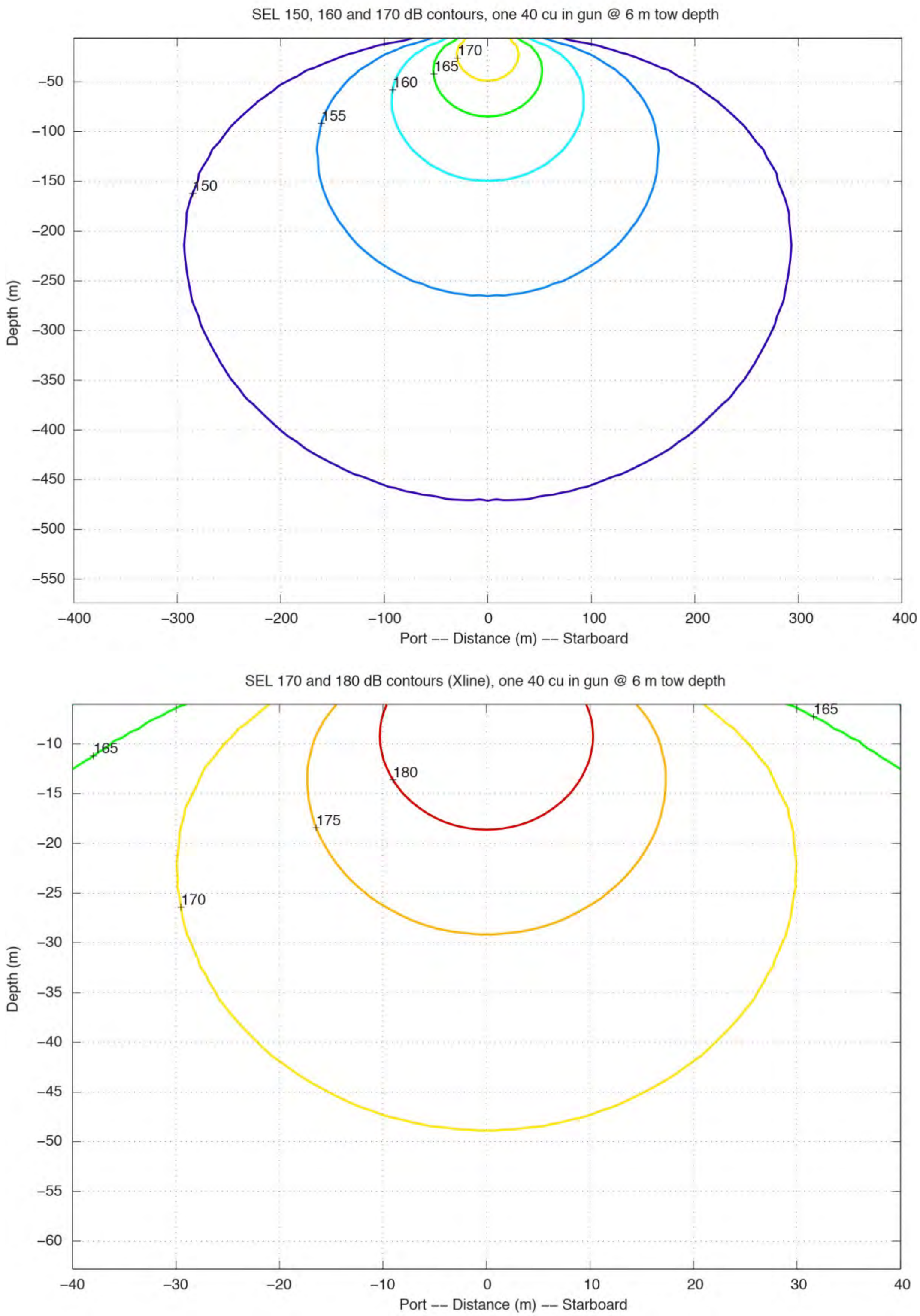

Figure 4. Modelled distances for the 40 in^3 mitigation gun at six meter tow depth in deep water.

Table 3 shows the distances at which four rms (root mean squared) sound levels are expected to be received from the four-airgun arrays and a single airgun. The 180 dB re 1 μPa_{rms} distance is the safety criteria as specified by NMFS (1995) as applicable to cetaceans under the MMPA. The 180 dB will be used as the exclusion zone (EZ) for marine mammals, as required by NMFS during most other recent L-DEO seismic projects (Holst and Beland 2008; Holst and Smultea 2008b; Holst et al. 2005a; Holt 2008; Smultea et al. 2004). The 180 dB isopleth would also be the EZ boundary for sea turtles. The 166 dB isopleth represents our best understanding of the threshold at which sea turtles exhibit behavioral responses to seismic airguns. The 160 dB re 1 μPa_{rms} distance is the distance at which MMPA take, by Level B harassment, is expected to occur.

Table 3. Predicted distances to which sound levels of 180, 166, and 160 dB re 1 μPa_{rms} could be received from the four-airgun arrays as well as the 40 in^3 airgun in water depths under 100 m.

Source, volume, and tow depth	Predicted RMS radii (m)		
	180 dB	**166 dB**	**160 dB**
four-airgun array 700 in^3 @ 4.5 m	378	2,229	5,240
four-airgun array 700 in^3 @ 6 m	439	2,599	6,100
single Bolt airgun, 40 in^3 @ 6 m	100	424	995

2.2 NMFS Permits and Conservation Division's Incidental Harassment Authorization

The NMFS' Permits and Conservation Division is proposing to issue an IHA authorizing non-lethal "takes" by Level B harassment of marine mammals incidental to the planned seismic survey. The IHA will be valid from June 1, 2015 through August 31, 2015, and will authorize the incidental harassment of the following endangered species (among other species): blue whales (*Balaenoptera musculus*), fin whales (*Balaenoptera physalus*), sei whales (*Balaenoptera borealis*), humpback whales (*Megaptera novaeangliae*), North Atlantic right whale (*Eubalaena glacialis*), sperm whales (*Physeter macrocephalus*), and other non-listed marine mammals. The proposed IHA identifies the following requirements that L-DEO must comply with as part of its authorization.

A. Establish a safety radius corresponding to the anticipated 180-dB isopleth for full (700 in^3) and single (40 in^3) airgun operations.

B. Use two, NMFS-approved, vessel-based PSVOs to watch for and monitor marine mammals near the seismic source vessel during daytime airgun operations, start-ups of airguns at night, and while the seismic array and streamers are being deployed and retrieved. Vessel crew will also assist in detecting marine mammals, when practical. Observers will have access to reticle binoculars (7 X 50 Fujinon), big-eye binoculars (25 X 150), optical range finders, and night vision devices. PSVOs shifts will last no longer than 4 hours at a time. PSVOs will also observe during daytime periods when the seismic system is not operating for comparisons of animal abundance and behavior, when feasible.

C. Record the following information when a marine mammal is sighted:

i. Species, group size, age/size/sex categories (if determinable), behavior when first sighted and after initial sighting, heading (if consistent), bearing and distance from seismic vessel, sighting cue, apparent reaction to the airguns or vessel (e.g., none, avoidance, approach, paralleling, etc., and including responses to ramp-up), and behavioral pace.

ii. Time, location, heading, speed, activity of the vessel (including number of airguns operating and whether in state of ramp-up or power-down), Beaufort sea state and wind force, visibility, cloud cover, and sun glare.

iii. The data listed under ii. would also be recorded at the start and end of each observation watch and during a watch whenever there is a change in one or more of the variables.

D. Visually observe the entire extent of the safety radius using PSVOs, for at least 30 min prior to starting the airgun (day or night). If PSVOs find a marine mammal within the safety zone, L-DEO must delay the seismic survey until the marine mammal has left the area. If the PSVO sees a marine mammal that surfaces, then dives below the surface, the observer shall wait 30 minutes. If the PSVO sees no marine mammals during that time, they should assume that the animal has moved beyond the safety zone. If for any reason the entire radius cannot be seen for the entire 30 min (e.g. rough seas, fog, darkness), or if marine mammals are near, approaching or in the safety radius, the airguns may not be started up. If one airgun is already running at a source level of at least 180 dB, L-DEO may start subsequent guns without observing the entire safety radius for 30 min prior, provided no marine mammals are known to be near the safety radius. In the event a North Atlantic right whale (*Eubalaena glacialis*) is visually sighted, the airgun array will be shut-down regardless of the distance of the animal(s) to the sound source. The array will not resume firing until 30 min after the last documented whale visual sighting. If concentrations (six or more individuals) of blue, fin, humpback, sei, or sperm whales are observed, then the array will be powered down and the group avoided if possible if they do not appear to be traveling.

E. Use the passive acoustic monitoring system (PAM) to detect marine mammals around the *Langseth* during all airgun operations and during most periods when airguns are not operating. One PSVO and/or bioacoustician will monitor the PAM at all times in shifts of up to 6 h. A bioacoustician shall design and set up the PAM system and be present to operate or oversee PAM, and available when technical issues occur during the survey.

F. Record the following when an animal is detected by the PAM:

i. Contact the PSVO immediately (and initiate power or shut-down, if required);

ii. Enter the information regarding the vocalization into a database. The data to be entered include an acoustic encounter identification number, whether it was linked with a visual sighting, date, time when first and last heard and whenever any additional information was recorded, position and water depth when first detected, bearing if determinable, species or species group, types and nature of sounds heard (e.g., clicks, continuous, sporadic, whistles, creaks, burst pulses, strength of signal, etc.), and any other notable information.

G. Apply a “ramp-up” procedure when starting up at the beginning of seismic operations or any time after the entire array has been shut down for more than 8 min, which means start the smallest gun first and add airguns in a sequence such that the source level of the array will increase in steps not exceeding approximately 6 dB per 5-min period. During ramp-up, the PSVOs will monitor the safety radius, and if marine mammals are sighted, a course/speed alteration, power-down, or shut-down will occur as though the full array were operational.

H. Alter speed or course during seismic operations if a marine mammal, based on its position and relative motion, appears likely to enter the safety zone. If speed or course alteration is not safe or practical, or if after alteration the marine mammal still appears likely to enter the safety zone, further mitigation measures, such as power-down or shut-down, will be taken.

I. Shut-down or power-down the airguns upon marine mammal detection within, approaching, or entering the safety radius. A power-down means shutting down one or more airguns and reducing the safety radius to the degree that the animal is outside of it. Following a power-down, if the marine mammal approaches the smaller designated safety radius, the airguns must completely shut down. Airgun activity will not resume until the marine mammal has cleared the safety radius, which means it was visually observed to have left the safety radius, or has not been seen within the radius for 15 min (small odontocetes) or 30 min (mysticetes and large odontocetes). The array will not resume firing until 30 min after the last documented whale visual sighting. The *Langseth* may operate a small-volume airgun (*i.e.*, mitigation airgun) during turns and maintenance at approximately one shot per minute. During turns or brief transits between seismic tracklines, one airgun would continue to operate.

J. To the maximum extent practicable, schedule seismic operations (i.e., shooting airguns) during daylight hours. Marine seismic operations may continue into night and low-light hours if such segment(s) of the survey is initiated when the entire relevant exclusion zones are visible and can be effectively monitored. No initiation of airgun array operations is permitted from a shut-down position at night or during low-light hours (such as in dense fog or heavy rain) when the entire relevant exclusion zone cannot be effectively monitored by the PSVO(s) on duty.

K. In the unanticipated event that any taking of a marine mammal in a manner prohibited by the proposed Authorization occurs, such as an injury, serious injury or mortality, and is judged to result from these activities, L-DEO will immediately cease operating all authorized sound sources and report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to Jolie.Harrison@noaa.gov as well as the NMFS Greater Atlantic Region Marine Mammal Stranding Network at 866-755-6622 (Mendy.Garron@noaa.gov). L-DEO will postpone the research activities until NMFS is able to review the circumstances of the take. NMFS will work with L-DEO to determine whether modifications in the activities are appropriate and necessary, and notify L-DEO that they may resume the seismic survey operations.

The report must include the following information:

- Time, date, and location (latitude/longitude) of the incident;
- Name and type of vessel involved;
- Vessel's speed during and leading up to the incident;
- Description of the incident;
- Status of all sound sources used in the 24 hours preceding the incident;
- Water depth;
- Environmental conditions (*e.g.*, wind speed and direction, Beaufort sea state, cloud cover, and visibility);
- Description of all marine mammal observations in the 24 hours preceding the incident;
- Species identification or description of the animal(s) involved;
- Fate of the animal(s); and
- Photographs or video footage of the animal(s) (if equipment is available).

L. In the unanticipated event that any cases of marine mammal injury or mortality are judged to result from these activities (*e.g.*, ship-strike, gear interaction, and/or entanglement), L-DEO will cease operating seismic airguns and report the incident to NMFS' Office of Protected Resources at 301-427-8401 and/or by email to Jolie.Harrison@noaa.gov as well as the NMFS Greater Atlantic Region Marine Mammal Stranding Network at 866-755-6622 (Mendy.Garron@noaa.gov) immediately. Airgun operation will then be postponed until NMFS is able to review the circumstances and work with L-DEO to determine whether modifications in the activities are appropriate and necessary. If the lead observer judged that the injury or mortality is not a result of the authorized activities, operations may continue.

M. L-DEO is required to comply with the Terms and Conditions of this Opinion's Incidental Take Statement issued to both the NSF and the NMFS' Office of Protected Resources.

In addition, the proposed IHA requires L-DEO to adhere to the following reporting requirements:

A. The Holder of this Authorization is required to submit a report on all activities and monitoring results to the Office of Protected Resources, NMFS, within 90 days after the expiration of the IHA. This report must contain and summarize the following information:

i. Dates, times, locations, heading, speed, weather, and associated activities during all seismic operations.

ii. Species, number, location, distance from the vessel, and behavior of any marine mammals, as well as associated seismic activity (number of power-downs and shutdowns), observed throughout all monitoring activities.

iii. An estimate of the number (by species) of marine mammals that:

a. Are known to have been exposed to the seismic activity (visual observation) at received levels greater than or equal to 160 dB re 1 microPa (rms) and/or 180 dB re 1 microPa (rms) for cetaceans with a discussion of any specific behaviors those individuals exhibited.

b. May have been exposed (modeling results) to the seismic activity at received levels greater than or equal to 160 dB re 1 microPa (rms) and/or 180 dB re 1 microPa (rms) with a discussion of the nature of the probable consequences of that exposure on the individuals that have been exposed.

iv. A description of the implementation and effectiveness of the:

a. Terms and conditions of the Opinion's Incidental Take Statement.

b. Mitigation measures of the IHA. For the Opinion, the report will confirm the implementation of each term and condition and describe the effectiveness, as well as any conservation measures, for minimizing the adverse effects of the action on listed whales.

3 APPROACH TO THE ASSESSMENT

The NMFS approaches its section 7 analyses of agency actions through a series of steps. The first step identifies those aspects of proposed actions that are likely to have direct and indirect physical, chemical, and biotic effects on listed species or on the physical, chemical, and biotic environment of an action area. As part of this step, we identify the spatial extent of these direct and indirect effects, including changes in that spatial extent over time. The result of this step includes defining the *action area* for the consultation. The second step of our analyses identifies the listed resources that are likely to co-occur with these effects in space and time and the nature of that co-occurrence (these represent our *Exposure analyses*). In this step of our analyses, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to an action's effects and the populations or subpopulations those individuals represent. Once we identify which listed resources are likely to be exposed to an action's effects and the nature of that exposure, we examine the scientific and commercial data available to determine whether and how those listed resources are likely to respond given their exposure (these represent our *Response analyses*).

The final steps of our analyses – establishing the risks those responses pose to ESA-listed resources – are different for listed species and designated critical habitat (these represent our *Risk analyses*). Our jeopardy determinations must be based on an action's effects on the continued existence of threatened or endangered species as those "species" have been listed, which can include true biological species, subspecies, or distinct population segments of vertebrate species. The continued existence of these "species" depends on the fate of the populations that comprise them. Similarly, the continued existence of populations are determined by the fate of the individuals that comprise them – populations grow or decline as the individuals that compose the population live, die, grow, mature, migrate, and reproduce (or fail to do so).

Our risk analyses reflect these relationships between listed species, the populations that comprise that species, and the individuals that comprise those populations. Our risk analyses begin by identifying the probable risks actions pose to listed individuals that are likely to be exposed to an action's effects. Our analyses then integrate those individual risks to identify consequences to the populations those individuals represent. Our analyses conclude by determining the consequences of those population-level risks to the species those populations comprise.

We measure risks to listed individuals using the individuals' "fitness," or the individual's growth, survival, annual reproductive success, and lifetime reproductive success. In particular, we examine the scientific and commercial data available to determine if an individual's probable lethal, sub-lethal, or behavioral responses to an action's effect on the environment (which we identify during our response analyses) are likely to have consequences for the individual's fitness.

When an individual is expected to experience reductions in fitness in response to an action's effects, those fitness reductions may reduce the abundance, reproduction, or growth rates (or increase the variance in these measures) of the populations those individuals represent (see Stearns 1992). Reductions in at least one of these variables (or one of the variables we derive from them) is a *necessary* condition for reductions in a population's viability, which is itself a *necessary* condition for reductions in a species' viability. As a result, when listed plants or animals exposed to an action's effects are *not* expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (e.g., Anderson 2000; Brandon 1978; Mills and Beatty 1979; Stearns 1992). As a result, if we conclude that listed plants or animals are *not* likely to experience reductions in their fitness, we would conclude our assessment.

Although reductions in fitness of individuals is a *necessary* condition for reductions in a population's viability, reducing the fitness of individuals in a population is not always *sufficient* to reduce the viability of the population(s) those individuals represent. Therefore, if we conclude that listed plants or animals are likely to experience reductions in their fitness, we determine whether those fitness reductions are likely to reduce the viability of the populations the individuals represent (measured using changes in the populations' abundance, reproduction, spatial structure and connectivity, growth rates, variance in these measures, or measures of extinction risk). In this step of our analyses, we use the population's base condition (established in the *Environmental baseline* and *Status of listed resources* sections of this Opinion) as our point of reference. If we conclude that reductions in individual fitness are not likely to reduce the viability of the populations those individuals represent, we would conclude our assessment.

Reducing the viability of a population is not always *sufficient* to reduce the viability of the species those populations comprise. Therefore, in the final step of our analyses, we determine if reductions in a population's viability are likely to reduce the viability of the species those populations comprise using changes in a species' reproduction, numbers, distribution, estimates of extinction risk, or probability of being conserved. In this step of our analyses, we use the species' status (established in the *Status of listed resources* section of this Opinion) as our point of reference. Our final determinations are based on whether threatened or endangered species are likely to experience reductions in their viability and whether such reductions are likely to be appreciable.

To conduct these analyses, we rely on all of the best scientific and commercial evidence available to us. This evidence consists of the environmental assessment submitted by the NSF, monitoring reports submitted by past and present seismic survey operators, reports from NMFS Science Centers; reports prepared by natural resource agencies in states and other countries, reports from non-governmental organizations involved in marine conservation issues, the information provided by NMFS' Permits and Conservation Division when it initiates formal consultation, the general scientific literature, and our expert opinion.

We supplement this evidence with reports and other documents – environmental assessments, environmental impact statements, and monitoring reports – prepared by other federal and state agencies like the Bureau of Ocean Energy Management, U.S. Coast Guard, and U.S. Navy whose operations extend into the marine environment.

During the consultation, we conducted electronic searches of the general scientific literature using search engines, including Agricola, Ingenta Connect, Aquatic Sciences and Fisheries Abstracts, JSTOR, Conference Papers Index, First Search (Article First, ECO, WorldCat), Web of Science, Oceanic Abstracts, Google Scholar, and Science Direct. We also referred to an internal electronic library that represents a major repository on the biology of ESA-listed species under the NMFS' jurisdiction.

We supplemented these searches with electronic searches of doctoral dissertations and master's theses. These searches specifically tried to identify data or other information that supports a particular conclusion (for example, a study that suggests whales will exhibit a particular response to acoustic exposure or close vessel approach) as well as data that do not support that conclusion. When data are equivocal or when faced with substantial uncertainty, our decisions are designed to avoid the risks of incorrectly concluding that an action would not have an adverse effect on listed species when, in fact, such adverse effects are likely (i.e., Type II error).

3.1 Assessment approach applied to this consultation

In this particular assessment, we identified the potential stressors associated with the action and determined which were probable based upon previous seismic surveys. Of the probable stressors, we identified the species that are expected to co-occur with the effects of the action, particularly the acoustic isopleths of the airgun and other sound sources. Utilizing survey data from previous years and predictive environmental factors, density estimates per unit area of ESA-listed whales were multiplied by the area to be ensonified where effects were expected. Our primary concerns in this consultation revolve around exposure of listed individuals to anthropogenic sound sources, where those individuals may respond with behaviors that may result in fitness consequences (Francis and Barber 2013; Nowacek and Tyack 2013) (Figure 5). However, it should not be assumed that anthropogenic stressors lead to fitness consequences at the individual or population levels (New et al. 2013).

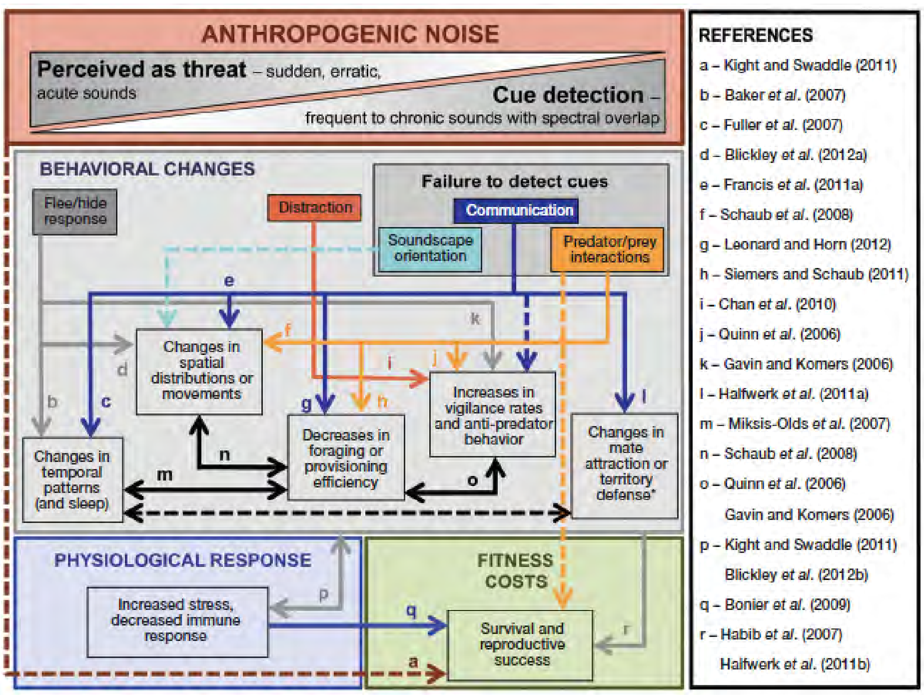

Figure 5. Conceptual framework of how anthropogenic noise impacts individuals and how those impacts may lead to fitness consequences.[1]

1 Figure taken from Francis et al. Francis, C. D., and J. R. Barber. 2013. A framework for understanding noise impacts on wildlife: An urgent conservation priority. Frontiers in Ecology and the Environment 11(6):305-313.

In order to reach conclusions regarding whether proposed actions are likely to jeopardize ESA-listed species, we had to make several assumptions. These included:

- Baleen whales can generally hear low-frequency sound (Southall et al. 2007a) better than high frequencies (Southall et al. 2007a), as the former is primarily the range in which they vocalize. Humpback whales frequently vocalize with mid-frequency sound (Southall et al. 2007a) and are likely to hear at these frequencies as well. Because of this, we can partition baleen whales into two groups: those that are specialists at hearing low frequencies (e.g., fin, North Atlantic right, and sei whales) and those that hear at low- to mid-frequencies (blue and humpback whales). Toothed whales (such as sperm whales) are better adapted to hear mid- and high-frequency sound for the same reason (although this species also responds to low-frequency sound and is considered to hear at low-, mid-, and high frequencies; i.e., vocalization, as is assumed for baleen whales). Sperm whales are also assumed to have similar hearing qualities as other, better studied, toothed whales. Hearing in sea turtles is generally similar within the taxa, with data from loggerhead and green sea turtles being representative of the taxa as a whole.
- Species for which little or no information on response to sound at different received sound levels will respond similarly to their close taxonomic or ecological relatives (i.e., baleen whales respond similarly to each other; same for sea turtles).

4 ACTION AREA

The seismic survey will be conducted off the New Jersey coast, outside of state waters, and within the Exclusive Economic Zone of the U.S. The region in which the seismic survey will occur is between 39.6° and 39.4° N and 73.7° and 73.8° W (Figure 6). The region encompasses water depths from 20-75 m along roughly 3,920 km of trackline, including turns and other seismic operations. In addition, the applicant estimated a 25% increase in trackline due to equipment failures, a need to reshoot some areas, and other logistical impacts, increasing the expected trackline to 4,900 km. Responses to seismic sound sources by listed marine mammals occur within the 160 dB isopleths (modeled to be up to 6.1 km from the *Langseth*), increasing the area ensonified along the trackline, including overlapping areas, to 72,348 km^2. Responses to seismic sound sources by listed sea turtles occur within the 166 dB isopleths (modeled to be up to 2.599 km from the *Langseth*), increasing the area ensonified along the trackline, including overlapping areas but including 25% increase due to contingencies, to 25,470 km^2. We also assessed the vessel transit to and from port for potential effects.

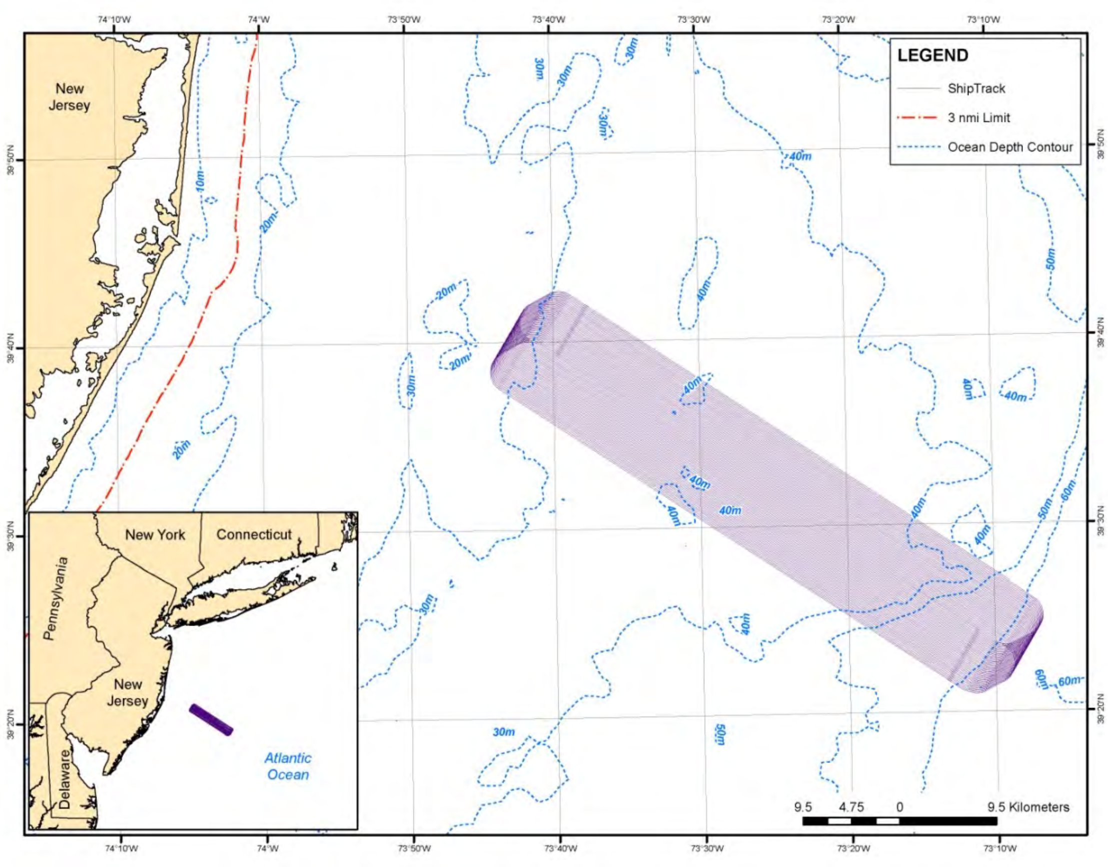

Figure 6. Proposed area for the marine seismic survey off New Jersey.

5 STATUS OF LISTED RESOURCES

The actions considered in this Opinion may affect species listed in **Table 4**, which are provided protection under the ESA.

Table 4. Species listed under the Endangered Species Act (ESA) in the action area that may experience adverse effects as a result of the proposed actions.

Species	ESA Status*	Critical Habitat	Recovery Plan
Marine Mammals – Cetaceans			
Blue Whale (*Balaenoptera musculus*)	E - 35 FR 18319	-- --	07/1998
Fin Whale (*Balaenoptera physalus*)	E - 35 FR 18319	-- --	71 FR 38385
Humpback Whale (*Megaptera novaeangliae*)	E - 35 FR 18319	-- --	55 FR 29646
Sei Whale (*Balaenoptera borealis*)	E - 35 FR 18319	-- --	-- --
Sperm Whale (*Physeter macrocephalus*)	E - 35 FR 18619	-- --	75 FR 81584
North Atlantic Right Whale (*Eubalaena glacialis*)	E - 35 FR 18319	59 FR 28805	70 FR 32293
Sea Turtles			
Kemp's Ridley (*Lepidochelys kempii*)	E - 35 FR 18319	-- --	-- --
Loggerhead (*Caretta caretta*): Northeast Atlantic DPS	E - 76 FR 58868	79 FR 39855	63 FR 28359†
Green (*Chelonia mydas*)	T - 43 FR 32800	-- --	63 FR 28359†
Leatherback (*Dermochelys coriacea*)	E - 35 FR 8491	-- --	63 FR 28359

*E=Endangered; T=Threatened
†Recovery Plan pertains to the U.S. Pacific population of loggerhead sea turtles

†A recovery plan for leatherbacks in the U.S. Atlantic (i.e., within the action area) is not available. However, there is a Recovery plan in place for leatherbacks in the Pacific (63 FR 28359), although it is not directly applicable to this action area.

5.1 Species and Critical Habitat Not Considered Further

Although the area in which the seismic survey is proposed to occur is relatively close to shore, we do not believe that listed sturgeons are likely to be present in the action area. Both Atlantic and shortnose sturgeon occur in nearshore marine waters along the mid-Atlantic, but tagging studies have not found them to occur as far offshore as the proposed action area. We also do not expect Atlantic salmon to occur in the action area during the seismic survey. Thus, NMFS does not anticipate that the proposed seismic survey would incidentally take any listed sturgeons or Atlantic salmon. Hawksbill sea turtles have been known to rarely strand along New Jersey shores or further north. However, the lack of sighting or bycatch data, as well as the rarity of strandings, leads us to believe that hawksbill sea turtles are unlikely to be in the action area at the time of the proposed seismic survey. The biology and ecology of species with anticipated exposure below informs the effects analysis for this Opinion. Summaries of the global status and trends of each species presented provide a foundation for the analysis of species as a whole.

5.2 Species Considered Further in this Opinion

The species narrative that follows focuses on attributes of life history and distribution that influence the manner and likelihood that this species may be exposed to the proposed action, as well as the potential response and risk when exposure occurs. Consequently, the species' narrative is a summary of a larger body of information on localized movements, population structure, feeding, diving, and social behaviors.

A summary of the status and trends of ESA-listed whales and sea turtles is presented here to provide a foundation for the analysis of the species as a whole. We also provide this brief summary of the species' status and trends as a point of reference for the jeopardy determination, made later in this Opinion. That is, we rely on a species' status and trend to determine whether an action's direct or indirect effects are likely to increase the species' probability of becoming extinct.

5.2.1 Blue whale

Subspecies. Several blue whale subspecies have been characterized from morphological and geographical variability, but the validity of blue whale subspecies designations remains uncertain (McDonald et al. 2006). The largest, the Antarctic or true blue whale (*Balaenoptera musculus intermedia*), occurs in the highest Southern Hemisphere latitudes (Gilpatrick and Perryman. 2009). During austral summers, "true" blue whales occur close to Antarctic ice. A slightly smaller blue whale, *B. musculus musculus*, inhabits the Northern Hemisphere (Gilpatrick and Perryman. 2009). The pygmy blue whale (*B. musculus brevicauda*), may be geographically distinct from *B. m. musculus* (Kato et al. 1995). Pygmy blue whales occur north of the Antarctic Convergence (60°-80° E and 66°-70° S), while true blue whales are found south of the Convergence (58° S) in the austral summer (Kasamatsu et al. 1996; Kato et al. 1995). A fourth subspecies, *B. musculus indica*, may exist in the northern Indian Ocean (McDonald et al. 2006), although these whales are frequently referred to as *B. m. brevicauda* (Anderson et al. 2012). Inbreeding between *B. m. intermedia* and *B. m. brevicauda* does occur (Attard et al. 2012).

Population structure. Little is known about population and stock structure[2] of blue whales. Studies suggest a wide range of alternative population and stock scenarios based on movement, feeding, and acoustic data. Some suggest that as many as 10 global populations may exist, while other studies suggest that the species is composed of a single panmictic population (Gambell 1979; Gilpatrick and Perryman. 2009; Reeves et al. 1998). For management purposes, the International Whaling Commission (IWC) considers all Pacific blue whales to be a single stock, whereas under the MMPA, the NMFS recognizes four stocks of blue whales: western North Pacific Ocean, eastern North Pacific Ocean, Northern Indian Ocean, and Southern Hemisphere.

Until recently, blue whale population structure had not been tested using molecular or nuclear genetic analyses (Reeves et al. 1998). A recent study by Conway (2005) suggested that the global population could be divided into four major subdivisions, which roughly correspond to major ocean basins: eastern North and tropical Pacific Ocean, Southern Indian Ocean, Southern

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"Populations" herein are a group of individual organisms that live in a given area and share a common genetic heritage. While genetic exchange may occur with neighboring populations, the rate of exchange is greater between individuals of the same population than among populations---a population is driven more by internal dynamics, birth and death processes, than by immigration or emigration of individuals. To differentiate populations, NMFS considers geographic distribution and spatial separation, life history, behavioral and morphological traits, as well as genetic differentiation, where it has been examined. In many cases, the behavioral and morphological differences may evolve and be detected before genetic variation occurs. In some cases, the term "stock" is synonymous with this definition of "population" while other usages of "stock" are not.

Ocean, and western North Atlantic Ocean.

North Atlantic. Blue whales are found from the Arctic to at least mid-latitude waters, and typically inhabit the open ocean with occasional occurrences in the U.S. Exclusive Economic Zone (EEZ) (Gagnon and Clark 1993; Wenzel et al. 1988; Yochem and Leatherwood 1985). Yochem and Leatherwood (1985) summarized records suggesting winter range extends south to Florida and the Gulf of Mexico. The U.S. Navy's Sound Surveillance System acoustic system has detected blue whales in much of the North Atlantic, including subtropical waters north of the West Indies and deep waters east of the U.S. Atlantic EEZ (Clark 1995). Blue whales are rare in the shelf waters of the eastern U.S. In the western North Atlantic, blue whales are most frequently sighted from the Gulf of St. Lawrence and eastern Nova Scotia and in waters off Newfoundland, during the winter (Sears et al. 1987). In the eastern North Atlantic, blue whales have been observed off the Azores, although Reiner et al. (1993) did not consider them common in that area. Observations of feeding have recently occurred over Ireland's western continental slope (Wall et al. 2009). No sightings have been made in the action area, although scattered rare sightings in the general region are documented (NSF 2014).

Age distribution. Blue whales may reach 70–80 years of age (COSEWIC 2002; Yochem and Leatherwood 1985).

Reproduction. Gestation takes 10-12 months, followed by a 6-7 month nursing period. Sexual maturity occurs at 5-15 years of age and calves are born at 2-3 year intervals (COSEWIC 2002; NMFS 1998b; Yochem and Leatherwood 1985). Recent data from illegal Russian whaling for Antarctic and pygmy blue whales support sexual maturity at 23 m and 19-20 m, respectively (Branch and Mikhalev 2008). The mean intercalving interval in the Gulf of California is roughly two and half years (Sears et al. 2014). Once mature, females return to the same areas where they were born to give birth themselves (Sears et al. 2014).

Movement. Satellite tagging indicates that, for blue whales tagged off Southern California, movement is more linear and faster (3.7 km/h) while traveling versus while foraging (1.7 km/h)(Bailey et al. 2009). Residency times in what are likely prey patches averages 21 days and constituted 29% of an individual's time overall, although foraging could apparently occur at any time of year for tagged individuals (Bailey et al. 2009). Broad scale movements also varied greatly, likely in response to oceanographic conditions influencing prey abundance and distribution (Bailey et al. 2009). Blue whales along Southern California were found to be traveling 85% of the time and milling 11% (Bacon et al. 2011). Blue whales are highly mobile, and their migratory patterns are not well known (Perry et al. 1999; Reeves et al. 2004). Blue whales migrate toward the warmer waters of the subtropics in fall to reduce energy costs, avoid ice entrapment, and reproduce (NMFS 1998a). In the eastern Central Atlantic, blue whales appear to migrate from areas along Greenland and Iceland to the Azores over and east of the Mid-Atlantic Ridge, apparently engaging in some random movement along the way (Anil et al. 2013).

Feeding. Data indicate that some summer feeding takes place at low latitudes in upwelling-modified waters, and that some whales remain year-round at either low or high latitudes (Clarke and Charif 1998b; Hucke-Gaete et al. 2004; Reilly and Thayer 1990; Yochem and Leatherwood 1985). Prey availability likely dictates blue whale distribution for most of the year (Burtenshaw et al. 2004; Clapham et al. 1999; Sears 2002 as cited in NMFS 2006a). The large size of blue whales requires higher energy requirements than smaller whales and potentially prohibits fasting

Mate et al. (1999). Blue whales typically occur alone, or in groups of two or three and up to five animals (Aguayo 1974; Mackintosh 1965; Nemoto 1964; Pike and MacAskie 1969; Ruud 1956; Slijper 1962). (Corkeron et al. 1999; Shirihai 2002). However, larger foraging aggregations, even with other species such as fin whales, are regularly reported (Fiedler et al. 1998; Schoenherr 1991).While feeding, blue whales show slowed and less obvious avoidance behavior then when not feeding (Sears et al. 1983 as cited in NMFS 2005b).

Vocalization and hearing. Blue whales produce prolonged low-frequency vocalizations that include moans in the range from 12.5-400 Hz, with dominant frequencies from 16-25 Hz, and songs that span frequencies from 16-60 Hz that last up to 36 sec repeated every 1 to 2 min (see Cummings and Thompson 1971; Cummings and Thompson 1977; Edds-Walton 1997b; Edds 1982; McDonald et al. 1995a; Thompson and Friedl 1982). Berchok et al. (2006) examined vocalizations of St. Lawrence blue whales and found mean peak frequencies ranging from 17.0-78.7 Hz. Reported source levels are 180-188 dB re 1μPa, but may reach 195 dB re 1μPa (Aburto et al. 1997; Clark and Ellison 2004; Ketten 1998b; McDonald et al. 2001). Samaran et al. (2010) estimated Antarctic blue whale calls in the Indian Ocean at 179 ± 5 dB re 1 μPa_{rms} in the 17-30 Hz range and pygmy blue whale calls at 175± 1 dB re 1 μPa_{rms} in the 17-50 Hz range. Direct studies of blue whale hearing have not been conducted, but it is assumed that blue whales can hear the same frequencies that they produce (low-frequency) and are likely most sensitive to this frequency range (Ketten 1997; Richardson et al. 1995c).

Vocalizations attributed to blue whales have been recorded in presumed foraging areas, along migration routes, and during the presumed breeding season (Beamish and Mitchell 1971; Cummings et al. 1972; Cummings and Thompson 1971; Cummings and Thompson 1977; Cummings and Thompson 1994; Rivers 1997; Thompson et al. 1996). As with other baleen whale vocalizations, blue whale vocalization function is unknown, although numerous hypotheses exist (maintaining spacing between individuals, recognition, socialization, navigation, contextual information transmission, and location of prey resources (Edds-Walton 1997a; Payne and Webb 1971; Thompson et al. 1992a). Intense bouts of long, patterned sounds are common from fall through spring in low latitudes, but these also occur less frequently while in summer high-latitude feeding areas. Short, rapid sequences of 30-90 Hz calls are associated with socialization and may be displays by males based upon call seasonality and structure. Blue whale calls appear to vary between western and eastern North Pacific regions, suggesting possible structuring in populations (Rivers 1997; Stafford et al. 2001).

The seasonality and structure of long patterned sounds suggest that these sounds are male displays for attracting females, competing with other males, or both. The context for the 30-90 Hz calls suggests that they are communicative but not related to a reproductive function.

Status and trends. Blue whales (including all subspecies) were originally listed as endangered in 1970 (35 FR 18319), and this status continues since the inception of the ESA in 1973.

Table 5 contains historic and current estimates of blue whales by region. Globally, blue whale abundance has been estimated at between 5,000-13,000 animals (COSEWIC 2002; Yochem and Leatherwood 1985); a fraction of the 200,000 or more that are estimated to have populated the oceans prior to whaling (Maser et al. 1981; U.S. Department of Commerce 1983). Consideration of the status of populations outside of the action area is important under the present analysis to determine the how the risk to the affected population(s) bears on the status of the species as a whole.

Table 5. Summary of past and present blue whale abundance.

Region	Population, stock, or study area	Pre-exploitation estimate	95% CI	Current estimate	95% CI	Source
Global	~~	200,000	~~	11,200-13,000	~~	(DOC 1983; Maser et al. 1981)
	~~	~~	~~	5,000-12,000	~~	(COSEWIC 2002)
North Atlantic	Basinwide	1,100-1,500	~~	100-555	~~	(Braham 1991; Gambell 1976)
	~~			1,000-2,000		(Sigurjonsson 1995)
	NMFS-western North Atlantic stock	~~	~~	440	~~	(Waring et al. 2013)
	Central and northeast Atlantic	~~	~~	855	351-1,589	(Pike et al. 2009b)

*Note: Confidence Intervals (C.I.) not provided by the authors were calculated from Coefficients of Variation (C.V.) where available, using the computation from Gotelli and Ellison (2004).

North Atlantic. Commercial hunting had a severe effect on blue whales, such that they remain rare in some formerly important habitats, notably in the northern and northeastern North Atlantic (Sigurjónsson and Gunnlaugsson 1990). Sigurjónsson and Gunnlaugsson (1990) estimated that at least 11,000 blue whales were harvested from all whaling areas from the late-nineteenth to mid-twentieth centuries.

Current trends are unknown, although an increasing annual trend of 4.9% was reported for 1969–1988 off western and southwestern Iceland (Sigurjónsson and Gunnlaugsson 1990). Sigurjónsson and Gunnlaugsson (1990) concluded that the blue whale population had been increasing since the late 1950s. In the northeastern Atlantic, blue whales are most common west and south of Iceland and may be the largest concentration of blue whales in the North Atlantic (Pike et al. 2009b). In this area, the population may be recovering at a rate of 4-5% (Pike et al. 2009b). Punt (2010) estimated the rate of increase for blue whales in the central North Atlantic to be 9% annually (3.83 standard error) between 1987 and 2001.

Natural threats. As the world's largest animals, blue whales are only occasionally known to be killed by killer whales (Sears et al. 1990; Tarpy 1979). Blue whales engage in a flight response to evade killer whales, which involves high energetic output, but show little resistance if overtaken (Ford and Reeves 2008). Blue whales are known to become infected with the nematode *Carricauda boopis*, which are believed to have caused mortality in fin whale due to renal failure (Lambertsen 1986).

Anthropogenic threats. Blue whales have faced threats from several historical and current sources. Blue whale populations were severely depleted due to historical whaling activity.

Increasing noise in the ocean may impair blue whale behavior. The general trend in increasing ambient low-frequency noise in the deep oceans of the world, primarily from ship engines, could impair the ability of blue whales to communicate or navigate through these vast expanses (Aburto et al. 1997; Clark 2006). Blue whales off California altered call levels and rates in association with changes in local vessel traffic (McKenna 2011). Either due to ship strike, vessel noise, whale watching, or a combination of these factors displacement from preferred habitat may be occurring off Sri Lanka (Ilangakoon 2012).

There is a paucity of contaminant data related to blue whales. Available information indicates that organochlorines, including dichloro-diphenyl-trichloroethane (DDT), polychlorinated biphenyls (PCB), benzene hexachloride, hexachlorobenzene (HCB), chlordane, dieldrin, methoxychlor, and mirex have been isolated from blue whale blubber and liver samples (Gauthier et al. 1997c; Metcalfe et al. 2004). Contaminant transfer between mother and calf occurs, meaning that young often start life with concentrations of contaminants equal to their mothers, before accumulating additional contaminant loads during life and passing higher loads to the next generation (Gauthier et al. 1997b; Metcalfe et al. 2004). This is supported by ear plug data showing maternal transfer of pesticides and flame retardants in the first year of life (Trumble et al. 2013). These data also support pulses of mercury in body tissues of the male studied (Trumble et al. 2013).

5.3 Fin whale

Subspecies. There are two recognized subspecies of fin whales, *Balaenoptera physalus physalus*, which occurs in the North Atlantic Ocean, and *B. p. quoyi*, which occurs in the Southern Ocean. These subspecies and North Pacific fin whales appear to be organized into separate populations, although there is a lack of consensus in the published literature as to population structure.

Population structure. Population structure has undergone only a rudimentary framing. Genetic studies by Bérubé et al. (1998) indicate that there are significant genetic differences among fin whales in differing geographic areas (Sea of Cortez, Gulf of St. Lawrence, and Gulf of Maine). Further, individuals in the Sea of Cortez may represent an isolated population from other eastern North Pacific fin whales (Berube et al. 2002). Even so, mark-recapture studies also demonstrate that individual fin whales migrate between management units designated by the IWC (Mitchell 1974; Sigujónsson and Gunnlaugsson 1989).

North Atlantic. Fin whales are common off the Atlantic coast of the U.S. in waters immediately off the coast seaward to the continental shelf (about the 1,800 m contour). Fin whales occur during the summer from Baffin Bay to near Spitsbergen and the Barents Sea, south to Cape Hatteras in North Carolina and off the coasts of Portugal and Spain (Rice 1998a). In areas north of Cape Hatteras, fin whales account for about 46% of the large whales observed in 1978-1982 surveys (CETAP 1982). Little is known about the winter habitat of fin whales, but in the western North Atlantic, the species has been found from Newfoundland south to the Gulf of Mexico and Greater Antilles, and in the eastern North Atlantic their winter range extends from the Faroes and Norway south to the Canary Islands. Fin whales in the eastern North Atlantic have been found in highest densities in the Irminger Sea between Iceland and Greenland (Víkingsson et al. 2009). The singing location of fin whales in the Davis Strait and Greenland has been correlated with sea ice fronts; climate change may impact fin whale distribution and movement by altering sea ice conditions (Simon et al. 2010). A general fall migration from the Labrador and Newfoundland region, south past Bermuda, and into the West Indies has been theorized (Clark 1995). Historically, fin whales were by far the most common large whale found off Portugal (Brito et al. 2009).

Fin whales are also endemic to the Mediterranean Sea, where (at least in the western Mediterranean), individuals tend to aggregate during summer and disperse in winter over large spatial scales (Cotte et al. 2009), although this seasonal trend is reversed in the Bonifacio Strait (Arcangeli et al. 2013a). Mediterranean fin whales are genetically distinct from fin whales in the rest of the North Atlantic at the population level (Berube et al. 1999). However, some fin whales from the northeastern North Atlantic have been tracked into the Mediterranean during winter and overlap in time and space with the Mediterranean population may exist (Castellote et al. 2010). Individuals also tend to associate with colder, saltier water, where steep changes in temperature, and where higher northern krill densities would be expected (Cotte et al. 2009). A genetically distinct population resides year-round in the Ligurian Sea (IWC 2006). Fin whales seem to track areas of high productivity in the Mediterranean, particularly along coastal areas of France, northern Italy, and the southern and middle Adriatic (Druon et al. 2012). Hundreds of sightings have been made along New Jersey during the approximate time frame of the proposed seismic survey (NSF 2014).

Age distribution. Aguilar and Lockyer (1987) suggested annual natural mortality rates in northeast Atlantic fin whales may range from 0.04 to 0.06. Fin whales live 70-80 years (Kjeld et al. 2006).

Reproduction. Fin whales reach sexual maturity between 5-15 years of age (COSEWIC 2005; Gambell 1985a; Lockyer 1972). Mating and calving occurs primarily from October-January, gestation lasts ~11 months, and nursing occurs for 6-11 months (Boyd et al. 1999; Hain et al. 1992). The average calving interval in the North Atlantic is estimated at about 2-3 years (Agler et al. 1993; Christensen et al. 1992a). The location of winter breeding grounds is uncertain but mating is assumed to occur in pelagic mid-latitude waters (Perry et al. 1999). This was recently contradicted by acoustic surveys in the Davis Strait and off Greenland, where singing by fin whales peaked in November through December; the authors suggested that mating may occur prior to southbound migration (Simon et al. 2010). Although seasonal migration occurs between presumed foraging and breeding locations, fin whales have been acoustically detected throughout the North Atlantic Ocean and Mediterranean Sea year-round, implying that not all individuals follow a set migratory pattern (Notarbartolo-Di-Sciara et al. 1999; Simon et al. 2010). Reductions in pregnancy rates appear correlated with reduced blubber thickness and prey availability (Williams et al. 2013).

Movement. In the eastern Central Atlantic, fin whales appear to migrate from areas along Iceland to the Azores east of the Mid-Atlantic Ridge, apparently traveling directly without random movement patterns in between (Anil et al. 2013).

Behavior. Fin whales along Southern California were found to be traveling 87% of the time and milling 5% in groups that averaged 1.7 individuals (Bacon et al. 2011). Fin whales tend to avoid tropical and pack-ice waters, with the high-latitude limit of their range set by ice and the lower-latitude limit by warm water of approximately 15° C (Sergeant 1977). Fin whale concentrations generally form along frontal boundaries or mixing zones between coastal and oceanic waters, which corresponds roughly to the 200 m isobath (the continental shelf edge (Cotte et al. 2009; Nasu 1974)).

Feeding. Fin whales in the North Atlantic eat pelagic crustaceans (mainly krill and schooling fish such as capelin, herring, and sand lance (Borobia and Béland 1995; Christensen et al. 1992a; Hjort and Ruud 1929; Ingebrigtsen 1929; Jonsgård 1966; Mitchell 1974; Overholtz and Nicolas 1979; Sergeant 1977; Shirihai 2002; Watkins et al. 1984)). Fin whales frequently forage along cold eastern current boundaries (Perry et al. 1999). Feeding may occur in waters as shallow as 10 m when prey are at the surface, but most foraging is observed in high-productivity, upwelling, or thermal front marine waters (Gaskin 1972; Nature Conservancy Council 1979 as cited in ONR 2001; Panigada et al. 2008; Sergeant 1977). While foraging, fin whales in the Mediterranean Sea have been found to move through restricted territories in a convoluted manner (Lafortuna et al. 1999). Fin whales in the central Tyrrhenian Sea appear to ephemerally exploit the area for foraging during summer, particularly areas of high primary productivity (Arcangeli et al. 2013b).

Vocalization and hearing. Fin whales produce a variety of low-frequency sounds in the 10-200 Hz range (Edds 1988; Thompson et al. 1992a; Watkins 1981; Watkins et al. 1987b). Typical vocalizations are long, patterned pulses of short duration (0.5-2 s) in the 18-35 Hz range, but only males are known to produce these (Croll et al. 2002; Patterson and Hamilton 1964). Richardson et al. (1995b) reported the most common sound as a 1 sec vocalization of about 20 Hz, occurring in short series during spring, summer, and fall, and in repeated stereotyped patterns during winter. Au (2000b) reported moans of 14-118 Hz, with a dominant frequency of 20 Hz, tonal vocalizations of 34-150 Hz, and songs of 17-25 Hz (Cummings and Thompson 1994; Edds 1988; Watkins 1981). Source levels for fin whale vocalizations are 140-200 dB re 1μPa·m (Clark and Ellison. 2004; Erbe 2002b). The source depth of calling fin whales has been reported to be about 50 m (Watkins et al. 1987b). In temperate waters, intense bouts of long patterned sounds are very common from fall through spring, but also occur to a lesser extent during the summer in high latitude feeding areas (Clarke and Charif 1998a). Short sequences of rapid pulses in the 20-70 Hz band are associated with animals in social groups (McDonald et al. 1995b). Each pulse lasts on the order of one second and contains twenty cycles (Tyack 1999).

Although their function is still debated, low-frequency fin whale vocalizations travel over long distances and may aid in long-distance communication (Edds-Walton 1997a; Payne and Webb 1971). During the breeding season, fin whales produce pulses in a regular repeating pattern, which have been proposed to be mating displays similar to those of humpbacks (Croll et al. 2002). These vocal bouts last for a day or longer (Tyack 1999). The seasonality and stereotype of the bouts of patterned sounds suggest that these sounds are male reproductive displays (Watkins et al. 1987a), while the individual counter-calling data of McDonald et al. (1995b) suggest that the more variable calls are contact calls. Some authors feel there are geographic differences in the frequency, duration and repetition of the pulses (Thompson et al. 1992b).

Direct studies of fin whale hearing have not been conducted, but it is assumed that fin whales can hear the same frequencies that they produce (low) and are likely most sensitive to this frequency range (Ketten 1997; Richardson et al. 1995c).

Status and trends. Fin whales were originally listed as endangered in 1970 (35 FR 18319), and this status continues since the inception of the ESA in 1973. Although fin whale population structure remains unclear, various abundance estimates are available (**Table 6**). Consideration of the status of populations outside of the action area is important under the present analysis to determine the how the risk to the affected population(s) bears on the status of the species as a whole. Historically, worldwide populations were severely depleted by commercial whaling, with more than 700,000 whales harvested in the twentieth century (Cherfas 1989b; Cherfas 1989a).

Table 6. Summary of past and present fin whale abundance.

Region	**Population, stock, or study area**	**Pre-exploitation estimate**	**95% CI**	**Recent estimate**	**95% CI**	**Source**
Global	~~	>464,000	~~	119,000	~~	(Braham 1991)
North Atlantic	Basinwide	30,000-50,000	~~	~~	~~	(Sergeant 1977)
	~~	360,000	249,000-481,000	~~	~~	(Roman and Palumbi 2003)
	~~			>50,000		(Sigurjonsson 1995)
	Eastern North Atlantic			25,000		(2009) circa 2001
	Central and northeastern Atlantic	~~	~~	30,000	23,000-39,000	(IWC 2007)
	Western North Atlantic	~~	~~	3,590-6,300	~~	(Braham 1991)
	NMFS-western North Atlantic stock	~~	~~	3,985	CV=0.24	(NMFS 2008; Waring et al. 2012)(NMFS 2008; Waring et al. 2012)(NMFS 2008; Waring et al. 2012)
	Northeastern U.S. Atlantic cont'l shelf	~~	~~	2,200-5,000	~~	(Hain et al. 1992; Waring et al. 2000)
	IWC-Newfoundland-Labrador stock	~~	~~	13,253	0-50,139*	(IWC 1992)
	Bay of Biscay			7,000-8,000		(Goujon et al. 1994)
	IWC-British Isles, Spain, and Portugal stock	10,500	9,600-11,400	4,485	3,369-5,600	(Braham 1991)
	~~	~~	~~	17,355	10,400-28,900	(Buckland et al. 1992)
	IWC-east Greenland to Faroe Islands	~~	~~	22,000	16,000-30,000	(IWC 2014)

IWC-west Greenland stock	~~	~~	4,500	1,900-10,000	(IWC 2014)

*Note: Confidence Intervals (C.I.) not provided by the authors were calculated from Coefficients of Variation (C.V.) where available, using the computation from Gotelli and Ellison (2004).

North Atlantic. Over 48,000 fin whales were caught between 1860-1970 (Braham 1991). Although protected by the IWC, from 1988-1995 there have been 239 fin whales harvested from the North Atlantic. Recently, Iceland resumed whaling of fin whales despite the 1985 moratorium imposed by the IWC. Vikingsson et al. (2009) concluded that actual numbers were likely higher due to negative bias in their analysis, and that the population(s) were increasing at 4% annually. The abundance of fin whales in the Baffin Bay-Davis Strait summer feeding area is believed to be increasing (Heide-Jorgensen et al. 2010).

Natural threats. Natural sources and rates of mortality are largely unknown, but Aguilar and Lockyer (1987) suggested annual natural mortality rates might range from 0.04 to 0.06 for northeast Atlantic fin whales. The occurrence of the nematode *Crassicauda boopis* appears to increase the potential for kidney failure and may be preventing some fin whale populations from recovering (Lambertsen 1992). Adult fin whales engage in a flight responses (up to 40 km/h) to evade killer whales, which involves high energetic output, but show little resistance if overtaken (Ford and Reeves 2008). Shark attacks may also result in serious injury or death in very young and sick individuals (Perry et al. 1999).

Anthropogenic threats. Increased noise in the ocean stemming from shipping seems to alter the acoustic patterns of singing fin whales, possibly hampering reproductive parameters across wide regions (Castellote et al. 2012).

The organochlorines DDE, DDT, and PCBs have been identified from fin whale blubber, but levels are lower than in toothed whales due to the lower level in the food chain that fin whales feed at (Aguilar and Borrell 1988; Borrell 1993; Borrell and Aguilar 1987; Henry and Best 1983; Marsili and Focardi 1996). Females contained lower burdens than males, likely due to mobilization of contaminants during pregnancy and lactation (Aguilar and Borrell 1988; Gauthier et al. 1997b; Gauthier et al. 1997c). Contaminant levels increase steadily with age until sexual maturity, at which time levels begin to drop in females and continue to increase in males (Aguilar and Borrell 1988).

Climate change also presents a potential threat to fin whales, particularly in the Mediterranean Sea, where fin whales appear to rely exclusively upon northern krill as a prey source. These krill occupy the southern extent of their range and increases in water temperature could result in their decline and that of fin whales in the Mediterranean Sea (Gambaiani et al. 2009).

5.4 Humpback whale

Population designations. Populations have been relatively well defined for humpback whales.

North Atlantic. Humpback whales range from the mid-Atlantic Bight and the Gulf of Maine across the southern coast of Greenland and Iceland to Norway in the Barents Sea. Whales migrate to the western coast of Africa (Waerebeek et al. 2013), the Cape Verde Islands, and the Caribbean Sea during the winter. Humpback whales aggregate in four summer feeding areas: Gulf of Maine and eastern Canada, west Greenland, Iceland, and Norway (Boye et al. 2010; Katona and Beard 1990; Smith et al. 1999).

Increasing range and occurrence in the Mediterranean Sea coincides with population growth and may represent reclaimed habitat from pre-commercial whaling (Frantzis et al. 2004; Genov et al. 2009). The principal breeding range for Atlantic humpback whales lies from the Antilles and northern Venezuela to Cuba (Balcomb III and Nichols 1982; Whitehead and Moore 1982; Winn et al. 1975). The largest breeding aggregations occur off the Greater Antilles where humpback whales from all North Atlantic feeding areas have been photo-identified (Clapham et al. 1993; Katona and Beard 1990; Mattila et al. 1994; Palsbøll et al. 1997; Smith et al. 1999; Stevick et al. 2003b). However, the possibility of historic and present breeding further north remains enigmatic but plausible (Smith and G.Pike 2009). Winter aggregations also occur at the Cape Verde Islands in the eastern North Atlantic and along Angola (Cerchio et al. 2010; Reeves et al. 2002; Reiner et al. 1996; Weir 2007). Accessory and historical aggregations also occur in the eastern Caribbean (Levenson and Leapley 1978; Mitchell and Reeves 1983; Reeves et al. 2001a; Reeves et al. 2001b; Schwartz 2003; Smith and Reeves 2003; Swartz et al. 2003; Winn et al. 1975). To further highlight the “open” structure of humpback whales, a humpback whale migrated from the Indian Ocean to the South Atlantic Ocean, demonstrating that interoceanic movements can occur (Pomilla and Rosenbaum 2005). Genetic exchange at low-latitude breeding groups between Northern and Southern Hemisphere individuals and wider-range movements by males has been suggested to explain observed global gene flow (Rizzo and Schulte 2009). However, there is little genetic support for wide-scale interchange of individuals between ocean basins or across the equator. Dozens of sightings have been made along New Jersey during the approximate time frame of the proposed seismic survey (NSF 2014).

Reproduction and growth. Humpback whale calving and breeding generally occurs during winter at lower latitudes. Gestation takes about 11 months, followed by a nursing period of up to one year (Baraff and Weinrich 1993). Sexual maturity is reached at between 5-7 years of age in the western North Atlantic, but may take as long as 11 years in the North Pacific, and perhaps over 11 years (e.g., southeast Alaska, Gabriele et al. 2007). Females usually breed every 2-3 years, although consecutive calving is not unheard of (Clapham and Mayo 1987; 1990; Glockner-Ferrari and Ferrari 1985 as cited in NMFS 2005b; Weinrich et al. 1993). Males appear to return to breeding grounds more frequently than do females (Herman et al. 2011). Larger females tend to produce larger calves that may have a greater chance of survival (Pack et al. 2009). Females appear to preferentially select larger-sized males (Pack et al. 2012). In some Atlantic areas, females tend to prefer shallow nearshore waters for calving and rearing, even when these areas are extensively trafficked by humans (Picanco et al. 2009). Offspring appear to return to the same breeding areas at which they were born one they are independent (Baker et al. 2013).

Generation time for humpback whales is estimated at 21.5 years, with individuals surviving from 80-100 years (COSEWIC 2011).

Feeding. During the feeding season, humpback whales form small groups that occasionally aggregate on concentrations of food that may be stable for long-periods of times. Humpbacks use a wide variety of behaviors to feed on various small, schooling prey including krill and fish (Hain et al. 1982; Hain et al. 1995; Jurasz and Jurasz 1979; Weinrich et al. 1992; Witteveen et al. 2011). The principal fish prey in the western North Atlantic are sand lance, herring, and capelin (Kenney et al. 1985b). There is good evidence of some territoriality on feeding and calving areas (Clapham 1994; Clapham 1996; Tyack 1981). Humpback whales are generally believed to fast while migrating and on breeding grounds, but some individuals apparently feed while in low-latitude waters normally believed to be used exclusively for reproduction and calf-rearing (Danilewicz et al. 2009; Pinto De Sa Alves et al. 2009). Some individuals, such as juveniles, may not undertake migrations at all (Findlay and Best. 1995). Additional evidence, such as songs sung in northern latitudes during winter, provide additional support to plastic seasonal distribution (Smith and G.Pike 2009). Relatively high rates of resighting in foraging sites suggest whales return to the same areas year after year (Ashe et al. 2013; Kragh Boye et al. 2010). This trend appears to be maternally linked, with offspring returning to the same areas their mothers brought them to once calves are independent (Baker et al. 2013; Barendse et al. 2013). Humpback whales in foraging areas may forage largely or exclusively at night when prey are closer to the surface (Friedlaender et al. 2013).

Vocalization and hearing. Humpback whale vocalization is much better understood than is hearing. Different sounds are produced that correspond to different functions: feeding, breeding, and other social calls (Dunlop et al. 2008). Males sing complex sounds while in low-latitude breeding areas in a frequency range of 20 Hz to 4 kHz with estimated source levels from 144-174 dB (Au 2000b; Au et al. 2006; Frazer and Mercado 2000; Payne 1970; Richardson et al. 1995c; Winn et al. 1970). Both mature and immature males sing in breeding areas (Herman et al. 2013). Males also produce sounds associated with aggression, which are generally characterized as frequencies between 50 Hz to 10 kHz and having most energy below 3 kHz (Silber 1986; Tyack 1983). Such sounds can be heard up to 9 km away (Tyack and Whitehead 1983). Other social sounds from 50 Hz to 10 kHz (most energy below 3 kHz) are also produced in breeding areas (Richardson et al. 1995c; Tyack and Whitehead 1983). While in northern feeding areas, both sexes vocalize in grunts (25 Hz to 1.9 kHz), pulses (25-89 Hz), and songs (ranging from 30 Hz to 8 kHz but dominant frequencies of 120 Hz to 4 kHz) which can be very loud (175-192 dB re 1 μPa at 1 m; (Au 2000b; Erbe 2002a; Payne and Payne 1985; Richardson et al. 1995c; Thompson et al. 1986; Vu et al. 2012). However, humpbacks tend to be less vocal in northern feeding areas than in southern breeding areas, possibly due to foraging (Richardson et al. 1995c; Vu et al. 2012). During migration, social vocalizations are generated at 123 to 183 dB re 1 µPa at1 m with a median of 158 dB re 1 µPa at 1 m (Dunlop et al. 2013).

Status and trends. Humpback whales were originally listed as endangered in 1970 (35 FR 18319), and this status remains under the ESA. (Winn and Reichley 1985) argued that the global humpback whale population consisted of at least 150,000 whales in the early 1900s, mostly in the Southern Ocean. Consideration of the status of populations outside of the action area is important under the present analysis to determine the risk to the affected population(s) bears on the status of the species as a whole. **Table 7** provides estimates of historic and current abundance for ocean regions.

North Atlantic. Historical estimates have ranged from 40,000-250,000 (Smith and G.Pike 2009). Smith and Reeves (2010) estimated that roughly 31,000 individuals were removed from the North Atlantic due to whaling since the 1600s. Estimates of animals on Caribbean breeding grounds exceed 2,000 individuals (Balcomb III and Nichols 1982). Several researchers report an increasing trend in abundance for the North Atlantic population, which is supported by increased sightings within the Gulf of Maine feeding aggregation (Barlow 1997; Katona and Beard 1990; Smith et al. 1999; Waring et al. 2001). The rate of increase varies from 3.2-9.4%, with rates of increase slowing over the past two decades (Barlow 1997; Katona and Beard 1990; Stevick et al. 2003a). If the North Atlantic population has grown according to the estimated instantaneous rate of increase ($r = 0.0311$), this would lead to an estimated 18,400 individual whales in 2008

(Stevick et al. 2003a). Punt (2010) estimated the rate of increase for humpback whales in the Gulf of Maine to be 6.3% annually (1.2 SE). Pike et al. (2009a) suggested that the eastern and northeastern waters off Iceland are areas of significant humpback utilization for feeding, estimating nearly 5,000 whales in 2001 and proposing an annual growth rate of 12% for the area.

Table 7. Summary of past and present humpback whale abundance.

Region	**Population, stock, or study area**	**Pre-exploitation estimate**	**95% CI**	**Recent estimate**	**95% CI**	**Source**
Global	~~	1,000,000	~~	~~	~~	(Roman and Palumbi 2003)
				10,000		(NMFS 1987)
North Atlantic	Basinwide	240,000	156,000-401,000*	11,570	10,005-13,135*	(Stevick et al. 2003a)
	~~	~~	~~	>5,500	~~	(Sigurjonsson 1995)
	Basinwide-females	~~	~~	2,804	1,776-4,463	(Palsbøll et al. 1997)
	Basinwide-males	~~	~~	4,894	3,374-7,123	(Palsbøll et al. 1997)
	Western North Atlantic	~~	~~	11,600	10,000-13,000	(IWC 2014)
	Western North Atlantic from Davis Strait, Iceland, to the West Indies	>4,685*	~~	~~	~~	*circa 1865; (Mitchell and Reeves 1983)
	West Greenland	~~	~~	2,154	CV=0.36	(Heide-Jorgensen et al. 2012)
	Iceland	~~	~~	5,000	~~	(Pike et al. 2009a)
	NMFS-Gulf of Maine stock	~~	~~	847	CV=0.55	(Waring et al. 2012)
	NMFS-Gulf of Maine stock including portions of the Scotian Shelf	~~	~~	902	177-1,627	(Clapham et al. 2003)
	Barents and Norwegian Seas	~~	~~	889	331-1,447*	(Øien 2001) *in* (Waring et al. 2004)

*Note: Confidence Intervals (C.I.) not provided by the authors were calculated from Coefficients of Variation (C.V.) where available, using the computation from Gotelli and Ellison (2004).

The authors suggest that humpback whales in the area had probably recovered from whaling.

However, recent data suggest that the upward growth may have slowed or ceased around Iceland according to analysis of survey data there (Pike et al. 2010). The Gulf of Maine stock is estimated to be increasing at a rate of 3.1% annually (Waring et al. 2013). Humpback whales summering off West Greenland appear to be increasing at a rate of 9.4% annually (Heide-Jorgensen et al. 2012).

Natural threats. Natural sources and rates of mortality of humpback whales are not well known. Based upon prevalence of tooth marks, attacks by killer whales appear to be highest among humpback whales migrating between Mexico and California, although populations throughout the Pacific Ocean appear to be targeted to some degree (Steiger et al. 2008). Juveniles appear to be the primary age group targeted. Humpback whales engage in grouping behavior, flailing tails, and rolling extensively to fight off attacks. Calves remain protected near mothers or within a group and lone calves have been known to be protected by presumably unrelated adults when confronted with attack (Ford and Reeves 2008).

Parasites and biotoxins from red-tide blooms are other potential causes of mortality (Perry et al. 1999). The occurrence of the nematode *Crassicauda boopis* appears to increase the potential for kidney failure in humpback whales and may be preventing some populations from recovering (Lambertsen 1992). Studies of 14 humpback whales that stranded along Cape Cod between November 1987 and January 1988 indicate they apparently died from a toxin produced by dinoflagellates during this period. One-quarter of humpback whales of the Arabian Sea population show signs of tattoo skin disease, which may reduce the fitness of afflicted individuals (Baldwin et al. 2010).

Anthropogenic threats. Three human activities are known to represent major threats to humpback whales: whaling, commercial fishing, and shipping. Historically, whaling represented the greatest threat to every population of whales and was ultimately responsible for several species being listed as endangered.

Organochlorines, including PCB and DDT, have been identified in humpback whale blubber (Gauthier et al. 1997b). Higher PCB levels have been observed in western Atlantic waters versus Pacific waters along the United States and levels tend to increase with individual age (Elfes et al. 2010); eastern Atlantic individuals fall between these two in contaminant burden (Ryan et al. 2014) . Although humpback whales in the Gulf of Maine and off Southern California tend to have the highest PCB concentrations, overall levels are on par with other baleen whales, which are generally lower than odontocete cetaceans (Elfes et al. 2010). These contaminants are transferred to young through the placenta, leaving newborns with contaminant loads equal to that of mothers before bioaccumulating additional contaminants during life and passing the additional burden to the next generation (Metcalfe et al. 2004). Contaminant levels are relatively high in humpback whales as compared to blue whales. Humpback whales feed higher on the food chain, where prey carry higher contaminant loads than the krill that blue whales feed on.

5.5 North Atlantic right whale

Population. All North Atlantic right whales compose a single population. Although not all individuals undergo the same migratory pattern, no subpopulation structuring has been identified.

Distribution. Right whales occur in sub-polar to temperate waters in all major ocean basins in the world, with a clear migratory pattern of high latitudes in summer and lower latitudes in winter (Cummings 1985; Perry et al. 1999; Rice 1998b). The historical range of North Atlantic right whales extended as far south as Florida and northwestern Africa, and as far north as Labrador, southern Greenland, Iceland, and Norway (Cummings 1985; Reeves et al. 1978; Rice 1998b). Recent sightings have been made through some of the broader historical range, including Iceland, Greenland, Norway, and the Azores (Hamilton et al. 2009; Hamilton et al. 2007; Jacobsen et al. 2004; Silva et al. 2012). Additional rare sightings have been made in the Gulf of Mexico (Moore and Clark 1963; Schmidly et al. 1972). Most sightings in the western North Atlantic are concentrated within five primary habitats or high-use areas: coastal waters of the southeastern U.S., Cape Cod and Massachusetts Bays, the Great South Channel, the Bay of Fundy, and the Scotian Shelf (Winn et al. 1986). In 1994, the first three of these areas were designated as critical habitat for the North Atlantic right whale.

North Atlantic right whales have been observed from the mid-Atlantic Bight northward through the Gulf of Maine year-round, but are primarily found along the northeast U.S. during summer and Florida during winter, with migratory routes in between. In New England, peak abundance of North Atlantic right whales in feeding areas occurs in Cape Cod Bay beginning in late winter. In early spring (late February to April), peak North Atlantic right whale abundance occurs in Jordan and Wilkinson Basins to the Great South Channel (Kenney et al. 1995; Nichols et al. 2008; Pace III and Merrick 2008). In late June and July, North Atlantic right whale distribution gradually shifts to the northern edge of Georges Bank. In late summer (August) and fall, much of the population is found in waters in the Bay of Fundy, the western Gulf of Maine and around Roseway Basin (Kenney et al. 2001; Kenney et al. 1995; Pace III and Merrick 2008; Winn et al. 1986). However, year-to-year variation in space and time are known and likely result from patchy prey distribution (Nichols et al. 2008). Variation in the abundance and development of suitable food patches appears to modify the general patterns of movement by reducing peak numbers, stay durations, and specific locales (Brown et al. 2001; Kenney 2001). In particular, large changes in the typical pattern of food abundance will dramatically change the general pattern of North Atlantic right whale habitat use (Kenney 2001). Several sightings have been made along New Jersey during the approximate time frame of the proposed seismic survey (NSF 2014).

Migration and movement. North Atlantic right whales exhibit extensive migratory patterns, traveling along the eastern seaboard of the U.S. and Canada between calving grounds off Georgia and Florida to northern feeding areas off the northeast U.S. and Canada in March/April and the reverse direction in November/December. The longest tracking of a North Atlantic right whale was a migration of 1,200 miles in 23 days the Bay of Fundy to Georgia (Mate and Baumgartner 2001). Migrations are typically within 30 nautical miles of the coastline and in waters less than 160 feet deep. Although this pattern is well-known, most of the population, particularly the males and non-pregnant females, is not found in the calving area and may not follow this pattern. It is unknown where the majority of the non-calving population spends the winter. Whales may remain in their foraging habitat during winter (Morano et al. 2012).

There have been a few recent sightings of North Atlantic right whales far offshore, including those from Dutch ships indicating some individuals occur between 40° and 50° N, in waters influenced by the North Atlantic Current (the broad, eastward-flowing extension of the Gulf Stream). Right whales have been sighted offshore (greater than 30 miles) during surveys flown off the coast of northeastern Florida and southeastern Georgia from 1996 to 2001. These include three sightings in 1996, one in 1997, 13 in 1998, six in 1999, 11 in 2000, and six in 2001 (within each year, some were repeat sightings). Mate et al. (1997) recorded radio-tagged animals making extensive movements from the Gulf of Maine into deeper waters off the continental shelf (Mate et al. 1997). The frequency with which North Atlantic right whales occur in offshore waters in the southeastern U.S. remains unclear. Occasionally, individuals are observed in distant locations, including the Gulf of Mexico, Bermuda, Azores, the Gulf of St. Lawrence, Newfoundland, Greenland, Iceland, and northern Norway (an area known as a historical North Atlantic right whale feeding area Silva et al. 2012; Smith et al. 2006). The Norwegian sighting (September 1992) represents one of only two sightings this century of a right whale in Norwegian waters, and the first since 1926. Together, these long-range matches indicate an extended range for at least some individuals and perhaps the existence of important habitat areas not presently well described.

Reproduction, growth, and demography. Data through the 1990s suggests that mean calving interval increased since 1992 from 3.67 years to more than five years, a significant trend that hampers North Atlantic right whale recovery (Best et al. 2001a; Kraus et al. 2007). This reproductive rate was approximately half that reported from studied populations of southern right whales (Best et al. 2001b). This has been attributed to several possible causes, including higher abortion or perinatal losses (Browning et al. 2009). An analysis of the age structure of North Atlantic right whales suggests that the population contains a smaller proportion of juvenile whales than expected, which may reflect lowered recruitment and/or high juvenile mortality (Best et al. 2001a; Hamilton et al. 1998). In addition, it is possible that the apparently low reproductive rate is due in part to unstable age structure or to reproductive senescence on the part of some females. However, knowledge on either factor is poor. Even though investment in calves is high for North Atlantic right whales, an incident of calf exchange (probably accidentally and soon after birth) and subsequent adoption through weaning has been found (Frasier et al. 2010). Although North Atlantic right whales historically separated from their calves within one year, a shift appears to have taken place around 2001 where mothers (particularly less experienced mothers) return to wintering grounds with their yearling at a much greater frequency (71% overall)(Hamilton and Cooper. 2010). The significance of this change is unknown.

Calves reach roughly three-quarters of their adult body size by the time they wean at 12 months, roughly doubling their original body size and gaining about 36 kg daily (Fortune et al. 2012).

Habitat. Available evidence from North Atlantic right whale foraging and habitat studies shows that North Atlantic right whales focus foraging activities where physical oceanographic features such as water depth, current, and mixing fronts combine to concentrate copepods (Baumgartner et al. 2003; Davies et al. 2014; Mayo and Marx 1990; Murison and Gaskin 1989; Wishner et al. 1988).

Feeding. North Atlantic right whales fast during the winter and feed during the summer, although some may opportunistically feed during migration. North Atlantic right whales use their baleen to sieve copepods from dense patches, found in highly variable and spatially unpredictable locations in the Bay of Fundy, Roseway Basin, Cape Cod Bay, the Great South Channel, and other areas off of northern U.S. and Canada (Pendleton et al. 2009). The primary prey of North Atlantic right whales is zooplankton, especially shrimp-like copepods such as *Calanus* (Beardsley et al. 1996; Kenney et al. 1985a). North Atlantic right whales feed largely by skimming these prey from the ocean surface (Mayo and Marx 1990; Pivorunas 1979), but may feed anywhere in the water column (Goodyear 1993; Watkins and Schevill 1976; Watkins and

Schevill 1979; Winn et al. 1995). Feeding behavior has only been observed in northern areas and not on calving grounds or during migration (Kraus et al. 1993).

Vocalization and hearing. Right whales vocalize to communicate over long distances and for social interaction, including communication apparently informing others of prey patch presence (Biedron et al. 2005; Tyson and Nowacek 2005). Vocalization patterns amongst all right whale species are generally similar, with six major call types: scream, gunshot, blow, up call, warble, and down call (McDonald and Moore 2002; Parks and Tyack 2005). A large majority of vocalizations occur in the 300-600 Hz range with up- and down sweeping modulations (Vanderlaan et al. 2003). Vocalizations below 200 Hz and above 900 Hz were rare (Vanderlaan et al. 2003). Calls tend to be clustered, with periods of silence between clusters (Vanderlaan et al. 2003). Gunshot bouts last 1.5 hours on average and up to seven hours (Parks et al. 2012a). Blows are associated with ventilation and are generally inaudible underwater (Parks and Clark 2007). Up calls are 100-400 Hz (Gillespie and Leaper 2001). Gunshots appear to be a largely or exclusively male vocalization (Parks et al. 2005b). Smaller groups vocalize more than larger groups and vocalization is more frequent at night (Matthews et al. 2001). Moans are usually produced within 10 m of the surface (Matthews et al. 2001). Up calls were detected year-round in Massachusetts Bay except July and August and peaking in April (Mussoline et al. 2012). Individuals remaining in the Gulf of Maine through winter continue to call, showing a strong diel pattern of up call and gunshot vocalizations from November through January possibly associated with mating (Bort et al. 2011; Morano et al. 2012; Mussoline et al. 2012). Estimated source levels of gunshots in non-surface active groups are 201 dB re 1 μPa p-p (Hotchkin et al. 2011). While in surface active groups, females produce scream calls and males produce up calls and gunshot calls as threats to other males; calves (at least female calves) produce warble sounds similar top their mothers' screams (Parks et al. 2003; Parks and Tyack 2005). North Atlantic right whales produce a variety of calls from 159-192 dB re: 1 μPa while in surface active groups on breeding grounds (Tryonis et al. 2013). Source levels for these calls in surface active groups range from 137-162 dB rms re: 1 μPa-m, except for gunshots, which are 174-192 dB rms re: 1 μPa-m (Parks and Tyack 2005). Up calls may also be used to reunite mothers with calves (Parks and Clark 2007). Atlantic right whales shift calling frequencies, particularly of up calls, as well as increase call amplitude over both long and short term periods due to exposure to vessel noise (Parks and Clark 2007; Parks et al. 2005a; Parks et al. 2007a; Parks et al. 2011a; Parks et al. 2010; Parks et al. 2012b; Parks et al. 2006), particularly the peak frequency (Parks et al. 2009). North Atlantic right whales respond to anthropogenic sound designed to alert whales to vessel presence by surfacing (Nowacek et al. 2003; Nowacek et al. 2004b).

No direct measurements of right whale hearing have been undertaken (Parks and Clark 2007). Models based upon right whale auditory anatomy suggest a hearing range of 10 Hz to 22 kHz (Parks et al. 2007b).

Status and trends. The Northern right whale was originally listed as endangered in 1970 (35 FR 18319), and this status remained since the inception of the ESA in 1973. The early listing included both the North Atlantic and the North Pacific populations, although subsequent genetic studies conducted by Rosenbaum (2000) resulted in strong evidence that North Atlantic and North Pacific right whales are separate species. Following a comprehensive status review, NMFS concluded that North Atlantic and North Pacific right whales are separate species. In March 2008, NMFS published a final rule listing North Pacific and North Atlantic right whales as separate species (73 FR 12024).

North Atlantic right whales were formerly abundant, with an estimated 5,500 individuals present in the 16th century throughout the North Atlantic (Reeves 2001; Reeves et al. 2007). However, genetic evidence suggests a much large historical population size of 112,000 individuals (95 % CI 45,000–235,000)(Ruegg et al. 2013). A review of the photo-id recapture database in June 2006, indicated that only 313 individually recognized North Atlantic right whales were observed during 2001. Recent additions to the photo-ID catalog lead to a minimum population estimate of 444 individuals (Waring et al. 2013). This represents a nearly complete census, and the estimated minimum population size. However, no estimate of abundance with an associated coefficient of variation has been calculated for the population. Furthermore, 55% of fathers have not been genetically identified, suggesting the population may be significantly larger than presently thought (Frasier 2005). This also suggests the occurrence of right whales in as yet unidentified habitats (Frasier 2005). The population growth rate reported for the period 1986 to 1992 by Knowlton et al. (1994) was 2.5%, suggesting the stock was showing signs of slow recovery. However, work by Caswell et al. (1999) suggested that crude survival probability declined from about 0.99 in the early 1980's to about 0.94 in the late 1990s. Additional work conducted in 1999 showed that survival had indeed declined in the 1990s, particularly for adult females (Best et al. 2001a). Another workshop in September 2002 further confirmed the decline in this population (Clapham 2002). The best available estimate of population trajectory suggests the population is increasing at a rate of 2.6% over the 1990-2009 timeframe (Waring et al. 2013).

Natural threats. Several researchers have suggested that the recovery of North Atlantic right whales has been impeded by competition with other whales for food (Rice 1974; Scarff 1986). Mitchell (1975) analyzed trophic interactions among baleen whales in the western North Atlantic and noted that the foraging grounds of North Atlantic right whales overlapped with the foraging grounds of sei whales. Both species feed preferentially on copepods. Mitchell (1975) argued that the North Atlantic right whale population had been depleted by several centuries of whaling before steam-driven boats allowed whalers to hunt sei whales; from this, he hypothesized that the decline of the right whale population made more food available to sei whales and helped their population to grow. He then suggested that competition with the sei whale population impedes or prevents the recovery of the right whale population. Shark predation has been repeatedly documented on right whales calves along the southeastern U.S., some of which may be fatal (Taylor et al. 2013).

Other natural factors influencing right whale recovery are possible, but unquantified. Right whales have been subjects of killer whale attacks and, because of their robust size and slow swimming speed, tend to fight killer whales when confronted (Ford and Reeves 2008). Similarly, mortality or debilitation from disease and red tide events are not known, but have the potential to be significant problems in the recovery of right whales because of their small population size.

Anthropogenic threats. Several human activities are known to threaten North Atlantic right whales: whaling, commercial fishing, shipping, and environmental contaminants. Historically, whaling represented the greatest threat to every population of right whales and was ultimately responsible for listing right whales as an endangered species. As its legacy, whaling reduced North Atlantic right whales to about 300 individuals in the western North Atlantic Ocean; the number of North Atlantic right whales in the eastern North Atlantic Ocean is probably much smaller, if present at all.

Concern also exists over climate change and its effect on the ability of North Atlantic right whales to recover (Greene et al. 2003b). Specifically, the variations in oceanography resulting from current shifts and water temperatures can significantly affect the occurrence of the North Atlantic right whale's primary food, copepod crustaceans. If climate changes such that current feeding areas cannot sustain North Atlantic right whales, the population may have to shift to reflect changes in prey distribution, pursue other prey types, or face prey shortage. Changes in calving intervals with sea surface temperature have already been documented for southern right whales (Leaper et al. 2006).

North Atlantic right whales, as with many marine mammals, are exposed to numerous toxins in their environment, many of which are introduced by humans. Levels of chromium in North Atlantic right whale tissues are sufficient to be mutagenic and cause cell death in lung, skin, or testicular cells and are a concern for North Atlantic right whale recovery (Chen et al. 2009; Wise et al. 2008). The organochlorines DDT, DDE, PCBs, dieldrin, chlordane, HCB, and heptachlor epoxide have been isolated from blubber samples and reported concentrations may underestimate actual levels (Woodley et al. 1991). Mean PCB levels in North Atlantic right whales are greater than any other baleen whale species thus far measured, although less than one-quarter of the levels measured in harbor porpoises (Gauthier et al. 1997a; Van Scheppingen et al. 1996). Organochlorines and pesticides, although variable in concentration by season, do not appear to currently threaten North Atlantic right whale health and recovery (Weisbrod et al. 2000). Flame retardants such as polybrominated diphenyl ethers (known to be carcinogenic) have also been measured in North Atlantic right whales (Montie et al. 2010).

5.6 Sei whale

Population designations. The population structure of sei whales is unknown and populations herein assume (based upon migratory patterns) population structuring is discrete by ocean basin (north and south), except for sei whales in the Southern Ocean, which may form a ubiquitous population or several discrete ones.

North Atlantic. In the western North Atlantic, a major portion of the sei whale population occurs in northern waters, potentially including the Scotian Shelf, along Labrador and Nova Scotia, south into the U.S. EEZ, including the Gulf of Maine and Georges Bank (Mitchell and Chapman 1977; Waring et al. 2004). These whales summer in northern areas before migrating south to waters along Florida, in the Gulf of Mexico, and the northern Caribbean Sea (Gambell 1985b; Mead 1977). Sei whales may range as far south as North Carolina. In the U.S. EEZ, the greatest abundance occurs during spring, with most sightings on the eastern edge of Georges Bank, in the Northeast Channel, and in Hydrographer Canyon (CETAP 1982). In 1999, 2000, and 2001, the NMFS aerial surveys found sei whales concentrated along the northern edge of Georges Bank during spring (Waring et al. 2004). Surveys in 2001 found sei whales south of Nantucket along the continental shelf edge (Waring et al. 2004). During years of greater prey abundance (e.g., copepods), sei whales are found in more inshore waters, such as the Great South Channel (1987 and 1989), Stellwagen Bank (1986), and the Gulf of Maine (Payne et al. 1990a; Schilling et al. 1992). In the eastern Atlantic, sei whales occur in the Norwegian Sea, occasionally occurring as far north as Spitsbergen Island, and migrate south to Spain, Portugal, and northwest Africa (Gambell 1985b; Jonsgård and Darling 1977). Sei whales have rarely been sighted along New Jersey during the approximate time frame of the proposed seismic survey (NSF 2014).

Movement. The migratory pattern of this species is thought to encompass long distances from high-latitude feeding areas in summer to low-latitude breeding areas in winter; however, the location of winter areas remains largely unknown (Perry et al. 1999). Sei whales are often associated with deeper waters and areas along continental shelf edges (Hain et al. 1985). This general offshore pattern is disrupted during occasional incursions into shallower inshore waters (Waring et al. 2004). The species appears to lack a well-defined social structure and individuals are usually found alone or in small groups of up to six whales (Perry et al. 1999). When on feeding grounds, larger groupings have been observed (Gambell 1985b).

Reproduction. Very little is known regarding sei whale reproduction. Reproductive activities for sei whales occur primarily in winter. Gestation is about 12.7 months, calves are weaned at 6-9 months, and the calving interval is about 2-3 years (Gambell 1985b; Rice 1977). Sei whales become sexually mature at about age 10 (Rice 1977). Of 32 adult female sei whales harvested by Japanese whalers, 28 were found to be pregnant while one was pregnant and lactating during May-July 2009 cruises in the western North Pacific (Tamura et al. 2009).

Feeding. Sei whales are primarily planktivorous, feeding mainly on euphausiids and copepods, although they are also known to consume fish (Waring et al. 2006). In the Northern Hemisphere, sei whales consume small schooling fish such as anchovies, sardines, and mackerel when locally abundant (Konishi et al. 2009; Mizroch et al. 1984; Rice 1977).

Vocalization and hearing. Data on sei whale vocal behavior is limited, but includes records off the Antarctic Peninsula of broadband sounds in the 100-600 Hz range with 1.5 sec duration and tonal and upsweep calls in the 200-600 Hz range of 1-3 sec durations (McDonald et al. 2005). Source levels of 189 ±5.8 dB re 1 µPa at 1m have been established for sei whales in the northeastern Pacific (Weirathmueller et al. 2013). Differences may exist in vocalizations between ocean basins (Rankin and Barlow 2007a). The first variation consisted of sweeps from 100 to 44 Hz, over 1.0 sec. During visual and acoustic surveys conducted in the Hawaiian Islands in 2002, Rankin and Barlow (2007b) recorded 107 sei whale vocalizations, which they classified as two variations of low-frequency downswept calls. The second variation, which was more common (105 out of 107) consisted of low frequency calls which swept from 39 to 21 Hz over 1.3 sec. These vocalizations are different from sounds attributed to sei whales in the Atlantic and Southern Oceans but are similar to sounds that had previously been attributed to fin whales in Hawaiian waters. Vocalizations from the North Atlantic consisted of paired sequences (0.5-0.8 sec, separated by 0.4-1.0 sec) of 10-20 short (4 ms) FM sweeps between 1.5-3.5 kHz (Thomson and Richardson 1995).

Status and trends. The sei whale was originally listed as endangered in 1970 (35 FR 18319), and this status remained since the inception of the ESA in 1973. Consideration of the status of populations outside of the action area is important under the present analysis to determine the risk to the affected population(s) bears on the status of the species as a whole. **Table 8** provides estimates of historic and current abundance for ocean regions.

North Atlantic. No information on sei whale abundance exists prior to commercial whaling (Perry et al. 1999). Between 1966 and 1972, whalers from land stations on the east coast of Nova Scotia engaged in extensive hunts of sei whales on the Nova Scotia shelf, killing about 825 individuals (Mitchell and Chapman 1977). In 1974, the North Atlantic stock was estimated to number about 2,078 individuals, including 965 whales in the Labrador Sea group and 870 whales in the Nova Scotia group (Mitchell and Chapman 1977). In the northwest Atlantic, Mitchell and Chapman (1977) estimated the Nova Scotia stock to contain 1,393-2,248 whales; an aerial survey program conducted from 1978 to 1982 on the continental shelf and edge between Cape Hatteras, North Carolina, and Nova Scotia generated an estimate of 280 sei whales (CETAP 1982). These two estimates are more than 30 years out of date and likely do not reflect the current true abundance; in addition, the CETAP estimate has a high degree of uncertainty and is considered statistically unreliable (Perry et al. 1999; Waring et al. 2004; Waring et al. 1999). The total number of sei whales in the U.S. Atlantic EEZ remains unknown (Waring et al. 2006). Rice (1977) estimated total annual mortality for adult females as 0.088 and adult males as 0.103.

Table 8. Summary of past and present sei whale abundance.

Region	Population, stock, or study area	Pre-exploitation estimate	95% CI	Recent estimate	95% CI	Source
Global	--	>105,000	--	25,000	--	(Braham 1991)
North Atlantic	Basinwide	--	--	>4000	--	(Braham 1991)
	~~			>13,500		(Sigurjonsson 1995)
	NMFS-Nova Scotia stock	--	--	386	--	(NMFS 2008; Waring et al. 2012)
	Northeast Atlantic	--	--	10,300	0.268	(Cattanach et al. 1993)

*Note: Confidence Intervals (C.I.) not provided by the authors were calculated from Coefficients of Variation (C.V.) where available, using the computation from Gotelli and Ellison (2004).

Natural threats. Andrews (1916) suggested that killer whales attacked sei whales less frequently than fin and blue whales in the same areas. Sei whales engage in a flight responses to evade killer whales, which involves high energetic output, but show little resistance if overtaken (Ford and Reeves 2008). Endoparasitic helminths (worms) are commonly found in sei whales and can result in pathogenic effects when infestations occur in the liver and kidneys (Rice 1977).

Anthropogenic threats. Human activities known to threaten sei whales include whaling, commercial fishing, and maritime vessel traffic. Historically, whaling represented the greatest threat to every population of sei whales and was ultimately responsible for listing sei whales as an endangered species. Sei whales are thought to not be widely hunted, although harvest for scientific whaling or illegal harvesting may occur in some areas.

Sei whales are known to accumulate DDT, DDE, and PCBs (Borrell 1993; Borrell and Aguilar 1987; Henry and Best 1983). Males carry larger burdens than females, as gestation and lactation transfer these toxins from mother to offspring.

5.7 Sperm whale

Populations. There is no clear understanding of the global population structure of sperm whales (Dufault et al. 1999). Recent ocean-wide genetic studies indicate low, but statistically significant, genetic diversity and no clear geographic structure, but strong differentiation between social groups (Lyrholm and Gyllensten 1998; Lyrholm et al. 1996; Lyrholm et al. 1999). Chemical analysis also suggest significant differences in diet for animals captured in different regions of the North Atlantic. However, vocal dialects indicate parent-offspring transmission that support differentiation in populations (Rendell et al. 2011). Therefore, population-level differences may be more extensive than are currently understood.

The IWC currently recognizes four sperm whale stocks: North Atlantic, North Pacific, northern Indian Ocean, and Southern Hemisphere (Dufault et al. 1999; Reeves and Whitehead 1997). The NMFS recognizes six stocks under the MMPA- three in the Atlantic/Gulf of Mexico and three in the Pacific (Alaska, California-Oregon-Washington, and Hawaii; (Perry et al. 1999; Waring et al. 2004)). Genetic studies indicate that movements of both sexes through expanses of ocean basins are common, and that males, but not females, often breed in different ocean basins than the ones in which they were born (Whitehead 2003). Sperm whale populations appear to be structured socially, at the level of the clan, rather than geographically (Whitehead 2003; Whitehead et al. 2008). Matrilinear groups in the eastern Pacific share nuclear DNA within broader clans, but North Atlantic matrilinear groups do not share this genetic heritage (Whitehead et al. 2012).

North Atlantic. In the western North Atlantic, sperm whales range from Greenland south into the Gulf of Mexico and the Caribbean, where they are common, especially in deep basins off of the continental shelf (Romero et al. 2001; Wardle et al. 2001). The northern distributional limit of female/immature pods is probably around Georges Bank or the Nova Scotian shelf (Whitehead et al. 1991). Seasonal aerial surveys confirm that sperm whales are present in the northern Gulf of Mexico in all seasons (Hansen et al. 1996; Mullin et al. 1994). Sperm whale distribution follows a distinct seasonal cycle, concentrating east-northeast of Cape Hatteras in winter and shifting northward in spring when whales are found throughout the mid-Atlantic Bight. Distribution extends further northward to areas north of Georges Bank and the Northeast Channel region in summer and then south of New England in fall, back to the Mid-Atlantic Bight. A long-term study of sperm whales along Dominica, West Indies supports 17 discreet groups habituating this area (Gero et al. 2013). In the eastern Atlantic, mature male sperm whales have been recorded as far north as Spitsbergen (Øien 1990). Recent observations of sperm whales and stranding events involving sperm whales from the eastern North Atlantic suggest that solitary and paired mature males predominantly occur in waters off Iceland, the Faroe Islands, and the Norwegian Sea (Christensen et al. 1992a; Christensen et al. 1992b; Gunnlaugsson and Sigurjónsson 1990; Øien 1990). Hundreds of sightings have been made along New Jersey during the approximate time frame of the proposed seismic survey (NSF 2014).

Movement. Mature males range between 70º N in the North Atlantic and 70º S in the Southern Ocean (Perry et al. 1999; Reeves and Whitehead 1997), whereas mature females and immature individuals of both sexes are seldom found higher than 50º N or S (Reeves and Whitehead 1997). In winter, sperm whales migrate closer to equatorial waters (Kasuya and Miyashita 1988; Waring et al. 1993) where adult males join them to breed. Males identified in the Azores have been resighted in Norwegian waters (Steiner et al. 2012). Movement patterns of Pacific female and immature male groups appear to follow prey distribution and, although not random, movements are difficult to anticipate and are likely associated with feeding success, perception of the environment, and memory of optimal foraging areas (Whitehead et al. 2008). However, no sperm whale in the Pacific has been known to travel to points over 5,000 km apart and only rarely have been known to move over 4,000 km within a time frame of several years. This means that although sperm whales do not appear to cross from eastern to western sides of the Pacific (or vice-versa), significant mixing occurs that can maintain genetic exchange. Movements of several hundred kilometers are common (i.e. between the Galapagos Islands and the Pacific coastal

Americas). Movements appear to be group or clan specific, with some groups traveling straighter courses than others over the course of several days. However, general transit speed averages about 4 km/h. Sperm whales in the Caribbean region appear to be much more restricted in their movements, with individuals repeatedly sighted within less than 160 km of previous sightings.

Habitat. Sperm whales have a strong preference for waters deeper than 1,000 m (Reeves and Whitehead 1997; Watkins 1977), although Berzin (1971) reported that they are restricted to waters deeper than 300 m. While deep water is their typical habitat, sperm whales are rarely found in waters less than 300 m in depth (Clarke 1956; Rice 1989a). Sperm whales have been observed near Long Island, New York, in water between 40-55 m deep (Scott and Sadove 1997). When they are found relatively close to shore, sperm whales are usually associated with sharp increases in topography where upwelling occurs and biological production is high, implying the presence of a good food supply (Clarke 1956). Such areas include oceanic islands and along the outer continental shelf.

Sperm whales are frequently found in locations of high productivity due to upwelling or steep underwater topography, such as continental slopes, seamounts, or canyon features (Jaquet and Whitehead 1996; Jaquet et al. 1996). Cold-core eddy features are also attractive to sperm whales in the Gulf of Mexico, likely because of the large numbers of squid that are drawn to the high concentrations of plankton associated with these features (Biggs et al. 2000; Davis et al. 2000a; Davis et al. 2000b; Davis et al. 2000c; Davis et al. 2002; Wormuth et al. 2000). Surface waters with sharp horizontal thermal gradients, such as along the Gulf Stream in the Atlantic, may also be temporary feeding areas for sperm whales (Griffin 1999; Jaquet et al. 1996; Waring et al. 1993). Sperm whales over George's Bank were associated with surface temperatures of 23.2-24.9° C (Waring et al. 2003).

Reproduction. Female sperm whales become sexually mature at an average of 9 years or 8.25-8.8 m (Kasuya 1991). Males reach a length of 10 to 12 m at sexual maturity and take 9-20 years to become sexually mature, but require another 10 years to become large enough to successfully breed (Kasuya 1991; Würsig et al. 2000). Mean age at physical maturity is 45 years for males and 30 years for females (Waring et al. 2004). Adult females give birth after roughly 15 months of gestation and nurse their calves for 2-3 years (Waring et al. 2004). The calving interval is estimated to be every 4-6 years between the ages of 12 and 40 (Kasuya 1991; Whitehead et al. 2008). It has been suggested that some mature males may not migrate to breeding grounds annually during winter, and instead may remain in higher latitude feeding grounds for more than one year at a time (Whitehead and Arnbom 1987).

Sperm whale age distribution is unknown, but sperm whales are believed to live at least 60 years (Rice 1978). Estimated annual mortality rates of sperm whales are thought to vary by age, but previous estimates of mortality rate for juveniles and adults are now considered unreliable (IWC 1980).

Stable, long-term associations among females form the core of sperm whale societies (Christal et al. 1998). Up to about a dozen females usually live in such groups, accompanied by their female and young male offspring. Young individuals are subject to alloparental care by members of either sex and may be suckled by non-maternal individuals (Gero et al. 2009). Group sizes may be smaller overall in the Caribbean Sea (6-12 individuals; 7-9 along Dominica) versus the Pacific (25-30 individuals)(Gero et al. 2013; Jaquet and Gendron 2009). Groups may be stable for long periods, such as for 80 days in the Gulf of California (Jaquet and Gendron 2009). Males start leaving these family groups at about six years of age, after which they live in "bachelor schools," but this may occur more than a decade later (Pinela et al. 2009). The cohesion among males within a bachelor school declines with age. During their breeding prime and old age, male sperm whales are essentially solitary (Christal and Whitehead 1997).

Feeding. Sperm whales appear to feed regularly throughout the year (NMFS 2006b). It is estimated they consume about 3-3.5% of their body weight daily (Lockyer 1981). They seem to forage mainly on or near the bottom, often ingesting stones, sand, sponges, and other non-food items (Rice 1989a). A large proportion of a sperm whale's diet consists of low-fat, ammoniacal, or luminescent squids (Clarke 1996; Clarke 1980b; Martin and Clarke 1986). While sperm whales feed primarily on large and medium-sized squids, the list of documented food items is fairly long and diverse. Prey items include other cephalopods, such as octopi, and medium- and large-sized demersal fishes, such as rays, sharks, and many teleosts (Angliss and Lodge 2004; Berzin 1972; Clarke 1977; Clarke 1980a; Rice 1989a). The diet of large males in some areas, especially in high northern latitudes, is dominated by fish (Rice 1989a). In some areas of the North Atlantic, however, males prey heavily on the oil-rich squid *Gonatus fabricii*, a species also frequently eaten by northern bottlenose whales (Clarke 1997).

Vocalization and hearing. Sound production and reception by sperm whales are better understood than in most cetaceans. Sperm whales produce broad-band clicks in the frequency range of 100 Hz to 20 kHz that can be extremely loud for a biological source (200-236 dB re 1μPa), although lower source level energy has been suggested at around 171 dB re 1 μPa (Goold and Jones 1995; Møhl et al. 2003; Weilgart and Whitehead 1993; Weilgart and Whitehead 1997). Most of the energy in sperm whale clicks is concentrated at around 2-4 kHz and 10-16 kHz (Goold and Jones 1995; NMFS 2006d; Weilgart and Whitehead 1993). The highly asymmetric head anatomy of sperm whales is likely an adaptation to produce the unique clicks recorded from these animals (Cranford 1992; Norris and Harvey 1972; Norris and Harvey. 1972). Long, repeated clicks are associated with feeding and echolocation (Goold and Jones 1995; Weilgart and Whitehead 1993; Weilgart and Whitehead 1997). However, clicks are also used in short patterns (codas) during social behavior and intragroup interactions (Weilgart and Whitehead 1993). They may also aid in intra-specific communication. Another class of sound, "squeals", are produced with frequencies of 100 Hz to 20 kHz (e.g., Weir et al. 2007).

Our understanding of sperm whale hearing stems largely from the sounds they produce. The only direct measurement of hearing was from a young stranded individual from which auditory evoked potentials were recorded (Carder and Ridgway 1990). From this whale, responses support a hearing range of 2.5-60 kHz. However, behavioral responses of adult, free-ranging individuals also provide insight into hearing range; sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses made by echosounders and submarine sonar (Watkins et al. 1985; Watkins and Schevill 1975). They also stop vocalizing for brief periods when codas are being produced by other individuals, perhaps because they can hear better when not vocalizing themselves (Goold and Jones 1995). Because they spend large amounts of time at depth and use low-frequency sound, sperm whales are likely to be susceptible to low frequency sound in the ocean (Croll et al. 1999).

Status and trends. Sperm whales were originally listed as endangered in 1970 (35 FR 18319), and this status remained with the inception of the ESA in 1973. Although population structure of sperm whales is unknown, several studies and estimates of abundance are available.

Consideration of the status of populations outside of the action area is important under the present analysis to determine how the risk to the affected population(s) bears on the status of the species as a whole. Table 9 contains historic and current estimates of sperm whales by region. Sperm whale populations probably are undergoing the dynamics of small population sizes, which is a threat in and of itself. In particular, the loss of sperm whales to directed Soviet whaling likely inhibits recovery due to the loss of adult females and their calves, leaving sizeable gaps in demographic and age structuring (Whitehead 2003). Small changes in reproductive parameters, such as the loss of adult females, can significantly alter the population trajectory of sperm whale populations (Chiquet et al. 2013).

Table 9. Summary of past and present sperm whale abundance.

Region	Population, stock, or study area	Pre-exploitation estimate	95% CI	Recent estimate	95% CI	Source
Global	~~	~~	~~	900,000	~~	(Würsig et al. 2000)
	~~	1,110,000	672,000-1,512,000	360,000	105,984-614,016*	(Whitehead 2002)
North Atlantic	Basinwide-females	224,800	~~	22,000	~~	(Gosho et al. 1984; Würsig et al. 2000)
	Northeast Atlantic, Faroes, Iceland, and U.S. East coast	~~	~~	13,190	~~	(Whitehead 2002)
	NMFS-North Atlantic stock	>4,685*	~~	4,804	1,226-8,382*	(Waring et al. 2012)
	Iceland	~~	~~	1,234	823-1,645*	(Gunnlaugsson and Sigurjónsson 1990)
	Faroe Islands	~~	~~	308	79-537*	(Gunnlaugsson and Sigurjónsson 1990)
	Norwegian Sea	~~	~~	5,231	2,053-8,409*	(Christensen et al. 1992b)
	Northern Norway to Spitsbergen	15,000	~~	2,548	1,200-3,896*	(Øien 1990)

*Note: Confidence Intervals (C.I.) not provided by the authors were calculated from Coefficients of Variation (C.V.) where available, using the computation from Gotelli and Ellison (2004).

North Atlantic. 190,000 sperm whales were estimated to have been in the entire North Atlantic, but CPUE data from which this estimate is derived are unreliable according to the IWC (Perry et al. 1999). The total number of sperm whales in the western North Atlantic is unknown (Waring et al. 2008). Sperm whale were widely harvested from the northeastern Caribbean (Romero et al. 2001) and the Gulf of Mexico where sperm whale fisheries operated during the late 1700s to the early 1900s (NMFS 2006b; Townsend 1935).

Natural threats. Sperm whales are known to be occasionally predated upon by killer whales (Arnbom et al. 1987; Jefferson and Baird 1991; Pitman et al. 2001) and large sharks (Best et al. 1984) and harassed by pilot whales (Arnbom et al. 1987; Palacios and Mate 1996; Rice 1989b; Weller et al. 1996; Whitehead 1995). Strandings are also relatively common events, with one to dozens of individuals generally beaching themselves and dying during any single event. Although several hypotheses, such as navigation errors, illness, and anthropogenic stressors, have been proposed (Goold et al. 2002; Wright 2005), direct widespread causes of strandings remain unclear. Calcivirus and papillomavirus are known pathogens of this species (Lambertsen et al. 1987; Smith and Latham 1978).

Anthropogenic threats. Sperm whales historically faced severe depletion from commercial whaling operations. From 1800 to 1900, the IWC estimated that nearly 250,000 sperm whales were killed by whalers, with another 700,000 from 1910 to 1982 (IWC Statistics 1959-1983). However, other estimates have included 436,000 individuals killed between 1800-1987 (Carretta et al. 2005). All of these estimates are likely underestimates due to illegal and inaccurate killings by Soviet whaling fleets between 1947-1973. In the Southern Hemisphere, these whalers killed an estimated 100,000 whales that they did not report to the IWC (Yablokov et al. 1998), with smaller harvests in the Northern Hemisphere, primarily the North Pacific, that extirpated sperm whales from large areas (Yablokov and Zemsky 2000). Additionally, Soviet whalers disproportionately killed adult females in any reproductive condition (pregnant or lactating) as well as immature sperm whales of either gender.

Whale-watching vessels are known to influence sperm whale behavior (Richter et al. 2006).

Contaminants have been identified in sperm whales, but vary widely in concentration based upon life history and geographic location, with northern hemisphere individuals generally carrying higher burdens (Evans et al. 2004). Contaminants include dieldrin, chlordane, DDT, DDE, PCBs, HCB and hexachlorocyclohexane in a variety of body tissues (Aguilar 1983; Evans et al. 2004), as well as several heavy metals (Law et al. 1996). However, unlike other marine mammals, females appear to bioaccumulate toxins at greater levels than males, which may be related to possible dietary differences between females who remain at relatively low latitudes compared to more migratory males (Aguilar 1983; Wise et al. 2009). Chromium levels from sperm whales skin samples worldwide have varied from undetectable to 122.6 μg Cr/g tissue, with the mean (8.8 μg Cr/g tissue) resembling levels found in human lung tissue with chromium-induced cancer (Wise et al. 2009). Older or larger individuals do not appear to accumulate chromium at higher levels.

Ingestion of marine debris can have fatal consequences even for large whales. In 1989, a stranded sperm whale along the Mediterranean was found to have died from ingesting plastic that blocked its' digestive tract. A sperm whale examined in Iceland had a lethal disease thought to have been caused by the complete obstruction of the gut with plastic marine debris (Lambertsen 1990). The stomach contents of two sperm whales that stranded separately in California included extensive amounts of discarded fishing netting (NMFS 2009). A fifth individual from the Pacific was found to contain nylon netting in its stomach when it washed ashore in 2004 (NMFS 2009). In March 2012, a sperm whale stranded dead, apparently dying as a result of plastic ingestion (de

Stephanis et al. 2013).

5.8 Green sea turtle

Populations. Populations are distinguished generally by ocean basin and more specifically by nesting location (Table 10).

Table 10. Locations and most recent abundance estimates of threatened green sea turtles as annual nesting females (AF).

Location	Most recent abundance	Reference
Western Atlantic Ocean		
Tortuguero, Costa Rica	17,402-37,290 AF	(Troëng and Rankin 2005)
Aves Island, Venezuela	335-443 AF	(Vera 2007)
Galibi Reserve, Suriname	1,803 AF	(Weijerman et al. 1998)
Isla Trindade, Brazil	1,500-2,000 AF	(Moreira and Bjorndal 2006)

Distribution. Green sea turtles have a circumglobal distribution, occurring throughout tropical, subtropical waters, and, to a lesser extent, temperate waters. Several sightings have been made along New Jersey during the approximate time frame of the proposed seismic survey (NSF 2014).

Growth and reproduction. Most green sea turtles exhibit particularly slow growth rates, which have been attributed to their largely plant-eating diet (Bjorndal 1982). Growth rates of juveniles vary substantially among populations, ranging from <1 cm/year (Green 1993) to >5 cm/year (McDonald Dutton and Dutton 1998), likely due to differences in diet quality, duration of foraging season (Chaloupka et al. 2004), and density of turtles in foraging areas (Balazs and Chaloupka 2004; Bjorndal et al. 2000; Seminoff et al. 2002b). Hart et al. (2013a) found growth rates of green sea turtles in the U.S. Virgin Islands to range from 0-9.5 cm annually (mean of 4.1, SD 2.4). The largest growth rates were in the 30-39 cm class. If individuals do not feed sufficiently, growth is stunted and apparently does not compensate even when greater-than-needed resources are available (Roark et al. 2009). In general, there is a tendency for green sea turtles to exhibit monotonic growth (declining growth rate with size) in the Atlantic and non-monotonic growth (growth spurt in mid-size classes) in the Pacific, although this is not always the case (Balazs and Chaloupka 2004; Chaloupka and Musick 1997; Seminoff et al. 2002b). It is estimated that green sea turtles reach a maximum size just under 100 cm in carapace length (Tanaka 2009). A female-bias has been identified from studies of green sea turtles (Wibbels 2003).

Consistent with slow growth, age-to-maturity for green sea turtles appears to be the longest of any sea turtle species and ranges from ~20-40 years or more (Balazs 1982; Chaloupka et al. 2004; Chaloupka and Musick 1997; Frazer and Ehrhart 1985a; Hirth 1997; Limpus and Chaloupka 1997; Seminoff et al. 2002b; Zug et al. 2002; Zug and Glor 1998). Estimates of reproductive longevity range from 17 to 23 years (Carr et al. 1978; Chaloupka et al. 2004; Fitzsimmons et al. 1995). Considering that mean duration between females returning to nest ranges from 2 to 5 years (Hirth 1997), these reproductive longevity estimates suggest that a female may nest 3 to 11 seasons over the course of her life. Each female deposits 1-7 clutches (usually 2-3) during the breeding season at 12-14 day intervals. Mean clutch size is highly variable among populations, but averages 110-115 eggs/nest. Females usually have 2-4 or more years between breeding seasons, whereas males may mate every year (Balazs 1983). Based on reasonable means of three nests per season and 100 eggs per nest (Hirth 1997), a female may deposit 9 to 33 clutches, or about 900 to 3,300 eggs, during her lifetime. Nesting sites appear to be related to beaches with relatively high exposure to wind or wind-generated waves (Santana Garcon et al. 2010).

Once hatched, sea turtles emerge and orient towards a light source, such as light shining off the ocean. They enter the sea in a “frenzy” of swimming activity, which decreases rapidly in the first few hours and gradually over the first several weeks (Ischer et al. 2009; Okuyama et al. 2009). Factors in the ocean environment have a major influence on reproduction (Chaloupka 2001; Limpus and Nicholls 1988; Solow et al. 2002). It is also apparent that during years of heavy nesting activity, density dependent factors (beach crowding and digging up of eggs by nesting females) may impact hatchling production (Tiwari et al. 2005; Tiwari et al. 2006). Precipitation, proximity to the high tide line, and nest depth can also significantly affect nesting success (Cheng et al. 2009). Precipitation can also be significant in sex determination, with greater nest moisture resulting in a higher proportion of males (Leblanc and Wibbels 2009). Green sea turtles often return to the same foraging areas following nesting migrations (Broderick et al. 2006; Godley et al. 2002). Once there, they move within specific areas, or home ranges, where they routinely visit specific localities to forage and rest (Godley et al. 2003; Makowski et al. 2006; Seminoff and Jones 2006; Seminoff et al. 2002a; Taquet et al. 2006). It is also apparent that some green sea turtles remain in pelagic habitats for extended periods, perhaps never recruiting to coastal foraging sites (Pelletier et al. 2003).

In general, survivorship tends to be lower for juveniles and subadults than for adults. Adult survivorship has been calculated to range from 0.82-0.97 versus 0.58-0.89 for juveniles (Chaloupka and Limpus 2005; Seminoff et al. 2003; Troëng and Chaloupka 2007), with lower values coinciding with areas of human impact on green sea turtles and their habitats (Bjorndal et al. 2003; Campbell and Lagueux 2005).

Migration and movement. Green sea turtles are highly mobile and undertake complex movements through geographically disparate habitats during their lifetimes (Musick and Limpus 1997; Plotkin 2003). The periodic migration between nesting sites and foraging areas by adults is a prominent feature of their life history. After departing as hatchlings and residing in a variety of marine habitats for 40 or more years (Limpus and Chaloupka 1997), green sea turtles make their way back to the same beach from which they hatched (Carr et al. 1978; Meylan et al. 1990). At approximately 20-25 cm carapace length, juveniles leave pelagic habitats and enter benthic foraging areas (Bjorndal 1997). Green sea turtles spend the majority of their lives in coastal foraging grounds (MacDonald et al. 2012). These areas include both open coastline and protected bays and lagoons. While in these areas, green sea turtles rely on marine algae and seagrass as their primary dietary constituents, although some populations also forage heavily on invertebrates. Although green sea turtles in tropical areas seem to undergo a sudden, permanent switch in habitat from oceanic to neritic habitats, individuals in more temperate areas seem to utilize a wider array of habitats dependent upon oceanographic conditions (González Carman et al. 2012). There is some evidence that individuals move from shallow seagrass beds during the day to deeper areas at night (Hazel 2009). However, avoidance of areas of greater than 10 m when moderate depths of 5-10 m with sea grass beds has been found, with speed and displacement from capture locations being similar at night as during the daytime (Senko et al. 2010a). East Pacific adults migrate along coastal corridors between Central American nesting and foraging locations (Blanco et al. 2012).

Habitat. Green turtles appear to prefer waters that usually remain around 20º C in the coldest month, but may occur considerably north of these regions during warm-water events, such as El Niño. Stinson (1984) found green turtles to appear most frequently in U.S. coastal waters with temperatures exceeding 18º C. Further, green sea turtles seem to occur preferentially in drift lines or surface current convergences, probably because of the prevalence of cover and higher prey densities that associate with flotsam. For example, in the western Atlantic Ocean, drift lines commonly containing floating *Sargassum* spp. are capable of providing juveniles with shelter (NMFS and USFWS 1998). Underwater resting sites include coral recesses, the underside of ledges, and sand bottom areas that are relatively free of strong currents and disturbance. Available information indicates that green turtle resting areas are near feeding areas (Bjorndal and Bolten 2000). Strong site fidelity appears to be a characteristic of juvenile green sea turtles along the Pacific Baja coast (Senko et al. 2010b).

Feeding. While offshore and sometimes in coastal habitats, green sea turtles are not obligate plant-eaters as widely believed, and instead consume invertebrates such as jellyfish, sponges, sea pens, and pelagic prey (Godley et al. 1998; Hart et al. 2013b; Hatase et al. 2006; Heithaus et al. 2002; Parker and Balazs in press; Seminoff et al. 2002a). A shift to a more herbivorous diet occurs when individuals move into neritic habitats, as vegetable mater replaces an omnivorous diet at around 59 cm in carapace length off Mauritania (Cardona et al. 2009). This transition may occur rapidly starting at 30 cm carapace length, but animal prey continue to constitute an important nutritional component until individuals reach about 62 cm (Cardona et al. 2010). Foraging within seagrass ecosystems by green sea turtles can be significant enough to alter habitat and ecological parameters, such as species composition (Lal et al. 2010). Although populations can consume a variety of prey and be considered generalists as a whole, individuals maintain a highly-selective diet over long time frames (Vander Zanden et al. 2013).

Vocalization and hearing. Sea turtles are low-frequency hearing specialists, typically hearing frequencies from 30 to 2,000 Hz, with a range of maximum sensitivity between 100 and 800 Hz (Bartol et al. 1999; Lenhardt 1994a; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Piniak et al. (2012) found green sea turtle juveniles capable of hearing underwater sounds at frequencies of 50-1,600 Hz (maximum sensitivity at 200-400 Hz). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994a). Based upon auditory brainstem responses green sea turtles have been measured to hear in the 50-1600 Hz range (Dow et al. 2008), with greatest response at 300 Hz (Yudhana et al. 2010); a value verified by Moein Bartol and Ketten (2006). Other studies have found greatest sensitivities are 200-400 Hz for the green turtle with a range of 100-500 Hz (Moein Bartol and Ketten 2006; Ridgway et al. 1969) and around 250 Hz or below for juveniles (Bartol et al. 1999). However, Dow et al. (2008) found best sensitivity between 50 and 400 Hz.

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 and 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3 kHz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1 kHz and almost no responses beyond 3 or 4 kHz (Patterson 1966).

Status and trends. Federal listing of the green sea turtle occurred on July 28, 1978, with all populations listed as threatened except for the Florida and Pacific coast of Mexico breeding populations, which are endangered (43 FR 32800).

Consideration of the status of populations outside of the action area is important under the present analysis to determine the risk to the affected population(s) bears on the status of the species as a whole. No trend data are available for almost half of important nesting sites, where numbers are based on recent trends and do not span a full green sea turtle generation, and impacts occurring over four decades ago that caused a change in juvenile recruitment rates may have yet to be manifested as a change in nesting abundance. The numbers also only reflect one segment of the population (nesting females), who are the only segment of the population for which reasonably good data are available and are cautiously used as one measure of the possible trend of populations.

Based on the mean annual reproductive effort, 108,761-150,521 females nest each year among 46 worldwide sites. Overall, of the 26 sites for which data enable an assessment of current trends, 12 nesting populations are increasing, 10 are stable, and four are decreasing. Long-term continuous datasets of 20 years are available for 11 sites, all of which are either increasing or stable. Despite the apparent global increase in numbers, the positive overall trend should be viewed cautiously because trend data are available for just over half of all sites examined and very few data sets span a full green sea turtle generation (Seminoff 2004b).

Atlantic Ocean. Primary sites for green sea turtle nesting in the Atlantic/Caribbean include: (1) Yucatán Peninsula, Mexico; (2) Tortuguero, Costa Rica; (3) Aves Island, Venezuela; (4) Galibi Reserve, Suriname; (5) Isla Trindade, Brazil; (6) Ascension Island, United Kingdom; (7) Bioko Island, Equatorial Guinea; and (8) Bijagos Achipelago, Guinea-Bissau (NMFS and USFWS 2007a). Nesting at all of these sites was considered to be stable or increasing with the exception of Bioko Island and the Bijagos Archipelago where the lack of sufficient data precludes a meaningful trend assessment for either site (NMFS and USFWS 2007a). Seminoff (2004a) reviewed green sea turtle nesting data for eight sites in the western, eastern, and central Atlantic. Seminoff (2004a) concluded that all sites in the central and western Atlantic showed increased nesting, with the exception of nesting at Aves Island, Venezuela, while both sites in the eastern Atlantic demonstrated decreased nesting. These sites are not inclusive of all green sea turtle nesting in the Atlantic. However, other sites are not believed to support nesting levels high enough that would change the overall status of the species in the Atlantic (NMFS and USFWS 2007a).

By far, the most important nesting concentration for green sea turtles in the western Atlantic is in Tortuguero, Costa Rica (NMFS and USFWS 2007a). Nesting in the area has increased considerably since the 1970s and nest count data from 1999-2003 suggest nesting by 17,402-37,290 females per year (NMFS and USFWS 2007a). The number of females nesting per year on beaches in the Yucatán, at Aves Island, Galibi Reserve, and Isla Trindade number in the hundreds to low thousands, depending on the site (NMFS and USFWS 2007a).

The vast majority of green sea turtle nesting within the southeastern U.S. occurs in Florida (Johnson and Ehrhart 1994; Meylan et al. 1995). Green sea turtle nesting in Florida has been increasing since 1989 (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute Index Nesting Beach Survey Database). Since establishment of index beaches in 1989, the pattern of green turtle nesting shows biennial peaks in abundance with a generally positive trend during the ten years of regular monitoring. This is perhaps due to increased protective legislation throughout the Caribbean (Meylan et al. 1995). A total statewide average (all beaches, including index beaches) of 5,039 green turtle nests were laid annually in Florida between 2001 and 2006, with a low of 581 in 2001 and a high of 9,644 in 2005 (NMFS and USFWS 2007a). Data from index nesting beaches substantiate the dramatic increase in nesting. In 2007, there were 9,455 green turtle nests found just on index nesting beaches, the highest since index beach monitoring began in 1989. The number fell back to 6,385 in 2008, further dropping under 3,000 in 2009, but that consecutive drop was a temporary deviation from the normal biennial nesting cycle for green turtles, as 2010 saw an increase back to 8,426 nests on the index nesting beaches (FWC Index Nesting Beach Survey Database). Occasional nesting has been documented along the Gulf coast of Florida (Meylan et al. 1995). More recently, green turtle nesting occurred on Bald Head Island, North Carolina; just east of the mouth of the Cape Fear River; on Onslow Island; and on Cape Hatteras National Seashore. In 2010, a total of 18 nests were found in North Carolina, six nests in South Carolina, and six nests in Georgia (nesting databases maintained on www.seaturtle.org). Increased nesting has also been observed along the Atlantic coast of Florida, on beaches where only loggerhead nesting was observed in the past (Pritchard 1997). Recent modeling by Chaloupka et al. (2008a) using data sets of 25 years or more has resulted in an estimate of the Florida nesting stock at the Archie Carr National Wildlife Refuge growing at an annual rate of 13.9%, and the Tortuguero, Costa Rica, population growing at 4.9%.

There are no reliable estimates of the number of immature green sea turtles that inhabit coastal areas of the southeastern U.S. However, information on incidental captures of immature green sea turtles at the St. Lucie Power Plant in St. Lucie County, Florida, shows that the annual number of immature green sea turtles captured by their offshore cooling water intake structures has increased significantly. Green sea turtle annual captures averaged 19 for 1977-1986, 178 for 1987-1996, and 262 for 1997-2001 (Florida Power and Light Company St. Lucie Plant 2002). More recent unpublished data shows 101 captures in 2007, 299 in 2008, 38 in 2009 (power output was cut—and cooling water intake concomitantly reduced—for part of that year) and 413 in 2010. Ehrhart et al. (2007) documented a significant increase in in-water abundance of green turtles in the Indian River Lagoon area.

Natural threats. Herons, gulls, dogfish, and sharks prey upon hatchlings. Adults face predation primarily by sharks and to a lesser extent by killer whales. Predators (primarily of eggs and hatchlings) also include dogs, pigs, rats, crabs, sea birds, reef fishes, and groupers (Bell et al. 1994; Witzell 1981).

For unknown reasons, the frequency of a disease called fibropapillomatosis is much higher in green sea turtles than in other species and threatens a large number of existing subpopulations. Extremely high incidence has been reported in Hawaii, where affliction rates peaked at 47-69% in some foraging areas (Murakawa et al. 2000). A to-date unidentified virus may aid in the development of fibropapillomatosis (Work et al. 2009). Green sea turtles with an abundance of barnacles have been found to have a much greater probability of having health issues (Flint et al. 2009). The fungal pathogens *Fusarium falciforme* and *F. keratoplasticum* can kill in excess of

90% of sea turtle embryos they infect and may constitute a major threat to nesting productivity under some conditions (Sarmiento-Ramırez et al. 2014).

All sea turtles except leatherbacks can undergo "cold stunning" if water temperatures drop below a threshold level, which can be lethal.

Anthropogenic threats. Major anthropogenic impacts to the nesting and marine environment affect green sea turtle survival and recovery. At nesting beaches, green sea turtles rely on intact dune structures, native vegetation, and normal beach temperatures for nesting (Ackerman 1997). Structural impacts to nesting habitat include the construction of buildings and pilings, beach armoring and renourishment, and sand extraction (Bouchard et al. 1998; Lutcavage et al. 1997b). These factors may directly, through loss of beach habitat, or indirectly, through changing thermal profiles and increasing erosion, serve to decrease the amount of nesting area available to females, and may evoke a change in the natural behaviors of adults and hatchlings (Ackerman 1997; Witherington et al. 2003; Witherington et al. 2007). The presence of lights on or adjacent to nesting beaches alters the behavior of nesting adults (Witherington 1992) and is often fatal to emerging hatchlings as they are attracted to light sources and drawn away from the water (Witherington and Bjorndal 1991). In addition to impacting the terrestrial zone, anthropogenic disturbances also threaten coastal marine habitats, particularly areas rich in seagrass and marine algae. These impacts include contamination from herbicides, pesticides, oil spills, and other chemicals, as well as structural degradation from excessive boat anchoring and dredging (Francour et al. 1999; Lee Long et al. 2000; Waycott et al. 2005). Ingestion of plastic and other marine debris is another source of morbidity and mortality (Stamper et al. 2009). Green sea turtles stranded in Brazil were all found to have ingested plastics or fishing debris (n=34), although mortality appears to have resulted in three cases (Tourinho et al. 2009). Low-level bycatch has also been documented in longline fisheries (Petersen et al. 2009). Further, the introduction of alien algae species threatens the stability of some coastal ecosystems and may lead to the elimination of preferred dietary species of green sea turtles (De Weede 1996). Very few green sea turtles are bycaught in U.S. fisheries (Finkbeiner et al. 2011).

Sea level rise may have significant impacts upon green turtle nesting on Pacific atolls. These low-lying, isolated locations could be inundated by rising water levels associated with global warming, eliminating nesting habitat (Baker et al. 2006; Fuentes et al. 2010). Fuentes et al. (2010) predicted that rising temperatures would be a much greater threat in the long term to the hatching success of sea turtles in general and green sea turtles along northeastern Australia particularly. Green sea turtles emerging from nests at cooler temperatures likely absorb more yolk that is converted to body tissue than do hatchlings from warmer nests (Ischer et al. 2009). Predicted temperature rises may approach or exceed the upper thermal tolerance limit of sea turtle incubation, causing widespread failure of nests (Fuentes et al. 2010). Although the timing of loggerhead nesting depends upon sea-surface temperature, green sea turtles do not appear to be affected (Pike 2009).

Green sea turtles have been found to contain the organochlorines chlordane, lindane, endrin, endosulfan, dieldrin, DDT and PCB (Gardner et al. 2003; Miao et al. 2001). Levels of PCBs found in eggs are considered far higher than what is fit for human consumption (Van de Merwe et al. 2009). The heavy metals copper, lead, manganese, cadmium, and nickel have also been found in various tissues and life stages (Barbieri 2009). Arsenic also occurs in very high levels in green sea turtle eggs (Van de Merwe et al. 2009). These contaminants have the potential to cause deficiencies in endocrine, developmental, and reproductive health, and depress immune function in loggerhead sea turtles (Keller et al. 2006; Storelli et al. 2007). Exposure to sewage effluent may also result in green sea turtle eggs harboring antibiotic-resistant strains of bacteria (Al-Bahry et al. 2009). DDE has not been found to influence sex determination at levels below cytotoxicity (Keller and McClellan-Green 2004; Podreka et al. 1998). To date, no tie has been found between pesticide concentration and susceptibility to fibropapillomatosis, although degraded habitat and pollution have been tied to the incidence of the disease (Aguirre et al. 1994; Foley et al. 2005). Flame retardants have been measured from healthy individuals (Hermanussen et al. 2008). It has been theorized that exposure to tumor-promoting compounds produced by the cyanobacteria *Lyngbya majuscule* could promote the development of fibropapillomatosis (Arthur et al. 2008). It has also been theorized that dinoflagellates of the genus *Prorocentrum* that produce the tumorogenic compound okadoic acid may influence the development of fibropapillomatosis (Landsberg et al. 1999).

5.9 Kemp’s ridley sea turtle

Population. Kemp’s ridley sea turtles are considered to consist of a single population, although expansion of nesting may indicate differentiation.

Distribution. The Kemp's ridley was formerly known only from the Gulf of Mexico and along the Atlantic coast of the U.S. (TEWG 2000a). However, recent records support Kemp’s ridley sea turtles distribution extending into the Mediterranean Sea on occasion (Tomas and Raga 2008). The vast majority of individuals stem from breeding beaches at Rancho Nuevo on the Gulf of Mexico coast of Mexico. Dozens of sightings have been made along New Jersey during the approximate time frame of the proposed seismic survey (NSF 2014).

Movement and migration. Tracking of post-nesting females from Rancho Nuevo and Texas beaches indicates that turtles move along coastal migratory corridors either to the north or south from the nesting beach (Byles 1989b; Byles and Plotkin 1994; Renaud 1995b; Renaud et al. 1996; Seney and Landry 2011; Shaver 1999; Shaver 2002) after remaining in the nesting area during the nesting period (Seney and Landry 2011). These migratory corridors appear to extend throughout the coastal areas of the Gulf of Mexico and most turtles appear to travel in waters less than roughly 50 m in depth. Turtles that headed north and east traveled as far as southwest Florida, whereas those that headed south and east traveled as far as the Yucatan Peninsula, Mexico (Morreale et al. 2007).

Kemp’s ridleys in south Florida begin to migrate northward during spring. With each passing month, the waters to the north become warmer and turtles migrate further to Long Island Sound and even Nova Scotia in late summer (Bleakney 1955). During winter, individuals return south in response to local water temperatures; the turtles in the northernmost areas begin their southward movement first. By early November, turtles from New York and New Jersey merge with turtles from the Chesapeake Bay (Byles 1988; Keinath 1993; Lutcavage and Musick 1985; Renaud 1995b) and North Carolina inshore waters (Epperly et al. 1995a; Epperly et al. 1995b; Musick et al. 1994).

Following migration, Kemp’s ridley sea turtles settle into resident feeding areas for several months (Byles and Plotkin 1994; Morreale et al. 2007). Females may begin returning along relatively shallow migratory corridors toward the nesting beach in the winter in order to arrive at the nesting beach by early spring.

During spring and summer, juvenile Kemp’s ridleys occur in the shallow coastal waters of the northern Gulf of Mexico from south Texas to north Florida. In the fall, most Kemp’s ridleys migrate to deeper or more southern, warmer waters and remain there through the winter (Schmid 1998a). As adults, many turtles remain in the Gulf of Mexico, with only occasional occurrence in the Atlantic Ocean (NMFS et al. 2010). Satellite telemetry of males caught near Padre Island, Texas, indicates no migration, but year-round occurrence in nearshore waters less than 50 m deep (Shaver et al. 2005b). Many postnesting females from Rancho Nuevo migrate north to areas offshore of Texas and Louisiana (Marquez-M. 1994b). Farther south, some post-nesting females migrate from Rancho Nuevo to the northern and western Yucatán Peninsula in the southern Gulf of Mexico, which contains important seasonal foraging sites for adult females, such as the Bay of Campeche (Marquez-M. 1994b; Márquez 1990a; Pritchard and Marquez 1973).

Reproduction. Mating is believed to occur about three to four weeks prior to the first nesting (Rostal 2007), or late-March through early- to mid-April. It is presumed that most mating takes place near the nesting beach (Morreale et al. 2007; Rostal 2007). Females initially ovulate within a few days after successful mating and lay the first clutch approximately two to four weeks later; if a turtle nests more than once per season, subsequent ovulations occur within approximately 48 hours after each nesting (Rostal 2007).

Approximately 60% of Kemp's ridley nesting occurs along an 40 km stretch of beach near Rancho Nuevo, Tamaulipas, Mexico from April to July, with limited nesting to the north (100 nests along Texas in 2006) and south (several hundred nests near Tampico, Mexico in 2006 USFWS 2006). Nesting at this location may be particularly important because hatchlings can more easily migrate to foraging grounds (Putman et al. 2010). The Kemp's ridley sea turtle tends to nest in large aggregations or arribadas (Bernardo and Plotkin 2007). The period between Kemp's ridley arribadas averages approximately 25 days, but the precise timing of the arribadas is unpredictable (Bernardo and Plotkin 2007; Rostal et al. 1997). Like all sea turtles, Kemp's ridley sea turtles nest multiple times in a single nesting season. The most recent analysis suggests approximately 3.075 nests per nesting season per female (Rostal 2007). The annual average number of eggs per nest (clutch size) is 94 to 100 and eggs typically take 45 to 58 days to hatch, depending on temperatures (Marquez-M. 1994a; Rostal 2007; USFWS 2000; USFWS 2001; USFWS 2002; USFWS 2003; USFWS 2004; USFWS 2005; USFWS 2006). The period between nesting seasons for each female is approximately 1.8 to 2.0 years (Marquez et al. 1989; Rostal 2007; TEWG 2000a). The nesting beach at Rancho Nuevo may produce a "natural" hatchling sex ratio that is female-biased, which can potentially increase egg production as those turtles reach sexual maturity (Coyne and Landry Jr. 2007; Wibbels 2007).

Growth. Kemp's ridleys require approximately 1.5 to two (range 1-4) years to grow from a hatchling to a size of approximately 20 cm long, at which size they are capable of making a transition to a benthic coastal immature stage (Caillouet et al. 1995; Ogren 1989; Schmid 1998b; Schmid and Witzell 1997b; Snover et al. 2007a; TEWG 2000a; Zug et al. 1997). Based on the size of nesting females, it is assumed that turtles must attain a size of approximately 60 cm long prior to maturing (Marquez-M. 1994a). Growth models based on mark-recapture data suggest that a time period of seven to nine years would be required for this growth from benthic immature to mature size (Schmid and Witzell 1997b; Snover et al. 2007a). Currently, age to sexual maturity is believed to range from approximately 10 to 17 years for Kemp's ridleys (Caillouet Jr. et al. 1995; Schmid and Witzell 1997a; Snover et al. 2007b; Snover et al. 2007a). However, estimates of 10 to 13 years predominate in previous studies (Caillouet et al. 1995;

Schmid and Witzell 1997b; TEWG 2000a).

Habitat. Stranding data indicate that immature turtles in this benthic stage are found in coastal habitats of the entire Gulf of Mexico and U.S. Atlantic coast (Morreale et al. 2007; TEWG 2000a). Developmental habitats for juveniles occur throughout the entire coastal Gulf of Mexico and U.S. Atlantic coast northward to New England (Morreale et al. 2007; Schmid 1998b; Wibbels et al. 2005). Key foraging areas in the Gulf of Mexico include Sabine Pass, Texas; Caillou Bay and Calcasieu Pass, Louisiana; Big Gulley, Alabama; Cedar Keys, Florida; and Ten Thousand Islands, Florida (Carr and Caldwell 1956; Coyne et al. 1995; Ogren 1989; Schmid 1998b; Schmid et al. 2002; Witzell et al. 2005b). Foraging areas studied along the Atlantic coast include Pamlico Sound, Chesapeake Bay, Long Island Sound, Charleston Harbor, and Delaware Bay. Near-shore waters of 35 m or less provide the primary marine habitat for adults, although it is not uncommon for adults to venture into deeper waters (Byles 1989a; Mysing and Vanselous 1989; Renaud et al. 1996; Shaver et al. 2005a; Shaver and Wibbels 2007a).

Benthic coastal waters of Louisiana and Texas seem to be preferred foraging areas for Kemp’s ridley sea turtles (particularly passes and beachfronts), although individuals may travel along the entire coastal margin of the Gulf of Mexico (Landry and Costa 1999; Landry et al. 1996; Renaud 1995a). Sightings are less frequent during winter and spring, but this is likely due to lesser sighting effort during these times (Keinath et al. 1996; Shoop and Kenney 1992b).

Feeding. Kemp’s ridley diet consists mainly of swimming crabs, but may also include fish, jellyfish, and an array of mollusks. Immature Kemp’s ridleys off southwest Florida predate on benthic tunicates, a previously undocumented food source (Witzell and Schmid 2005).

Vocalization and hearing. Sea turtles are low-frequency hearing specialists, typically hearing frequencies from 30 to 2,000 Hz, with a range of maximum sensitivity between 100 and 800 Hz (Bartol et al. 1999; Lenhardt 1994a; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994a). Juvenile Kemp‘s ridleys can hear from 100 to 500 Hz, with a maximum sensitivity between 100 and 200 Hz at thresholds of 110 dB re 1 μPa (Moein Bartol and Ketten 2006).

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 and 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3 kHz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1 kHz and almost no responses beyond 3 or 4 kHz (Patterson 1966).

Status and trends. The Kemp’s ridley sea turtle was listed as endangered on December 2, 1970 (35 FR 18319). Internationally, the Kemp’s ridley is considered the most endangered sea turtle (NRC 1990c; USFWS 1999).

During the mid-20th century, the Kemp's ridley was abundant in the Gulf of Mexico. Historic information indicates that tens of thousands of Kemp’s ridleys nested near Rancho Nuevo, Mexico, during the late 1940s (Hildebrand 1963). From 1978 through the 1980s, arribadas were 200 turtles or less, and by 1985, the total number of nests at Rancho Nuevo had dropped to approximately 740 for the entire nesting season, or a projection of roughly 234 turtles (TEWG 2000a; USFWS and NMFS 1992). Beginning in the 1990s, an increasing number of beaches in Mexico were being monitored for nesting, and the total number of nests on all beaches in Tamaulipas and Veracruz in 2002 was over 6,000; the rate of increase from 1985 ranged from

14-16% (Heppell et al. 2005; TEWG 2000a; USFWS 2002). In 2006, approximately 7,866 nests were laid at Rancho Nuevo with the total number of nests for all the beaches in Mexico estimated at about 12,000 nests, which amounted to about 4,000 nesting females based upon three nests per female per season (Rostal 2007; Rostal et al. 1997; USFWS 2006). Considering remigration rates, the population included approximately 7,000 to 8,000 adult female turtles at that time (Marquez et al. 1989; Rostal 2007; TEWG 2000a). The 2007 nesting season included an arribada of over 4,000 turtles over a three-day period at Rancho Nuevo (P. Burchfield, pers. comm. in NMFS and USFWS 2007b). The increased recruitment of new adults is illustrated in the proportion of first time nesters, which has increased from 6% in 1981 to 41% in 1994. Average population growth was estimated at 13% per year between 1991 and 1995 (TEWG 1998a). In 2008, there were 17,882 nests in Mexico (Gladys Porter Zoo 2008), and nesting in 2009 reached 21,144 (Burchfield 2010). In 2010, nesting declined significantly, to 13,302 but it is too early to determine if this is a one-time decline or if is indicative of a change in the trend. Preliminary estimates of 2011 and 2012 nesting supports 19,368 and 20,197 nests, respectively (back to 2009 levels)(Gallaway et al. 2013). Population modeling used by the TEWG (2000b) projected that Kemp's ridleys could reach the recovery plan's intermediate recovery goal of 10,000 nesters by the year 2015. Over one million hatchlings were released in 2011 and 2012 (Gallaway et al. 2013).

Nesting has also expanded geographically, with a Headstart program reestablishing nesting on South Padre Island starting in 1978. Growth remained slow until 1988, when rates of return started to grow slowly (Shaver and Wibbels 2007b). Nesting rose from 6 in 1996 to 128 in 2007, 195 in 2008, and 197 in 2009. Texas nesting then experienced a decline similar to that seen in Mexico for 2010, with 140 nests (National Park Service data, http://www.nps.gov/pais/naturescience/strp.htm), but nesting rebounded in 2011 with a record 199 nests (National Park Service data, http://www.nps.gov/pais/naturescience/current-season.htm). According to NMFS's FY11-12 ESA Report to Congress, Kemp's ridely sea turtle status is increasing.

Gallaway et al. (2013) estimated that nearly 189,000 female Kemp's ridley sea turtles over the age of two years were alive in 2012. Extrapolating based upon sex bias, the authors estimated that nearly a quarter million age two or older Kemp's ridleys were alive at this time.

Natural threats. Sea turtles face predation primarily by sharks and to a lesser extent by killer whales. All sea turtles except leatherbacks can undergo "cold stunning" if water temperatures drop below a threshold level, which can pose lethal effects. Kemp's ridley sea turtles are particularly prone to this phenomenon along Cape Cod (Innis et al. 2009). From 2006-201), the number of cold-stunned turtles on Cape Cod beaches averaged 115 Kemp's ridleys. The fungal pathogens *Fusarium falciforme* and *F. keratoplasticum* an kill in excess of 90% of sea turtle embryos they infect and may constitute a major threat to nesting productivity under some conditions (Sarmiento-Ramırez et al. 2014).

Anthropogenic threats. Population decline has been curtailed due to the virtual elimination of sea turtle and egg harvesting, as well as assistance in hatching and raising hatchlings (Headstart). However, habitat destruction remains a concern in the form of bottom trawling and shoreline development. Trawling destroys habitat utilized by Kemp's ridley sea turtles for feeding and construction activities can produce hazardous runoff. Bycatch is also a source of mortality for Kemp's ridley sea turtles (McClellan et al. 2009), with roughly three-quarters of annual mortality attributed to shrimp trawling prior to turtle excluder device regulations (Gallaway et al. 2013). However, this has dropped to an estimated one-quarter of total mortality nearly 20 years after turtle excluder devices were implemented in 1990 (Gallaway et al. 2013). In 2010, due to reductions in shrimping effort and turtle excluder device use, shrimp-trawl related mortality appears to have dropped to 4% (1,884) of total mortality (65,505 individuals)(Gallaway et al. 2013). This increased to 3,300 individuals in 2012 (20% of total mortality)(Gallaway et al. 2013). Finkbeiner et al. (2011) estimated that annual bycatch interactions total at least 98,300 individuals annually for U.S. Atlantic fisheries (resulting in 2,700 mortalities or more). The vast majority of fisheries interactions with sea turtles in the U.S. are either Kemp's ridley's or loggerhead sea turtles (Finkbeiner et al. 2011).

Toxin burdens in Kemp's ridley sea turtles include DDT, DDE, PCBs, perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), chlordane, and other organochlorines (Keller et al. 2005; Keller et al. 2004a; Lake et al. 1994; Rybitski et al. 1995). These contaminants have the potential to cause deficiencies in endocrine, developmental and reproductive health, and are known to depress immune function in loggerhead sea turtles (Keller et al. 2006; Storelli et al. 2007a). Along with loggerheads, Kemp's ridley sea turtles have higher levels of PCB and DDT than leatherback and green sea turtles (Pugh and Becker 2001a). Organochlorines, including DDT, DDE, DDD, and PCBs have been identified as bioaccumulative agents and in greatest concentration in subcutaneous lipid tissue (Rybitski et al. 1995). Concentrations ranged from 7.46 mu g/kg to 607 mu g/kg, with a mean of 252 mu g/kg in lipid tissue. Five PCB congeners composed most of the contaminants: 153/132, 138/158, 180, 118, and 187 in order of concentration. PCBs have also been identified in the liver, ranging in concentration from 272 ng/g to 655 ng/g of wet weight, values that are several fold higher than in other sea turtle species (Lake et al. 1994). However, concentrations are reportedly 5% of that which causes reproductive failure in snapping turtles. DDE was identified to range from 137 ng/g to 386 ng/g wet weight. Trans-nonachlor was found at levels between 129 ng/g and 275 ng/g wet weight. Blood samples may be appropriate proxies for organochlorines in other body tissues (Keller et al. 2004a). Perfluorinated compounds in the forms of PFOA and PFOS have been identified in the blood of Kemp's ridley turtles at concentrations of 39.4 ng/mL and 3.57 ng/mL, respectively (Keller et al. 2005). Perfluorinated carboxylic acids have also been detected. It is likely that age and habitat are linked to perflourinated chemical bioaccumulation.

Oil can also be hazardous to Kemp's ridley turtles, with fresh oil causing significant mortality and morphological changes in hatchlings, but aged oil having no detectable effects (Fritts and McGehee 1981). Blood levels of metals are lower in Kemp's ridley sea turtles than in other sea turtles species or similar to them, with copper (215 ng/g to 1,300 ng/g), lead (0 to 34.3 ng/g), mercury (0.5 ng/g to 67.3 ng/g), silver (0.042 ng/g to 2.74 ng/g), and zinc (3,280 ng/g to 18,900 ng/g) having been identified (Innis et al. 2008; Orvik 1997). It is likely that blood samples can be used as an indicator of metal concentration. Mercury has been identified in all turtle species studied, but are generally an order of magnitude lower than toothed whales. The higher level of contaminants found in Kemp's ridley sea turtles are likely due to this species tendency to feed higher on the food chain than other sea turtles. Females from sexual maturity through reproductive life should have lower levels of contaminants than males because contaminants are shared with progeny through egg formation.

5.10 Leatherback sea turtle

Populations. Leatherbacks break into four nesting aggregations: Pacific, Atlantic, and Indian oceans, and the Caribbean Sea. Detailed population structure is unknown, but is likely dependent upon nesting beach location.

Atlantic Ocean. Previous genetic analyses of leatherbacks using only mitochondrial DNA (mtDNA) resulted in an earlier determination that within the Atlantic basin there are at least three genetically different nesting populations: the St. Croix nesting population (U.S. Virgin Islands), the mainland nesting Caribbean population (Florida, Costa Rica, Suriname/French Guiana), and the Trinidad nesting population (Dutton et al. 1999). Further genetic analyses using microsatellite markers in nuclear DNA along with the mtDNA data and tagging data has resulted in Atlantic Ocean leatherbacks now being divided into seven groups or breeding populations: Florida, Northern Caribbean, Western Caribbean, Southern Caribbean/Guianas, West Africa, South Africa, and Brazil (TEWG 2007b).

Caribbean Sea. Nesting occurs in Puerto Rico, St. Croix, Costa Rica, Panama, Colombia, Trinidad and Tobago, Guyana, Suriname, and French Guiana (Bräutigam and Eckert 2006; Márquez 1990b; Spotila et al. 1996).

Distribution. Leatherbacks range farther than any other sea turtle species, having evolved physiological and anatomical adaptations that allow them to exploit cold waters (Frair et al. 1972; Greer et al. 1973; USFWS 1995). High-latitude leatherback range includes in the Atlantic includes the North and Barents Seas, Newfoundland and Labrador, Argentina, and South Africa (Goff and Lien 1988; Hughes et al. 1998; Luschi et al. 2003; Luschi et al. 2006; Márquez 1990b; Threlfall 1978). Pacific ranges extend to Alaska, Chile, and New Zealand (Brito 1998; Gill 1997; Hodge and Wing 2000). Several sightings have been made along New Jersey during the approximate time frame of the proposed seismic survey (NSF 2014). Associations exist with continental shelf and pelagic environments and sightings occur in offshore waters of 7-27˚ C (CETAP 1982). Juvenile leatherbacks usually stay in warmer, tropical waters >21˚ C (Eckert 2002). Males and females show some degree of natal homing to annual breeding sites (James et al. 2005).

Growth and reproduction. It has been thought that leatherbacks reach sexual maturity somewhat faster than other sea turtles (except Kemp's ridley), with an estimated range of 3-6 (Rhodin 1985) or 13-14 years (Zug and Parham 1996). However, recent research suggests otherwise, with western North Atlantic leatherbacks possibly not maturing until as late as 29 years of age (Avens and Goshe 2007; Avens and Goshe 2008; Avens et al. 2009). Female leatherbacks nest frequently (up to 13, average of 5-7 nests per year and about every 2-3 years)(Eckert et al. 2012). The average number of eggs per clutch varies by region: Atlantic Ocean (85 eggs), western Pacific Ocean (85 eggs), eastern Pacific Ocean (65 eggs) and Indian Ocean (>100 eggs (Eckert et al. 2012)). However, up to ~30% of the eggs can be infertile. Thus, the actual proportion of eggs that can result in hatchlings is less than this seasonal estimate. The eggs incubate for 55-75 days before hatching.

Habitat. Leatherbacks occur throughout marine waters, from nearshore habitats to oceanic environments (Grant and Ferrell 1993; Schroeder and Thompson 1987; Shoop and Kenney 1992a; Starbird et al. 1993). Movements are largely dependent upon reproductive and feeding cycles and the oceanographic features that concentrate prey, such as frontal systems, eddy features, current boundaries, and coastal retention areas (Benson et al. 2011b; Collard 1990; Davenport and Balazs 1991; Frazier 2001; HDLNR 2002). Aerial surveys off the western U.S. support continental slope waters as having greater leatherback occurrence than shelf waters (Bowlby et al. 1994; Carretta and Forney 1993; Green et al. 1992; Green et al. 1993). Nesting sites appear to be related to beaches with relatively high exposure to wind or wind-generated waves (Santana Garcon et al. 2010).

Areas above 30º N in the Atlantic appear to be popular foraging locations (Fossette et al. 2009b). Northern foraging areas were proposed for waters between 35º and 50º N along North American, Nova Scotia, the Gulf of Saint-Laurent, in the western and northern Gulf Stream, the Northeast Atlantic, the Azores front and northeast of the Azores Islands, north of the Canary Islands. Southern foraging was proposed to occur between 5º and 15º N in the Mauritania upwelling, south of the Cape Verde islands, over the Guinea Dome area, and off Venezuela, Guyana and Suriname.

Migration and movement. Leatherback sea turtles migrate throughout open ocean convergence zones and upwelling areas, along continental margins, and in archipelagic waters (Eckert 1998; Eckert 1999; Morreale et al. 1994). In a single year, a leatherback may swim more than 11,000 km to nesting and foraging areas throughout ocean basins (Benson et al. 2007a; Benson et al. 2011b; Benson et al. 2007b; Eckert 1998; Eckert 2006; Eckert et al. 2006; Ferraroli et al. 2004; Hays et al. 2004; Sale et al. 2006). Much of this travel may be due to movements within current and eddy features, moving individuals along (Sale and Luschi 2009). Return to nesting beaches may be accomplished by a form of geomagnetic navigation and use of local cues (Sale and Luschi 2009). Leatherback females will either remain in nearshore waters between nesting events (generally within 100-300 km) (Benson et al. 2011a; Eckert et al. 2012), or range widely, presumably to feed on available prey (Byrne et al. 2009; Fossette et al. 2009a).

Fossette et al. (2009b) identified three main migratory strategies in leatherbacks in the North Atlantic (almost all of studied individuals were female). One involved 12 individuals traveling to northern latitudes during summer/fall and returning to waters during winter and spring. Another strategy used by six individuals was similar to this, but instead of a southward movement in fall, individuals overwintered in northern latitudes (30-40º N, 25-30º W) and moved into the Irish Sea or Bay of Biscay during spring before moving south to between 5 and 10º in winter, where they remained or returned to the northwest Atlantic. A third strategy, which was followed by three females remaining in tropical waters for the first year subsequent to nesting and moving to northern latitudes during summer/fall and spending winter and spring in latitudes of 40-50º N. Individuals nesting in Caribbean Islands migrate to foraging areas off Canada (Richardson et al. 2012).

Genetic studies support the satellite telemetry data indicating a strong difference in migration and foraging fidelity between the breeding populations in the northern and southern hemispheres of the Atlantic Ocean (Dutton et al. 2013; Stewart et al. 2013). Genetic analysis of rookeries in Gabon and Ghana confirm that leatherbacks from West African rookeries migrate to foraging areas off South America (Dutton et al. 2013). Foraging adults off Nova Scotia, Canada, mainly originate from Trinidad and none are from Brazil, Gabon, Ghana, or South Africa (Stewart et al. 2013).

Leatherbacks occur along the southeastern U.S. year-round, with peak abundance in summer (TEWG 2007c). In spring, leatherback sea turtles appear to be concentrated near the coast, while other times of the year they are spread out at least to the Gulf Stream. From August 2009 through August 2010 off Jacksonville, Florida, surveys sighted 48 leatherback sea turtles, while simultaneous vessel surveys sighted four leatherback sea turtles (U.S. Department of the Navy 2010).

Sex ratio. A significant female bias exists in all leatherback populations thus far studied. An examination of strandings and in-water sighting data from the U.S. Atlantic and Gulf of Mexico coasts indicates that 60% of individuals were female. Studies of Suriname nesting beach temperatures suggest a female bias in hatchlings, with estimated percentages of females hatched over the course of each season at 75.4, 65.8, and 92.2% in 1985, 1986, and 1987, respectively (Plotkin 1995). Binckley et al. (1998) found a heavy female bias upon examining hatchling gonad histology on the Pacific coast of Costa Rica, and estimated male to female ratios over three seasons of 0:100, 6.5:93.5, and 25.7:74.3. James et al. (2007) also found a heavy female bias (1.86:1) as well as a primarily large sub-adult and adult size distribution. Leatherback sex determination is affected by nest temperature, with higher temperatures producing a greater proportion of females (Mrosovsky 1994; Witzell et al. 2005a).

Feeding. Leatherbacks may forage in high-invertebrate prey density areas formed by favorable oceanographic features (Eckert 2006; Ferraroli et al. 2004). Although leatherbacks forage in coastal waters, they appear to remain primarily pelagic through all life stages (Heppell et al. 2003). The location and abundance of prey, including medusae, siphonophores, and salpae, in temperate and boreal latitudes likely has a strong influence on leatherback distribution in these areas (Plotkin 1995).

Vocalization and hearing. Sea turtles are low-frequency hearing specialists, typically hearing frequencies from 30 to 2,000 Hz, with a range of maximum sensitivity between 100 and 800 Hz (Bartol et al. 1999; Lenhardt 1994a; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Piniak et al. (2012) found leatherback hatchlings capable of hearing underwater sounds at frequencies of 50-1,200 Hz (maximum sensitivity at 100-400 Hz). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994a).

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 and 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3 kHz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1 kHz and almost no responses beyond 3 or 4 kHz (Patterson 1966).

Status and trends. Leatherback sea turtles received protection on June 2, 1970 (35 FR 8491) under the Endangered Species Conservation Act and, since 1973, have been listed as endangered under the ESA, but declines in nesting have continued worldwide. Consideration of the status of populations outside of the action area is important under the present analysis to determine the risk to the affected population(s) bears on the status of the species as a whole. Breeding females were initially estimated at 29,000-40,000, but were later refined to ~115,000 (Pritchard 1971; Pritchard 1982). Spotila et al. (1996) estimated 34,500 females, but later issued an update of 35,860 (Spotila 2004). The species as a whole is declining and local populations are in danger of extinction (NMFS 2001b; NMFS 2001a)(Table 11).

Florida (March-July) and U.S. Caribbean nesting since the early 1980s has increased ~0.3% and 7.5% per year, respectively, but lags behind the French Guiana coast and elsewhere in magnitude

(NMFS/SEFSC 2001). This positive growth was seen within major nesting areas for the stock, including Trinidad, Guyana, and the combined beaches of Suriname and French Guiana (TEWG 2007c). Trinidad supports an estimated 7,000 to 12,000 leatherbacks nesting annually (Stewart et al. 2013), which represents more than 80% of the nesting in the insular Caribbean Sea (Fournillier and Eckert 1999). Using both Bayesian modeling and regression analyses, the TEWG (2007c) determined that the Southern Caribbean/Guianas stock had demonstrated a long-term, positive population growth rate (using nesting females as a proxy for population).

Table 11. Leatherback nesting population site location information where multiple-year surveys were conducted or trends are known (data type, years surveyed, annual number (nests, females, trend). Nesting population trend symbols: ▲ = increasing; ▼ = decreasing.

Location	Data: Nests, Females	Years	Annual number	Trend	Reference
Atlantic					
United States (Florida)	Nests	1979 - 2008	63-754	▲	Stewart et al. (2011)
Puerto Rico (Culebra)	Nests	1993 - 2012	395-32	▼	{C. Diez, Department of Natural and Environmental Resources of Puerto Rico, unpublished data in// NMFS and USFWS, 2013 #36241} Diez et al. (2010; Ramírez-Gallego et al. 2013)
Puerto Rico (other)	Nests	1993 - 2012	131-1,291	▲	C. Diez, Department of Natural and Environmental Resources of Puerto Rico, unpublished data in// NMFS and USFWS (2013)
United States Virgin Islands (Sandy Point National Wildlife Refuge, St. Croix)	Nests	1986 - 2004	143-1,008	▲[1]	Dutton et. al. (2005); Turtle Expert Working Group (2007a)
British Virgin Islands	Nests	1986 - 2006	0-65	▲	McGowan et al. (2008) ;Turtle Expert Working Group (2007a)

[1] A more recent trend analysis was not found in the literature. However, trends since 2001 suggest the population may be declining, possibly due to a decrease in the number of new nesters, lowered productivity (number of clutches per season and lower hatch success), and an increase in remigration intervals (Garner 2012; Garner et al. 2012).

The Caribbean coast of Costa Rica and extending through Chiriquí Beach, Panama, represents the fourth largest known leatherback rookery in the world (Troeng et al. 2004). Examination of data from three index nesting beaches in the region (Tortuguero, Gandoca, and Pacuare in Costa Rica) using various Bayesian and regression analyses indicated that the nesting population likely was not growing during 1995-2005 (TEWG 2007c). Other modeling of the nesting data for Tortuguero indicates a 67.8% decline between 1995 and 2006 (Troëng et al. 2007).

In Puerto Rico, the primary nesting beaches are at Fajardo and on the island of Culebra. Nesting between 1978 and 2005 ranged between 469-882 nests, and the population has been growing since 1978, with an overall annual growth rate of 1.1% (TEWG 2007c). At the primary nesting beach on St. Croix, the Sandy Point National Wildlife Refuge, nesting has fluctuated from a few hundred nests to a high of 1,008 in 2001, and the average annual growth rate has been approximately 1.1% from 1986-2004 (TEWG 2007c). Overall increases are recorded for mainland Puerto Rico and St. Croix, as well as the U.S. Virgin Islands (Ramírez-Gallego et al. 2013). Trends since 2001 suggest the population may be declining, possibly due to a decrease in the number of new nesters, lowered productivity (number of clutches per season and lower hatch success), and an increase in remigration intervals (Garner 2012; Garner et al. 2012).

The Florida nesting stock comes ashore primarily along the east coast of Florida. This stock is of growing importance, with total nests between 800-900 per year in the 2000s following nesting totals fewer than 100 nests per year in the 1980s (NMFS 2011). Using data from the index nesting beach surveys, the TEWG (2007c) estimated a significant annual nesting growth rate of 1% between 1989 and 2005. Stewart et al. (2011) evaluated nest counts from 68 Florida beaches over 30 years (1979-2008) and found that nesting increased at all beaches with trends ranging from 3.1%-16.3% per year, with an overall increase of 10.2% per year. In 2007, a record 517 leatherback nests were observed on the index beaches in Florida, with 265 in 2008, and then an increase to a new record of 615 nests in 2009, and a slight decline in 2010 back to 552 nests (FWC Index Nesting Beach database). This up-and-down pattern is thought to be a result of the cyclical nature of leatherback nesting, similar to the biennial cycle of green turtle nesting.

The most recent population estimate for leatherback sea turtles from the North Atlantic as a whole is between 34,000-90,000 adult individuals (20,000-56,000 adult females)(TEWG 2007c).

Annual survival probability (ca. 0.85) was constant over the 10-year period. Annual survival was lower than those estimated for Atlantic rookeries (Dutton et al. 2005; Rivalan et al. 2005). For the St. Croix, U.S. Virgin Islands population, the annual survival rate was approximately 0.893 (confidence interval = 0.87-0.92) for adult female leatherbacks at St. Croix (Dutton et al. 2005). Annual juvenile survival rate for St. Croix was estimated to be approximately 0.63, and the total survival rate from hatchling to first year of reproduction for a female hatchling was estimated to be between 0.004 and 0.02, given assumed age at first reproduction between 9 and 13 (Eguchi et al. 2006). In Florida, annual survival for nesting females was estimated to be 0.956 (Stewart 2007). Spotila et al. (1996) estimated the first year (from hatching) of survival for the global population to be 0.0625.

Natural threats. Sea turtles face predation primarily by sharks and to a lesser extent by killer whales (Pitman and Dutton 2004). Hatchlings are preyed upon by herons, gulls, dogfish, and sharks. Leatherback hatching success is particularly sensitive to nesting site selection, as nests that are overwashed have significantly lower hatching success and leatherbacks nest closer to the high-tide line than other sea turtle species (Caut et al. 2009b). The fungal pathogens *Fusarium falciforme* and *F. keratoplasticum* can kill in excess of 90% of sea turtle embryos they infect and may constitute a major threat to nesting productivity under some conditions (Sarmiento-Ramırez et al. 2014).

Anthropogenic threats. Leatherback nesting and marine environments are facing increasing impacts through widespread development and tourism along nesting beaches (Hamann et al. 2006; Hernandez et al. 2007; Maison 2006; Santidrián Tomillo et al. 2007). Structural impacts to beaches include building and piling construction, beach armoring and renourishment, and sand extraction (Bouchard et al. 1998; Lutcavage et al. 1997b). In some areas, timber and marine debris accumulation as well as sand mining reduce available nesting habitat (Bourgeois et al. 2009; Chacón Chaverri 1999; Formia et al. 2003; Laurance et al. 2008). Lights on or adjacent to nesting beaches alter nesting adult behavior and are often fatal to emerging hatchlings as they are drawn to light sources and away from the sea (Bourgeois et al. 2009; Cowan et al. 2002; Deem et al. 2007; Witherington 1992; Witherington and Bjorndal 1991). Leatherbacks are much more likely to emerge and not nest on developed beaches and much more likely to emerge and nest on undeveloped stretches (Roe et al. 2013). Plastic ingestion is very common in leatherbacks and can block gastrointestinal tracts leading to death (Mrosovsky et al. 2009). Along the coast of Peru, 13% of 140 leatherback carcasses were found to contain plastic bags and film (Fritts 1982). A leatherback found stranded along the northern Adriatic had been weakened by plastic ingestion, likely leading to an infection that ultimately killed the individual (Poppi et al. 2012). Although global warming may expand foraging habitats into higher latitude waters, increasing temperatures may increase feminization of nests (Hawkes et al. 2007b; James et al. 2006; McMahon and Hays 2006; Mrosovsky et al. 1984). Rising sea levels may also inundate nests on some beaches. Egg collection is widespread and attributed to catastrophic declines, such as in Malaysia. Harvest of females along nesting beaches is of concern worldwide.

Bycatch, particularly by longline fisheries, is a major source of mortality for leatherback sea turtles (Crognale et al. 2008; Fossette et al. 2009a; Gless et al. 2008; Petersen et al. 2009). Wallace et al. (2010) estimated that between 1990 and 2008, at least 85,000 sea turtles were captured as bycatch in fisheries worldwide. This estimate is likely at least two orders of magnitude low, resulting in a likely bycatch of nearly half a million sea turtles annually (Wallace et al. 2010); many of these turtles are expected to be leatherbacks. Currently, the U.S. tuna and swordfish longline fisheries managed under the HMS FMP are estimated to capture 1,764 leatherbacks (no more than 252 mortalities) for each 3-year period starting in 2007 (NMFS 2004). While 2010 total estimates are not yet available, in 2009, 285.8 (95% CI: 209.6-389.7) leatherback sea turtles are estimated to have been taken in the longline fisheries managed under the HMS FMP based on the observed takes (Garrison and Stokes 2010). Observer coverage for this period ranged from 54 to 92%. Trinidad and Tobago's Institute for Marine Affairs estimated that more than 3,000 leatherbacks were captured incidental to gillnet fishing in the coastal waters of Trinidad in 2000. Half or more of the gravid turtles in Trinidad and Tobago waters may be killed (Lee Lum 2003), though many of the turtles do not die as a result of drowning, but rather because the fishermen butcher them in order to get them out of their nets (NMFS 2001b).

We know little about the effects of contaminants on leatherback sea turtles. The metals arsenic, cadmium, copper, mercury, selenium, and zinc bioaccumulate, with cadmium in highest concentration in leatherbacks versus any other marine vertebrate (Caurant et al. 1999; Gordon et al. 1998). Along with these, lead has also been reported in high concentrations, potentially to the detriment of the individual (Perrault et al. 2013; Poppi et al. 2012). A diet of primarily jellyfish, which have high cadmium concentrations, is likely the cause (Caurant et al. 1999). Organochlorine pesticides have also been found (Mckenzie et al. 1999). PCB concentrations are reportedly equivalent to those in some marine mammals, with liver and adipose levels of at least one congener being exceptionally high (PCB 209: 500-530 ng/g wet weight Davenport et al. 1990; Oros et al. 2009).

5.11 Loggerhead sea turtle- Northwest Atlantic DPS

Populations. Five groupings represent loggerhead sea turtles by major sea or ocean basin:

Atlantic, Pacific, and Indian oceans, as well as Caribbean and Mediterranean seas. As with other sea turtles, populations are frequently divided by nesting aggregation (Hutchinson and Dutton 2007). On September 22, 2011, the NMFS designated nine distinct population segments (DPSs) of loggerhead sea turtles: South Atlantic Ocean and southwest Indian Ocean as threatened as well as Mediterranean Sea, North Indian Ocean, North Pacific Ocean, northeast Atlantic Ocean, northwest Atlantic Ocean, South Pacific Ocean, and southeast Indo-Pacific Ocean as endangered (75 FR 12598). Recent ocean-basin scale genetic analysis supports this conclusion, with additional differentiation apparent based upon nesting beaches (Shamblin et al. 2014).

Western Atlantic nesting locations include The Bahamas, Brazil, and numerous locations from the Yucatán Peninsula to North Carolina (Addison 1997; Addison and Morford 1996; Marcovaldi and Chaloupka 2007). This group comprises five nesting subpopulations: Northern, Southern, Dry Tortugas, Florida Panhandle, and Yucatán. Additional nesting occurs on Cay Sal Bank (Bahamas), Cuba, the Bahamian Archipelago, Quintana Roo (Yucatan Peninsula), Colombia, Brazil, Caribbean Central America, Venezuela, and the eastern Caribbean Islands. Genetic studies indicate that, although females routinely return to natal beaches, males may breed with females from multiple populations and facilitate gene flow Bowen et al. (2005). In the eastern Atlantic, we know of five rookeries from Cape Verde, Greece, Libya, Turkey, and the western Africa coast.

Distribution. Loggerheads are circumglobal, occurring throughout the temperate and tropical regions of the Atlantic Ocean. Loggerheads are the most abundant species of sea turtle found in U.S. coastal waters. Hundreds of sightings have been made along New Jersey during the approximate time frame of the proposed seismic survey (NSF 2014).

Reproduction and growth. Loggerhead nesting is confined to lower latitude temperate and subtropic zones but absent from tropical areas (NMFS and USFWS 1991b; NRC 1990b; Witherington et al. 2006b). The life cycle of loggerhead sea turtles can be divided into seven stages: eggs and hatchlings, small juveniles, large juveniles, subadults, novice breeders, first-year emigrants, and mature breeders (Crouse et al. 1987). Hatchling loggerheads migrate to the ocean (to which they are drawn by near ultraviolet light Kawamura et al. 2009), where they are generally believed to lead a pelagic existence for as long as 7-12 years (Avens et al. 2013; NMFS 2005a). Loggerheads in the Mediterranean, similar to those in the Atlantic, grow at roughly 11.8 cm/yr for the first six months and slow to roughly 3.6 cm/yr at age 2.5-3.5. As adults, individuals may experience a secondary growth pulse associated with shifting into neritic habitats, although growth is generally monotypic (declines with age Casale et al. 2009a; Casale et al. 2009b). Individually-based variables likely have a high impact on individual growth rates (Casale et al. 2009b). At 15-38 years, loggerhead sea turtles become sexually mature, although the age at which they reach maturity varies widely among populations (Casale et al. 2009b; Frazer and Ehrhart 1985b; Frazer et al. 1994; NMFS 2001b; Witherington et al. 2006). However, based on data from tag returns, strandings, and nesting surveys, NMFS (2001b) estimated ages of maturity ranging from 20-38 years and benthic immature stage lasting from 14-32 years. Notably, data from several studies showed decreased growth rates of loggerheads in U.S. Atlantic waters from 1997-2007, corresponding to a period of 43% decline in Florida nest counts (Bjorndal et al. 2013).

Loggerhead mating likely occurs along migration routes to nesting beaches, as well as in offshore from nesting beaches several weeks prior to the onset of nesting (Dodd 1988a; NMFS and USFWS 1998d). Females usually breed every 2-3 years, but can vary from 1-7 years (Dodd 1988a; Richardson et al. 1978). Females lay an average of 4.1 nests per season (Murphy and Hopkins 1984), although recent satellite telemetry from nesting females along southwest Florida support 5.4 nests per female per season, with increasing numbers of eggs per nest during the course of the season (Tucker 2009). The authors suggest that this finding warrants revision of the number of females nesting in the region. The western Atlantic breeding season is March-August. Nesting sites appear to be related to beaches with relatively high exposure to wind or wind-generated waves (Santana Garcon et al. 2010).

Nesting in the Gulf of Mexico does occur, although primarily in Florida, with rare nests along North and South Padre Island in Texas (Dodd 1988b; Hildebrand 1983).

Migration and movement. Loggerhead hatchlings migrate offshore and become associated with *Sargassum* spp. habitats, driftlines, and other convergence zones (Carr 1986). After 14-32 years of age, they shift to a benthic habitat, where immature individuals forage in the open ocean and coastal areas along continental shelves, bays, lagoons, and estuaries (Bowen et al. 2004; NMFS 2001b). Adult loggerheads make lengthy migrations from nesting beaches to foraging grounds (TEWG 1998b). In the Gulf of Mexico, larger females tend to disperse more broadly after nesting than smaller individuals, which tend to stay closer to their nesting locations (Girard et al. 2009). In the North Atlantic, loggerheads travel north during spring and summer as water temperatures warm and return south in fall and winter, but occur offshore year-round assuming adequate temperature. As water temperatures drop from October to December, most loggerheads emigrate from their summer developmental habitats to warmer waters south of Cape Hatteras, where they winter (Morreale and Standora 1998). For immature individuals, this movement occurs in two patterns: a north-south movement over the continental shelf with migration south of Cape Hatteras in winter and movement north along Virginia for summer foraging, and a not-so-seasonal oceanic dispersal into the Gulf Stream as far north as the 10-15˚ C isotherm (Mansfield et al. 2009). Wallace et al. (2009) suggested differences in growth rate based upon these foraging strategies. Long Island Sound, Core Sound, Pamlico Sound, Cape Cod Bay, and Chesapeake Bay are the most frequently used juvenile developmental habitats along the Northeast United States Continental Shelf Large Marine Ecosystem (Burke et al. 1991; Epperly et al. 1995a; Epperly et al. 1995b; Epperly et al. 1995c; Mansfield 2006; Prescott 2000; University of Delaware Sea Grant 2000). There is conflicting evidence that immature loggerheads roam the oceans in currents and eddies and mix from different natal origins or distribute on a latitudinal basis that corresponds with their natal beaches (Monzon-Arguello et al. 2009; Wallace et al. 2009). McCarthy et al. (2010) found that movement patterns of loggerhead sea turtles were more convoluted when sea surface temperatures were higher, ocean depths shallower, ocean currents stronger, and chlorophyll α levels lower. Satellite tracking of loggerheads from southeastern U.S. nesting beaches supports three dispersal modes to foraging areas: one northward along the continental shelf to the northeastern U. S., broad movement through the southeastern and mid-Atlantic U. S., and residency near breeding areas (Reina et al. 2012).

Gender, age, and survivorship. Although information on males is limited, several studies identified a female bias, although a single study has found a strong male bias (Dodd 1988a; NMFS 2001b; Rees and Margaritoulis 2004). Nest temperature seems to drive sex determination. Along Florida, males primarily derive from earlier-season nests (LeBlanc et al. 2012). Here, nests ranged from an average sex ratio of 55% female to 85% (LeBlanc et al. 2012).

Additionally, little is known about longevity, although Dodd (1988a) estimated the maximum female life span at 47-62 years. Heppell et al. (2003a) estimated annual survivorship to be 0.81 (southeast U.S. adult females), 0.78-0.91 (Australia adult females), 0.68-0.89 (southeast U.S. benthic juveniles, and 0.92 (Australia benthic juveniles). Another recent estimate suggested a survival rate of 0.41 or 0.60 (CIs 0.20-0.65 and 0.40-0.78, respectively), depending upon assumptions within the study (Sasso et al. 2011). Survival rates for hatchlings during their first year are likely very low (Heppell et al. 2003a; Heppell et al. 2003).

Feeding. Loggerhead sea turtles are omnivorous and opportunistic feeders through their lifetimes (Parker et al. 2005). Hatchling loggerheads feed on macroplankton associated with *Sargassum* spp. communities (NMFS and USFWS 1991b). Pelagic and benthic juveniles forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd 1988a; Wallace et al. 2009). Loggerheads in the deep, offshore waters of the western North Pacific feed on jellyfish, salps, and other gelatinous animals (Dodd Jr. 1988; Hatase et al. 2002). Sub-adult and adult loggerheads prey on benthic invertebrates such as gastropods, mollusks, and decapod crustaceans in hard-bottom habitats, although fish and plants are also occasionally eaten (NMFS and USFWS 1998d). Stable isotope analysis and study of organisms on turtle shells has recently shown that although a loggerhead population may feed on a variety of prey, individuals composing the population have specialized diets (Reich et al. 2010; Vander Zanden et al. 2010).

Vocalization and hearing. Sea turtles are low-frequency hearing specialists, typically hearing frequencies from 30 to 2,000 Hz, with a range of maximum sensitivity between 100 and 800 Hz (Bartol et al. 1999; Lenhardt 1994a; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994a). Bartol et al. (1999) reported effective hearing range for juvenile loggerhead turtles is from at least 250-750 Hz. Both yearling and two-year old loggerheads had the lowest hearing threshold at 500 Hz (yearling: about 81 dB re 1 μPa and two-year-olds: about 86 dB re 1 μPa), with thresholds increasing rapidly above and below that frequency (Moein Bartol and Ketten 2006).

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 and 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3 kHz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1 kHz and almost no responses beyond 3 or 4 kHz (Patterson 1966).

Status and trends. Loggerhead sea turtles were listed as threatened under the ESA of 1973 on July 28, 1978 (43 FR 32800). On September 22, 2011, the NMFS designated nine distinct population segments (DPSs) of loggerhead sea turtles (75 FR 12598).

There is general agreement that the number of nesting females provides a useful index of the species' population size and stability at this life stage, even though there are doubts about the ability to estimate the overall population size (Bjorndal et al. 2005). An important caveat for population trends analysis based on nesting beach data is that this may reflect trends in adult nesting females, but it may not reflect overall population growth rates well. Adult nesting females often account for less than 1% of total population numbers. The global abundance of nesting female loggerhead turtles is estimated at 43,320–44,560 (Spotila 2004).

The greatest concentration of loggerheads occurs in the Atlantic Ocean and the adjacent Caribbean Sea, primarily on the Atlantic coast of Florida, with other major nesting areas located on the Yucatán Peninsula of Mexico, Columbia, Cuba, and South Africa (EuroTurtle 2006 as cited in LGL Ltd. 2007; Márquez 1990b).

Among the five subpopulations, loggerhead females lay 53,000-92,000 nests per year in the southeastern U.S. and the Gulf of Mexico, and the total number of nesting females are 32,000-56,000. All of these are currently in decline or data are insufficient to assess trends (NMFS 2001b; TEWG 1998a). Loggerheads from western North Atlantic nesting aggregations may or may not feed in the same regions from which they hatch. Loggerhead sea turtles from the northern nesting aggregation, which represents about 9% of the loggerhead nests in the western North Atlantic, comprise 25-59% of individuals foraging from Georgia up to the northeast U.S. (Bass et al. 1998; Norrgard 1995; Rankin-Baransky 1997; Sears 1994; Sears et al. 1995). Loggerheads associated with the South Florida nesting aggregation occur in higher frequencies in the Gulf of Mexico (where they represent ~10% of the loggerhead captures) and the Mediterranean Sea (where they represent ~45% of loggerhead sea turtles captured). About 4,000 nests per year are laid along the Brazilian coast (Ehrhart et al. 2003).

The northern recovery unit along Georgia, South Carolina, and North Carolina has a forty-year time-series trend showing an overall decline in nesting, but the shorter comprehensive survey data (20 years) indicate a stable population (Georgia Department of Natural Resources, North Carolina Wildlife Resource Commission, and South Carolina Department of Natural Resources nesting data located at www.seaturtle.org). NMFS scientists have estimated that the northern subpopulation produces 65% males (NMFS 2001b).

The peninsular Florida recovery unit is the largest loggerhead nesting assemblage in the northwest Atlantic. A near-complete nest census (all beaches including index nesting beaches) undertaken from 1989 to 2007 showed a mean of 64,513 loggerhead nests per year, representing approximately 15,735 nesting females annually (NMFS and USFWS 2008). The statewide estimated total for 2010 was 73,702 (FWRI nesting database). An analysis of index nesting beach data shows a 26% nesting decline between 1989 and 2008, and a mean annual rate of decline of 1.6% despite a large increase in nesting for 2008, to 38,643 nests (FWRI nesting database)(NMFS and USFWS 2008; Witherington et al. 2009). In 2009, nesting levels, while still higher than the lows of 2004, 2006, and 2007, dropped below 2008 levels to approximately 32,717 nests, but in 2010, a large increase was seen, with 47,880 nests on the index nesting beaches (FWRI nesting database). The 2012[3] index nesting number is the largest since 2000. Nesting counts in 2013 and 2014 were lower than 2012, but still roughly equivalent to counts in 2000. With the addition of data through 2010, the nesting trend for the northwestern Atlantic DPS is slightly negative and not statistically different from zero (no trend) (NMFS and USFWS 2010).

Because of its size, the South Florida subpopulation of loggerheads may be critical to the survival of the species in the Atlantic, and in the past it was considered second in size only to the Oman nesting aggregation (NMFS 2006e; NMFS and USFWS 1991b). The South Florida population increased at ~5.3% per year from 1978-1990, and was initially increasing at 3.9-4.2% after 1990. An analysis of nesting data from 1989-2005, a period of more consistent and accurate

3 http://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/

surveys than in previous years, showed a detectable trend and, more recently (1998-2005), has shown evidence of a declining trend of approximately 22.3% (FFWCC 2007a; FFWCC 2007b; Witherington et al. 2009). This is likely due to a decline in the number of nesting females within the population (Witherington et al. 2009). Nesting data from the Archie Carr Refuge (one of the most important nesting locations in Southeast Florida) over the last 6 years shows nests declined from approximately 17,629 in 1998 to 7,599 in 2004, also suggesting a decrease in population size[4]. Loggerhead nesting is thought to consist of just 60 nesting females in the Caribbean and Gulf of Mexico (NMFS 2006c). Based upon the small sizes of almost all nesting aggregations in the Atlantic, the large numbers of individuals killed in fisheries, and the decline of the only large nesting aggregation, we suspect that the extinction probabilities of loggerhead sea turtle populations in the Atlantic are only slightly lower than those of populations in the Pacific.

Zurita et al. (2003) found a statistically significant increase in the number of nests on seven of the beaches on Quintana Roo, Mexico, from 1987-2001, where survey effort was consistent during the period. However, nesting has declined since 2001, and the previously reported increasing trend appears to have been temporary (NMFS and USFWS 2008).

Natural threats. Sea turtles face predation primarily by sharks and to a lesser extent by killer whales. All sea turtles except leatherbacks can undergo “cold stunning” if water temperatures drop below a threshold level, which can pose lethal effects. In January 2010, an unusually large cold-stunning event occurred throughout the southeast U. S., with well over 3,000 sea turtles (mostly greens but also hundreds of loggerheads) found cold-stunned. Most survived, but several hundred were found dead or died after being discovered in a cold-stunned state. Eggs are commonly eaten by raccoons and ghost crabs along the eastern U.S. (Barton and Roth 2008). In the water, hatchlings are hunted by herons, gulls, dogfish, and sharks. Heavy loads of barnacles are associated with unhealthy or dead stranded loggerheads (Deem et al. 2009). Brevetoxin-producing algal blooms can result in loggerhead sea turtle death and pathology, with nearly all stranded loggerheads in affected areas showing signs of illness or death resulting from exposure (Fauquier et al. 2013). The fungal pathogens *Fusarium falciforme* and *F. keratoplasticum* can kill in excess of 90% of sea turtle embryos they infect and may constitute a major threat to nesting productivity under some conditions (Sarmiento-Ramırez et al. 2014).

Anthropogenic threats. Anthropogenic threats impacting loggerhead nesting habitat are numerous: coastal development and construction, placement of erosion control structures, beachfront lighting, vehicular and pedestrian traffic, sand extraction, beach erosion, beach nourishment, beach pollution, removal of native vegetation, and planting of non-native vegetation (Baldwin 1992; Margaritoulis et al. 2003; Mazaris et al. 2009b; USFWS 1998). Surprisingly, beach nourishment also hampers nesting success, but only in the first year post-nourishment before hatching success increases (Brock et al. 2009). Loggerhead sea turtles face numerous threats in the marine environment as well, including oil and gas exploration, marine pollution, trawl, purse seine, hook and line, gill net, pound net, longline, and trap fisheries,

4 While this is a long period of decline relative to the past observed nesting pattern at this location, aberrant ocean surface temperatures complicate the analysis and interpretation of these data. Although caution is warranted in interpreting the decreasing nesting trend given inherent annual fluctuations in nesting and the short time period over which the decline has been noted, the recent nesting decline at this nesting beach is reason for concern.

underwater explosions, dredging, offshore artificial lighting, power plant entrapment, entanglement in debris, ingestion of marine debris, marina and dock construction and operation, boat collisions, and poaching. At least in the Mediterranean Sea, anthropogenic threats appear to disproportionally impact larger (more fecund) loggerheads (Bellido et al. 2010).

Marine debris ingestion is a widespread issue for loggerhead sea turtles. More than one-third of loggerheads found stranded or bycaught had injected marine debris in a Mediterranean study, with possible mortality resulting in some cases (Lazar and Gračan 2010). Another study in the Tyrrhenian Sea found 71% of stranded and bycaught sea turtles had plastic debris in their guts (Campani et al. 2013). Another threat marine debris poses is to hatchlings on beaches escaping to the sea. Two thirds of loggerheads contacted marine debris on their way to the ocean and many became severely entangled or entrapped by it (Triessnig et al. 2012).

Climate change may also have significant implications on loggerhead populations worldwide. In addition to potential loss of nesting habitat due to sea level rise, loggerhead sea turtles are very sensitive to temperature as a determinant of sex while incubating. Ambient temperature increase by just 1º-2º C can potentially change hatchling sex ratios to all or nearly all female in tropical and subtropical areas (Hawkes et al. 2007a). Over time, this can reduce genetic diversity, or even population viability, if males become a small proportion of populations (Hulin et al. 2009). Sea surface temperatures on loggerhead foraging grounds correlate to the timing of nesting, with higher temperatures leading to earlier nesting (Mazaris et al. 2009a; Schofield et al. 2009). Increasing ocean temperatures may also lead to reduced primary productivity and eventual food availability. This has been proposed as partial support for reduced nesting abundance for loggerhead sea turtles in Japan; a finding that could have broader implications for other populations in the future if individuals do not shift feeding habitat (Chaloupka et al. 2008b). Warmer temperatures may also decrease the energy needs of a developing embryo (Reid et al. 2009). Pike (2014) estimated that loggerhead populations in tropical areas produce about 30% fewer hatchlings than do populations in temperate areas. Historical climactic patterns have been attributed to the decline in loggerhead nesting in Florida, but evidence for this is tenuous (Reina et al. 2013).

Tissues taken from loggerheads sometimes contain very high levels of organochlorines chlorobiphenyl, chlordanes, lindane, endrin, endosulfan, dieldrin, PFOS, PFOA, DDT, and PCB (Alava et al. 2006; Corsolini et al. 2000; Gardner et al. 2003; Guerranti et al. 2013; Keller et al. 2005; Keller et al. 2004a; Keller et al. 2004b; Mckenzie et al. 1999; Monagas et al. 2008; Oros et al. 2009; Perugini et al. 2006; Rybitski et al. 1995; Storelli et al. 2007b). It appears that levels of organochlorines have the potential to suppress the immune system of loggerhead sea turtles and may affect metabolic regulation (Keller et al. 2004c; Keller et al. 2006; Oros et al. 2009). These contaminants could cause deficiencies in endocrine, developmental, and reproductive health (Storelli et al. 2007b). It is likely that the omnivorous nature of loggerheads makes them more prone to bioaccumulating toxins than other sea turtle species (Godley et al. 1999; Mckenzie et al. 1999). PAH pollution from petroleum origins has been found in Cape Verde loggerheads, where marine oil and gas extraction is not undertaken (Camacho et al. 2012).

Heavy metals, including arsenic, barium, cadmium, chromium, iron, lead, nickel, selenium, silver, copper, zinc, and manganese, have also been found in a variety of tissues in levels that increase with turtle size (Anan et al. 2001; Fujihara et al. 2003; Garcia-Fernandez et al. 2009; Gardner et al. 2006; Godley et al. 1999; Saeki et al. 2000; Storelli et al. 2008). These metals likely pass to turtles from plants and seem to have high transfer coefficients (Anan et al. 2001; Celik et al. 2006; Talavera-Saenz et al. 2007). Loggerhead sea turtles have higher mercury levels than any other sea turtle studied, but concentrations are an order of magnitude less than many toothed whales (Godley et al. 1999; Pugh and Becker 2001b). Arsenic occurs at levels several fold more concentrated in loggerhead sea turtles than marine mammals or seabirds.

Also of concern is the spread of antimicrobial agents from human society into the marine environment. Loggerhead sea turtles may harbor antibiotic-resistant bacteria, which may have developed and thrived as a result of high use and discharge of antimicrobial agents into freshwater and marine ecosystems (Foti et al. 2009).

ENVIRONMENTAL BASELINE

By regulation, the environmental baseline for ESA section 7 consultation includes the past and present impacts of all state, federal, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR §402.02). The *Environmental Baseline* for this Opinion includes the effects of several activities potentially affecting the survival and recovery of ESA-listed species in the action area.

5.12 Climate change

We primarily discuss climate change as a threat common to all species addressed in this Opinion, rather than in each of the species-specific narratives. As we better understand responses to climate change, we will address these effects in the relevant species-specific section.

In general, based on forecasts made by the Intergovernmental Panel on Climate Change, climate change is projected to have substantial direct and indirect effects on individuals, populations, species, and the structure and function of marine, coastal, and terrestrial ecosystems in the near future (IPCC 2002). From 1906 to 2006, global surface temperatures have risen 0.74º C and continue at an accelerating pace; 11 of the 12 warmest years on record since 1850 have occurred since 1995 (Poloczanska et al. 2009). Furthermore, the Northern Hemisphere (where a greater proportion of ESA-listed species occur) is warming faster than the Southern Hemisphere, although land temperatures are rising more rapidly than over the oceans (Poloczanska et al. 2009). North Atlantic and Pacific sea surface temperatures have shown trends in being anonymously warm in recent years (Blunden and Arndt 2013). The ocean along the U.S. eastern seaboard is also much saltier than historical averages (Blunden and Arndt 2013).

The direct effects of climate change will result in increases in atmospheric temperatures, changes in sea surface temperatures, patterns of precipitation, and sea level. As described in the *Status of Listed Resources* for each sea turtle species, temperature regimes are generally leading towards female-biased nests. This can result in heavily feminized populations incapable of fertilization of available females (Laloë et al. 2014). This is not considered to be an imminent threat and presently has the advantage of shifting the natural rates of population growth higher (Laloë et al. 2014). Oceanographic models project a weakening of the thermohaline circulation resulting in a reduction of heat transport into high latitudes of Europe as well as an increase in the mass of the Antarctic and Greenland ice sheets, although the magnitude of these changes remain unknown. Species that are shorter-lived, larger body size, or generalist in nature are liable to be better able to adapt to climate change over the long term versus those that are longer-lived, smaller-sized, or rely upon specialized habitats (Brashares 2003; Cardillo 2003; Cardillo et al. 2005; Issac 2009; Purvis et al. 2000). Climate change is most likely to have its most pronounced effects on species whose populations are already in tenuous positions (Isaac 2008). As such, we expect the risk of extinction to listed species to rise with the degree of climate shift associated with global warming.

Indirect effects of climate change would result from changes in the distribution of temperatures suitable for whale calving and rearing, the distribution and abundance of prey, and abundance of competitors or predators. For species that undergo long migrations, individual movements are usually associated with prey availability or habitat suitability. If either is disrupted by changing ocean temperature regimes, the timing of migration can change or negatively impact population sustainability (Simmonds and Eliott. 2009). With warming temperatures and decreasing sea ice, humpback and fin whales have been found in increasing numbers at the northern extreme of their Pacific range and are regularly found now in the southern Chukchi Sea (Clarke et al. 2013). We do not know if this is due to range expansion owing to species recovery, or due to altered habitat associated with climate change (Clarke et al. 2013). Climate change can influence reproductive success by altering prey availability, as evidenced by high success of northern elephant seals during El Niño periods, when cooler, more productive waters are associated with higher first year pup survival (McMahon and Burton. 2005). Reduced prey availability resulting from increased sea temperatures has also been suggested to explain reductions in Antarctic fur seal pup and harbor porpoise survival (Forcada et al. 2005; Macleod et al. 2007). Polygamous marine mammal mating systems can also be perturbed by rainfall levels, with the most competitive grey seal males being more successful in wetter years than in drier ones (Twiss et al. 2007). Sperm whale females were observed to have lower rates of conception following unusually warm sea surface temperature periods (Whitehead 1997). Marine mammals with restricted distributions linked to water temperature may be particularly exposed to range restriction (Issac 2009; Learmonth et al. 2006). MacLeod (2009) estimated that, based upon expected shifts in water temperature, 88% of cetaceans would be affected by climate change, 47% would be negatively affected, and 21% would be put at risk of extinction. Of greatest concern are cetaceans with ranges limited to non-tropical waters and preferences for shelf habitats (Macleod 2009). Modeling of North Atlantic cetacean species found that three of four odontocete species would likely undergo range contraction while one would expand its range (Lambert et al. 2014). Kaschner et al. (2011) modeled marine mammal species richness, overlaid with projections of climate change and found that species in lower-latitude areas would likely be more affected than those in higher-latitude regions. Variations in the recruitment of krill and the reproductive success of krill predators correlate to variations in sea-surface temperatures and the extent of sea-ice cover during winter months. Although the IPCC (2001) did not detect significant changes in the extent of Antarctic sea-ice using satellite measurements, Curran et al. (2003) analyzed ice-core samples from 1841 to 1995 and concluded Antarctic sea ice cover had declined by about 20% since the 1950s.

Roughly 50% of the Earth's marine mammal biomass occurs in the Southern Ocean, with all baleen whales feeding largely on a single krill species, *Euphausia superba*, here and feeding virtually nowhere else (Boyd 2002). However, Atkinson et al. (2004) found severe decreases in krill populations over the past several decades in some areas of the Antarctic, linked to sea ice loss. Reid and Croxall (2001) analyzed a 23-year time series of the reproductive performance of predators (Antarctic fur seals, gentoo penguins, macaroni penguins, and black-browed albatrosses) that depend on krill for prey and concluded that these populations experienced increases in the 1980s followed by significant declines in the 1990s accompanied by an increase in the frequency of years with reduced reproductive success. The authors concluded that macaroni penguins and black-browed albatrosses had declined by as much as 50% in the 1990s, although incidental mortalities from longline fisheries probably contributed to the decline of the albatross. However, these declines resulted, at least in part, from changes in the structure of the krill population, particularly reduced recruitment into older krill age classes, which lowered the number of predators krill could sustain. The authors concluded that the biomass of krill within the largest size class was sufficient to support predator demand in the 1980s but not in the 1990s. By 2055, severe reductions in fisheries catch due to climate change have been suggested to occur in the Indo-Pacific, Red Sea, Mediterranean Sea, Antarctic, and tropical areas worldwide while increased catches are expected in the Arctic, North Pacific, North Atlantic, and northern portions of the Southern Ocean (Cheung et al. 2010).

Climate-mediated changes in the distribution and abundance of keystone prey species like krill and climate-mediated changes in the distribution of cephalopod populations worldwide is likely to affect marine mammal populations as they re-distribute throughout the world's oceans in search of prey. If sea ice extent decreases, then larval krill may not be able to survive without access to underice algae to feed on. This may be a cause of decreased krill abundance in the northwestern Antarctic Peninsula during the last decade (Fraser and Hofmann 2003). Meltwaters have also reduced surface water salinities, shifting primary production along the Antarctic Peninsula (Moline et al. 2004). Blue whales, as predators that specialize in eating krill, are likely to change their distribution in response to changes in the distribution of krill (Clapham et al. 1999; Payne et al. 1986; Payne et al. 1990b). If they did not change their distribution or could not find the biomass of krill necessary to sustain their population numbers, their populations would likely experience declines similar to those observed in other krill predators, including dramatic declines in population size and increased year-to year variation in population size and demographics. These outcomes would dramatically increase the extinction probability of baleen whales. Edwards et al. (2007) found a 70% decrease in one zooplankton species in the North Sea and an overall reduction in plankton biomass as warm-water species invade formerly cold-water areas. However, in other areas, productivity may increase, providing more resources for local species (Brown et al. 2009). This has been proposed to be the case in the eastern North Pacific, where a poleward shift in the North Pacific Current that would likely continue under global warming conditions would enhance nutrient and planktonic species availability, providing more prey for many higher trophic level species (Sydeman et al. 2011). Species such as gray whales may experience benefits from such a situation (Salvadeo et al. 2013). In addition, reductions in sea ice may alleviate "choke points" that allow some marine mammals to exploit additional habitats (Higdon and Ferguson 2009).

Foraging is not the only potential aspect that climate change could influence. Acevedo-Whitehouse and Duffus (2009) proposed that the rapidity of environmental changes, such as those resulting from global warming, can harm immunocompetence and reproductive parameters in wildlife to the detriment of population viability and persistence. An example of this is the altered sex ratios observed in sea turtle populations worldwide (Fuentes et al. 2009a; Mazaris et al. 2008; Reina et al. 2008; Robinson et al. 2008). This does not appear to have yet affected population viabilities through reduced reproductive success, although nesting and emergence dates of days to weeks in some locations have changed over the past several decades (Poloczanska et al. 2009). Altered ranges can also result in the spread of novel diseases to new areas via shifts in host ranges (Schumann et al. 2013; Simmonds and Eliott. 2009). It has also been suggested that increases in harmful algal blooms could be a result from increases in sea surface temperature (Simmonds and Eliott. 2009).

Sims et al. (2001) found the timing of squid peak abundance in the English Channel advanced by 120-150 days in the warmest years compared with the coldest. Bottom water temperatures correlated with the extent of squid movement, and temperature increases over the five months before and during the month of peak squid movement did not differ between early and late years.

These authors concluded that the temporal variation in peak abundance of squid seen off Plymouth represents temperature-dependent movement, which climatic changes association with the North Atlantic Oscillation mediate. Cephalopods dominate the diet of sperm whales, who would likely re-distribute following changes in the distribution and abundance of their prey. If, however, cephalopod populations collapse or decline dramatically, sperm whales would likely decline as well. Long-term shifts of sperm whale prey in the California Current have also been attributed to the re-distribution of their prey resulting from climate-based shifts in oceanographic variables (Salvadeo et al. 2011). Similar changes have also been suggested for sardines and anchovy in the California Current (Salvadeo et al. 2011), which are important prey for humpback and fin whales, among others.

Climate change has been linked to changing ocean currents as well. Rising carbon dioxide levels have been identified as a reason for a poleward shift in the Eastern Australian Current, shifting warm waters into the Tasman Sea and altering biotic features of the area (Johnson et al. 2011; Poloczanska et al. 2009). Similarly, the Kuroshio Current in the western North Pacific (an important foraging area for juvenile sea turtles) has shifted southward as a result of altered long-term wind patterns over the Pacific Ocean (Blunden and Arndt 2013; Poloczanska et al. 2009). Ocean temperatures around Iceland are linked with alterations in the continental shelf ecosystem there, including shifts in minke whale diet (Víkingsson et al. 2014).

Changes in global climatic patterns will likely have profound effects on the coastlines of every continent by increasing sea levels and the intensity, if not the frequency, of hurricanes and tropical storms (Wilkinson and Souter 2008). A half degree Celsius increase in temperatures during hurricane season from 1965-2005 correlated with a 40% increase in cyclone activity in the Atlantic. Sea levels have risen an average of 1.7 mm/year over the 20th century due to glacial melting and thermal expansion of ocean water; this rate will likely increase. The current pace is nearly double this, with a 20-year trend of 3.2 mm/year (Blunden and Arndt 2013). This is largely due to thermal expansion of water, with minor contributions from melt water (Blunden and Arndt 2013). Based on computer models, these phenomena would inundate nesting beaches of sea turtles, change patterns of coastal erosion and sand accretion that are necessary to maintain those beaches, and would increase the number of turtle nests destroyed by tropical storms and hurricanes (Wilkinson and Souter 2008). In addition, flatter beaches preferred by smaller sea turtle species would be inundated sooner than would steeper beaches preferred by larger species (Hawkes et al. 2014). The loss of nesting beaches, by itself, would have catastrophic effects on sea turtle populations globally if they are unable to colonize new beaches that form or if the beaches do not provide the habitat attributes (sand depth, temperature regimes, refuge) necessary for egg survival. In some areas, increases in sea level alone may be sufficient to inundate sea turtle nests and reduce hatching success (Caut et al. 2009a). Storms may also cause direct harm to sea turtles, causing “mass” strandings and mortality (Poloczanska et al. 2009). Increasing temperatures in sea turtle nests alters sex ratios, reduces incubation times (producing smaller hatchling), and reduces nesting success due to exceeded thermal tolerances (Fuentes et al. 2009b; Fuentes et al. 2010; Fuentes et al. 2009c). Smaller individuals likely experience increased predation (Fuentes et al. 2009b).

Climactic shifts also occur due to natural phenomena. In the North Atlantic, this primarily concerns fluctuations in the NAO, which results from changes in atmospheric pressure between a semi-permanent high pressure feature over the Azores and a subpolar low pressure area over Iceland (Curry and McCartney 2001; Hurrell 1995; Stenseth et al. 2002a). This interaction affects sea surface temperatures, wind patterns, and oceanic circulation in the North Atlantic (Stenseth et al. 2002a). The NAO shifts between positive and negative phases, with a positive phase having persisted since 1970 (Hurrell 1995). North Atlantic conditions experienced during positive NAO phases include warmer than average winter weather in central and eastern North America and Europe and colder than average temperatures in Greenland and the Mediterranean Sea (Visbeck 2002). Effects are most pronounced during winter (Taylor et al. 1998). The NAO is significant for North Atlantic right whales due to its influence on the species primary prey, zooplankton of the genus *Calanus*, which are more abundant in the Gulf of Maine during positive NAO years (Conversi et al. 2001b; Greene and Pershing 2004; Greene et al. 2003a). This subsequently impacts the nutritional state of North Atlantic right whales and the rate at which sexually mature females can produce calves (Greene et al. 2003a).

5.13 Habitat degradation

A number of factors may be directly or indirectly affecting listed species in the action area by degrading habitat. These include ocean noise and fisheries impacts.

Natural sources of ambient noise include: wind, waves, surf noise, precipitation, thunder, and biological noise from marine mammals, fishes, and crustaceans. Anthropogenic sources of ambient noise include: transportation and shipping traffic, dredging, construction activities, geophysical surveys, and sonars. In general, it has been asserted that ocean background noise levels have doubled every decade for the last six decades in some areas, primarily due to shipping traffic (IWC 2004). The acoustic noise that commercial traffic contributes to the marine environment is a concern for listed species because it may impair communication between individuals (Hatch et al. 2008), among other effects (Eriksen and Pakkenberg 2013; Francis and Barber 2013). For species inhabiting Arctic waters, vessel and industrial noise may become much more problematic as oil and gas development and commercial shipping lanes through ice-free areas expand and intensify (Reeves et al. 2014). Vessels pose not only a risk of ship strike, but also impede the ability of whales to communicate. Hatch et al. (2012) estimated that roughly two-thirds of a right whales' communication space may be lost due to current ocean noise levels, which have greatly increased due to shipping noise. Shipping noise is also linked with increased stress levels in right whales (Rolland et al. 2012a).

Marine debris is another significant concern for listed species and their habitats. Marine debris has been discovered to be accumulating in gyres throughout the oceans. Law et al. (2010) presented a time series of plastic content at the surface of the western North Atlantic Ocean and Caribbean Sea from 1986 to 2008. More than 60% of 6,136 surface plankton net tows collected small, buoyant plastic pieces. The data identified an accumulation zone east of Bermuda that is similar in size to the accumulation zone in the Pacific Ocean. Over half of cetacean species (including humpback, fin, sei, and sperm whales) are known to ingest marine debris (mostly plastic), with up to 31% of individuals in some populations containing marine debris in their guts and being the cause of death for up to 22% of individuals found stranded on shorelines (Baulch and Perry 2014).

Ingestion of marine debris can have fatal consequences even for large whales as well as sea turtles. In 1989, a stranded sperm whale along the Mediterranean was found to have died from ingesting plastic that blocked its' digestive tract. A sperm whale examined in Iceland had a lethal disease thought to have been caused by the complete obstruction of the gut with plastic marine debris (Lambertsen 1990). Further incidents may occur but remain undocumented when carcasses do not strand.

For sea turtles, marine debris is a problem due primarily to individuals ingesting debris and blocking the digestive tract, causing death or serious injury (Laist et al. 1999; Lutcavage et al. 1997a). Gulko and Eckert (2003) estimated that between one-third and one-half of all sea turtles ingest plastic at some point in their lives; this figure is supported by data from Lazar and Gracan (Lazar and Gračan 2010), who found 35% of loggerheads had plastic in their gut. One study found 37% of dead leatherback turtles had ingested various types of plastic (Mrosovsky et al. 2009). A Brazilian study found that 60% of stranded green sea turtles had ingested marine debris (primarily plastic and oil; (Bugoni et al. 2001)). Loggerhead sea turtles had a lesser frequency of marine debris ingestion. Plastic is possibly ingested out of curiosity or due to confusion with prey items; for example, plastic bags can resemble jellyfish (Milton and Lutz 2003). Marine debris consumption has been shown to depress growth rates in post-hatchling loggerhead sea turtles, elongating the time required to reach sexual maturity and increasing predation risk (McCauley and Bjorndal 1999). Sea turtles can also become entangled and die in marine debris, such as discarded nets and monofilament line (Laist et al. 1999; Lutcavage et al. 1997a; NRC 1990a; O'Hara et al. 1988). This fundamentally reduces the reproductive potential of affected populations, many of which are already declining (such as loggerhead and leatherback sea turtle populations in the action area).

5.14 Dredging

Marine dredging vessels are common within U.S. coastal waters. Although the underwater noises from dredge vessels are typically continuous in duration (for periods of days or weeks at a time) and strongest at low frequencies, they are not believed to have any long-term effect on sea turtles. However, the construction and maintenance of federal navigation channels and dredging in sand mining sites have been identified as sources of sea turtle mortality and are currently being undertaken along the U.S. east coast, such as in Port Everglades, Florida. Hopper dredges in the dredging mode are capable of moving relatively quickly compared to sea turtle swimming speed and can thus overtake, entrain, and kill sea turtles as the suction draghead(s) of the advancing dredge overtakes the resting or swimming turtle. Entrained sea turtles rarely survive. Relocation trawling frequently occurs in association with dredging projects to reduce the potential for dredging to injure or kill sea turtles (Dickerson et al. 2007).

5.15 Seismic surveys

During October and November 2003, the NSF undertook a seismic survey over the mid-Atlantic Ridge. No marine mammals or sea turtles were observed during the cruise, which had airgun operations for six days (Holst 2004). The airgun array discharge size was 8,760 in^3.

There have also been numerous prior seismic surveys from 1979 to 2002. These include surveys with a six airgun, 1,350 in^3 array in 1990; a single, 45 in^3 GI gun in 1996 and 1998; and two 45 in^3 GI guns in 2002 (NSF 2014). Impacts to listed species were not identified.

The proposed seismic survey was originally scheduled for July and August of 2014. However, due to several issues, the cruise completed only a small amount of its effort. Airguns were operational at some level for a total of 61 hours (Ingram et al. 2014). During this time, 29 sea turtles were observed (10 were loggerhead, and the rest were unidentified hard-shelled turtles within the 166 dB isopleth). Most sea turtle detections (13 of 19) were made while airguns were on, while the humpback whale was sighted while airguns were off. Eight sea turtle detections resulted in shutdowns. Two sightings of mysticetes, including one for a humpback whale, were also made.

During August and September 2014, the U.S. Geological Survey funded a seismic survey along the U.S. eastern seaboard from roughly Massachusetts to South Carolina aboard the *Langseth*. The 6,600 in^3, 40-airgun array was operational for 357 hours and used the same sonars that will be used during the proposed seismic survey. Although loggerhead sea turtles and sperm whales were observed, no listed whales or sea turtles were observed within the 160 dB re 1 μPa exclusion zone. Almost all observations of the 20 marine mammal and sea turtle detections were made while the airguns were off. This project is composed of two cruises, the second of which will occur during 2015 in roughly the same area, using the same airgun array, vessel, and sonars.

Another seismic survey by the *Langseth* was conducted along North Carolina during September and October 2014. This seismic survey utilized a 3,300 in^3, 20-airgun array. A monitoring report is not yet available for this cruise and we are unaware of what protected species, if any, were actually impacted by this project and to what extent.

5.16 Vessel traffic

Vessel noise could affect marine animals in the study area. Shipping noise generally dominates ambient noise at frequencies from 20 to 300 Hz (Andrew et al. 2002; Hildebrand 2009; Richardson et al. 1995c). Background noise has increased significantly in the past 50 years as a result of increasing vessel traffic, and particularly shipping, with increases of as much as 12 dB in low frequency ranges; background noise may be 20 dB higher now versus preindustrial periods (Hildebrand 2009; Jasny et al. 2005; McDonald et al. 2006; NRC 1994; NRC 2003; NRC 2005; Richardson et al. 1995a). Over the past 50 years, the number of commercial vessels has tripled, carrying an estimated six times as much cargo (requiring larger, more powerful vessels)(Hildebrand 2009). Seismic signals also contribute significantly to the low frequency ambient sound field (Hildebrand 2009). Baleen whales may be more sensitive to sound at those low frequencies than are toothed whales. Masking of acoustic information can result (Simard et al. 2013); an important issue for marine mammals that rely primarily on sound as a sense. Dunlop et al. (2010) found that humpback whales shifted from using vocal communication (which carries relatively large amounts of information) to surface-active communication (splashes; carry relatively little information) when low-frequency background noise increased due to increased sea state. Other coping mechanisms include shifting the frequency or amplitude of calls, increasing the redundancy or length of calls, or waiting for a quieter period in which to vocalize (Boness et al. 2013; Holt et al. 2013; Parks et al. 2013). Increases in vessel traffic and marine industrial construction is associated with decreases in the presence of minke whales and gray seals, presumably due to increased noise in the area (Anderwald et al. 2013). Sonars and small vessels also contribute significantly to mid-frequency ranges (Hildebrand 2009).

5.17 U.S. Navy training and testing activities

Table 12 indicates the number of different listed species likely to be "taken" annually as a result of their exposure to U.S. Navy training activities (excluding active sonar) on East Coast Training Ranges from June 2012 through June 2014.

Table 12. Anticipated incidental take of ESA species within U.S. Navy East Coast Training Range Complexes.

Whale or sea turtle species	Operating area							
	Northeast		Virginia Capes		Cherry Point		Jacksonville	
	Harass	Harm	Harass	Harm	Harass	Harm	Harass	Harm
Blue	0	0	0	0	0	0	0	0
Fin	0	0	2	0	0	0	0	0
Humpback	0	0	2	0	0	0	0	0
North Atlantic right	0	0	0	0	0	0	0	0
Sei	0	0	0	0	0	0	0	0
Sperm	0	0	2	0	0	0	0	0
Hardshell sea turtles	0	0	300	2	0	0	11	1
Kemp’s ridley	0	0	555	5	0	0	2	0
Leatherback	0	0	9	0	0	0	11	1
Northwest Atlantic loggerhead	0	0	466	8	0	0	19	1

Anticipated effects from harassment include changes from foraging, resting, milling, and other behavioral states that require lower energy expenditures to traveling, avoidance, and behavioral states that require higher energy expenditures and, therefore, would represent disruptions of the normal behavioral patterns of the animals that have been exposed. Behavioral responses that result from stressors associated with these training activities are expected to be temporary and would not affect the reproduction, survival, or recovery of these species. Instances of harm identified generally represent animals that would have been exposed to underwater detonations at 205 dB re μPa^2-s or 13 psi, which corresponds to an exposure in which 50% of exposed individuals would be expected to experience rupture of their tympanic membrane, an injury that correlates with measures of permanent hearing impairment (Ketten 1998c).

U.S. Navy aerial bombing training in the ocean off the southeast U.S. involving live ordnance (500 and 1,000-lb bombs) has been estimated to have injured or killed 84 loggerhead, 12 leatherback, and 12 green or Kemp’s ridley sea turtles (NMFS 1997). From 2009- 2012, NMFS issued a series of biological opinions to the U.S. Navy for training activities occurring within their Northeast, Virginia Capes, Cherry Point and Jacksonville Range Complexes that anticipated annual levels of take of listed species incidental to those training activities through 2014. During the proposed activities 2 fin whales, 2 humpback whales, 2 sperm whales, 344 hardshell sea turtles (any combination of green hawksbill, Kemp’s ridley or Northwest Atlantic loggerhead sea turtles), 644 Kemp's ridley sea turtles, 21 leatherback sea turtles and 530 Northwestern Atlantic loggerhead sea turtles per year are expected to be harassed as a result of their behavioral responses to mid- and high frequency active sonar transmissions Another six Kemp's ridley and five Northwestern Atlantic loggerhead turtles per year are expected to be injured during exposure to underwater detonations.

5.18 U.S. Marine Corps training in the Cherry Point Range Complex

Table 13 identifies the likely take associated with Marine Corps activities in the Cherry Point Range Complex off North Carolina. Individual ESA-listed whales and sea turtles that could occur in the action area would possibly travel through the Cherry Point Range Complex, thus exposing these species to the training activities.

Table 13. Incidental take associated with U.S. Marine Corps training in the Cherry Point Range Complex that is currently authorized.

<table>
<tr><th rowspan="4">Species</th><th colspan="7">MCAS Cherry Point water ranges</th></tr>
<tr><th colspan="2">Boat maneuvers (BT-9 & BT-11)</th><th colspan="2">Ordnance/munitions delivery (BT-9 & BT-11)</th><th colspan="3">Underwater explosions (BT-9 only)</th></tr>
<tr><th rowspan="2">Harass</th><th rowspan="2">Harm (injury, mortality) from vessel strike</th><th rowspan="2">Harass</th><th rowspan="2">Harm (injury, mortality) from direct strike</th><th rowspan="2">Harass (temporary threshold shift and other behavioral impacts)</th><th colspan="2">Harm</th></tr>
<tr><th>Injury</th><th>Mortality</th></tr>
<tr><td>Green sea turtle</td><td rowspan="4">10 of any species per year</td><td rowspan="4">1 of any species over a 10-year period</td><td rowspan="4">10 of any species per year</td><td rowspan="4">2 of any species over a 10-year period</td><td rowspan="4">23 per year</td><td rowspan="4">1 per year (permanent threshold shift)</td><td rowspan="4">1 over a 10-year period</td></tr>
<tr><td>Kemp's ridley sea turtle</td></tr>
<tr><td>Leatherback sea turtle</td></tr>
<tr><td>Northwest Atlantic DPS Loggerhead sea turtle</td></tr>
</table>

5.19 Entrapment and entanglement in fishing gear

Fisheries interactions are a significant problem for several marine mammal species and particularly so for humpback whales, as well as sea turtles. Between 1970 and 2009, two-thirds of mortalities of large whales in the northwestern Atlantic were attributed to human causes, primarily ship strike and entanglement (Van der Hoop et al. 2013). In excess of 97% of entanglement is caused by derelict fishing gear (Baulch and Perry 2014). Aside from the potential of entrapment and entanglement, there is also concern that many marine mammals that die from entanglement in commercial fishing gear tend to sink rather than strand ashore, thus making it difficult to accurately determine the frequency of mortalities. Entanglement may also make whales more vulnerable to additional dangers, such as predation and ship strikes, by restricting agility and swimming speed. Like fin whales, humpback whales have been entangled by fishing gear off Newfoundland and Labrador, Canada. A total of 595 humpback whales were reported captured in coastal fisheries in those two provinces between 1969 and 1990, of which 94 died (Lien 1994; Perkins and Beamish 1979). Along the Atlantic coast of the U.S. and the Maritime Provinces of Canada, there were 160 reports of humpback whales being entangled in fishing gear between 1999 and 2005 (Cole et al. 2005c; Nelson et al. 2007c). Of these, 95 entangled humpback whales were confirmed, with 11 whales sustaining injuries and nine dying of their wounds. Waring et al. (2007) reported four fin whales in the western North Atlantic having died or were seriously injured in fishing gear

Of the current threats to North Atlantic right whales, entanglement in commercial fishing gear poses one of the greatest threats (**Figure 7**). Along the Atlantic coast of the U.S. and the Maritime Provinces of Canada, there were 46 confirmed reports of North Atlantic right whales entangled in fishing gear between 1990 and 2007 (Cole et al. 2005a; Nelson et al. 2007a; Waring et al. 2009). Of the 39 reports that NMFS could confirm, North Atlantic right whales were injured in five of the entanglements and killed in four entanglements. Three of the 24 entangled whales between 2004 and 2008 died and one other resulted in serious injury (Glass et al. 2009). Recent efforts to disentangle right whales have met with success (Anonmyous. 2009).

Nine instances of entanglement were recorded between 2006 and 2010, two of which were disentangled (Waring et al. 2013). From 1970-2010, 74 instances of entanglement have been documented (Waring et al. 2013). Scars examined between 1980 and 2002 revealed that 75% of 447 individuals examined showed scarring from fishing gear (Waring et al. 2013). It is also estimated that 14 and 51% of right whales are entangled on an annual basis (Knowlton et al. 2005). Another study assessing photographs of right whales from 1980-2009 found 626 individuals having 1,032 entanglement scars (Knowlton et al. 2012). This included 83% having at least one scar and 59% having multiple scars, with juveniles being entangled at higher rates than adults and the sexes entangling equally (Knowlton et al. 2012). Scars also became more abundant over the study period, suggesting entanglement rates are increasing (Knowlton et al. 2012). In August 1993, a dead sperm whale, with longline gear wound tightly around the jaw, was found floating about 32 km off Maine.

Figure 7. A North Atlantic right whale entangled in fisheries gear off Florida, with Georgia Department of Natural Resources and Coastwise Consulting staff attempting to cut rope off (Credit: EcoHealth Alliance and Georgia Department of Natural Resources, ESA permit number 932-1905).

Fishery interaction remains a major factor in sea turtle recovery and, frequently, the lack thereof. Wallace et al. (2010) estimated that worldwide, 447,000 turtles are killed each year from bycatch in commercial fisheries. NMFS (2002a) estimated that 62,000 loggerhead sea turtles have been killed as a result of incidental capture and drowning in shrimp trawl gear. Although turtle excluder devices and other bycatch reduction devices have significantly reduced the level of bycatch to sea turtles and other marine species in U.S. waters, mortality still occurs. The fisheries that have the most significant demographic effect on sea turtles are the Gulf of Mexico shrimp trawl fisheries. The estimated annual number of interactions and mortalities between sea turtles and shrimp trawls in the Gulf shrimp fisheries (state and federal) are believed to have declined versus prior regulations (Epperly et al. 2002; Nance et al. 2008) (**Table 14**). Although participants in this and other fisheries are required to use Turtle Exclusion Devices, which are estimated to reduce the number of sea turtles trawlers capture by as much as 97%, each year these fisheries are expected to capture about 185,000 sea turtles annually and kill about 5,000 of them. Loggerhead sea turtles account for most of this these: capturing about 163,000 loggerhead sea turtles, killing almost 4,000 of them. However, more recent estimates suggest interactions and mortality has decreased from pre-regulatory periods, with a conservative estimate of 26,500 loggerheads captured annually in U.S. Atlantic fisheries causing mortality to 1,400 individuals per year (Finkbeiner et al. 2011). These are followed by green sea turtles: about 18,700 green sea turtles are expected to be captured each year with more than 500 of them dying as a result of their capture (NMFS 2002b). Each year, various fisheries capture about 2,000 loggerhead sea turtles in Pamlico Sound, of which almost 700 die (Finkbeiner et al. 2011). The action area and its surrounding region appears to be a location of moderate sea turtle longline bycatch relative to long-term global levels (Lewison et al. 2014).

Table 14. Estimated annual interactions between sea turtles and shrimp trawls in the Gulf of Mexico shrimp fisheries associated estimated mortalities based on 2007 Gulf effort data taken from Nance et al. (2008).

Species	Estimated interactions	Estimated mortalities
Leatherback	520	15
Loggerhead	23,336	647
Kemp’s ridley	98,184	2,716
Green	11,311	319

Mortality of leatherbacks in the U.S. shrimp fishery is now estimated at 54 turtles per year. Data collected by the Northeast Fisheries Science Center Fisheries Observer Program from 1994 through 1998 (excluding 1997) indicate that a total of 37 leatherbacks were incidentally captured (16 lethally) in drift gillnets set in offshore waters from Maine to Florida during this period. Observer coverage for this period ranged from 54 to 92%. Trinidad and Tobago's Institute for Marine Affairs estimated that more than 3,000 leatherbacks were captured incidental to gillnet fishing in the coastal waters of Trinidad in 2000.

Portions of the Atlantic pelagic fisheries for swordfish, tuna, shark, and billfish also operate in the action area and capture and kill the second highest number of sea turtles along the Atlantic coast. These fisheries include purse seine fisheries for tuna, harpoon fisheries for tuna and swordfish, commercial and recreational rod and reel fisheries, gillnet fisheries for shark, driftnet fisheries, pelagic longline fisheries, and bottom longline fisheries. Lewison et al. (2004) estimated that 30,000-60,000 leatherbacks were taken in all Atlantic longline fisheries in 2000 (including the U.S. Atlantic tuna and swordfish longline fisheries, as well as others). Between 1986 and 1995, this fishery captured and killed one North Atlantic right whale, two humpback whales, and two sperm whales. Between 1992 and 1998, the longline components of these fisheries are estimated to have captured more than 10,000 sea turtles (4,585 leatherback sea turtles and 5,280 loggerhead sea turtles), killing 168 of these, disincluding sea turtles that might have died after being released (Johnson et al. 1999; Yeung 1999). Since then, all components of these fisheries are estimated to capture about 1,350 sea turtles each year, killing 345. Finkbeiner et al. (2011) estimated that annual bycatch interactions total 1,400 leatherbacks annually for U.S. Atlantic fisheries (resulting in roughly 40 mortalities).

On 4 July 2004, NMFS published a final rule to implement management measures to reduce bycatch and bycatch mortality of Atlantic sea turtles in the Atlantic pelagic longline fishery (6979 FR 40734). The management measures include mandatory circle hook and bait requirements and mandatory possession and use of sea turtle release equipment to reduce bycatch mortality. This is expected to significantly reduce sea turtle mortality from pelagic longlines.

In 2008, Southeast Fisheries Science Center observer programs and subsequent analyses indicated that the overall amount and extent of incidental take for sea turtles specified in the incidental take statement of the 2005 opinion on the reef fish fishery had been severely exceeded by the bottom longline component of the fishery (approximately 974 captures and at least 325 mortalities estimated for the period July 2006-2007). The Gulf of Mexico Fishery Management Council developed a long-term management strategy via a new amendment (Amendment 31 to the Reef Fish FMP). The amendment included a prohibition on the use of bottom longline gear in the Gulf of Mexico reef fish fishery, shoreward of a line approximating the 35-fathom contour east of Cape San Blas, Florida, from June through August; a reduction in the number of bottom longline vessels operating in the fishery via an endorsement program and a restriction on the total number of hooks that may be possessed onboard each Gulf of Mexico reef fish bottom longline vessel to 1,000, only 750 of which may be rigged for fishing. These changes are expected to greatly reduce the mortality of loggerhead sea turtles resulting from the operation of this fishery.

Observation of the directed highly migratory shark fisheries has been ongoing since 1994, but a mandatory program was not implemented until 2002. Neritic juvenile and adult loggerhead sea turtles are the primary species taken, but leatherback sea turtles have also been observed caught. From 1994-2002, observers covered 1.6% of all hooks, observing bycatch of 31 loggerhead, 4 leatherback, and 8 unidentified sea turtles with estimated annual average take levels of 30, 222, and 56, respectively (NMFS 2003).

In addition to commercial bycatch, recreational hook-and-line interaction also occurs. Cannon and Flanagan (1996) reported that from 1993 to 1995, at least 170 Kemp's ridley sea turtles were hooked or tangled by recreational hook-and-line gear in the northern Gulf of Mexico. Of these, 18 were dead stranded turtles, 51 were rehabilitated turtles, five died during rehabilitation, and 96 were reported as released by fishermen.

5.20 Invasive species

Invasive species have been referred to as one of the top four threats to the world's oceans consistently ranked behind habitat degradation and alteration (Pughiuc 2010; Raaymakers 2003; Raaymakers and Hilliard 2002; Terdalkar et al. 2005; Wambiji et al. 2007). In most cases, habitat is directly affected by human alterations, such as hydromodification, mining, dredging, drilling, and construction. However, invasive species, facilitated by human commerce, have the ability to directly alter ecosystems upon which listed species rely.

Invasive species are a major threat to many ESA-listed species. For species listed by the United States Fish and Wildlife Service (USFWS), 26% were listed partially because of the impacts of invasive species and 7% were listed because invasive species were the major cause of listing (Anttila et al. 1998). Pimentel et al. (2004) found that roughly 40% of listed species are at risk of becoming endangered or extinct completely or in part due to invasive species, while Wilcove et al. (1998) found this to be 49%, with 27% of invertebrates, 37% of reptiles, 53% of fishes, and 57% of plants imperiled partly or wholly due to non-native invasions. In some regions of the world, up to 80% of species facing extinction are threatened by invasive species (Pimentel et al.

2004; Yan et al. 2002). Clavero and Garcia-Bertro (2005) found that invasive species were a contributing cause to over half of the extinct species in the International Union for the Conservation of Nature database; invasive species were the only cited cause in 20% of those cases. Richter et al. (1997) identified invasive species as one of three top threats to threatened and endangered freshwater species in the U.S. as a whole.

5.21 Diseases

The impacts of introduced pathogens in the aquatic environment has been poorly explored and we likely know very little about the true frequency and significance of pathogen invasions (Drake et al. 2001). Pathogens are known to have adverse effects to invertebrate communities. Molluscs such as black and white abalone seem to be particularly sensitive to pathogens. Various species of the genus *Vibrio*, known to cause cholera in humans, white pox and white plague type II diseases in corals, and mortality in abalone of the same genus as black and white abalone, have been identified in ports and ballast water of vessels (Aguirremacedo et al. 2008; Anguiano-Beltrán et al. 1998; Ben-Haim and Rosenberg 2002). Oyster species have sustained several outbreaks from invasive pathogens, including *Haplosporidium nelsoni* (the cause of MSX disease, which Chesapeake Bay eastern oysters have shown 75-92% mortality to) and *Perkinsus marinus* (the cause of Dermo disease) in California, eastern North America, and Europe (Andrews 1984; Burreson and Ford 2004; Burreson et al. 2000; Ford and Haskin 1982; Renault et al. 2000), Bonamia ostreae in Europe (Ciguarria and Elston 1997; Van Banning 1987), and in the northeastern U.S., respectively (Ford 1996). Although specific instances of sea turtle pathogen transference via invasive species are not documented, their spread into new areas are easily possible, particularly given environmental perturbations and naïve individuals in receiving habitats.

5.22 Wind energy

Efforts to develop wind energy facilities offshore of the U.S. east coast have increased over the past several years. The Bureau of Ocean Energy Management assumed that the entire area of each Mid-Atlantic Wind Energy Area would be leased based on the expressions of commercial wind energy interest received. Leases could be issued and site characterization and assessment activities started as early as 2012. Site characterization and assessment activities would occur over a period of about 5.5 years per lease (BOEM 2012). The most advanced in development of these is the Cape Wind Energy project (Cape Cod, Massachusetts) calls for 130 wind turbine generators. The Bureau of Ocean Energy Management approved a construction and operations plan for the project in 2011 (USDOI 2011). Another six-turbine system is proposed off New Jersey, for which state permits were issued in 2011 (Fisherman's Energy of New Jersey LLC 2011). Several leases have been issued that would allow for testing and investigation of wind resources at various sites (BOEM 2012). Significant ocean noise and vessel activity is associated with construction of facilities such as these, which numerous studies have shown to displace marine mammals from the area, but who generally return post-construction. It is not known whether migratory species deflect to avoid facilities such as these once constructed.

5.23 Entrainment in power plants

Sea turtles entering coastal or inshore areas have been affected by entrainment in the cooling-water systems of electrical generating plants. A comprehensive biological opinion that covers all power plant cooling water intakes was issued by the Services in May 2014, but does not identify amount or extent of listed species expected to be taken. This will be undertaken on a case-by-case basis for each power plant.

5.24 Ship-strikes

Ship-strike is a significant concern for the recovery of listed whales and, to a lesser degree, sea turtles. Between 1970 and 2009, two-thirds of mortalities of large whales in the northwestern Atlantic were attributed to human causes, primarily ship strike and entanglement (Van der Hoop et al. 2013). Between 1999 and 2005, there were three reports of sei whales being struck by vessels along the U.S. Atlantic coast and Canada's Maritime Provinces (Cole et al. 2005c; Nelson et al. 2007c). Two of these ship strikes were reported as having resulted in death. An update (unpublished data 1995–2011) ship strike inventory for the eastern seaboard indicates the following percentage of strikes by species: North Atlantic right whale (19%), humpback whale (28%), sei whale (6%), fin whale (17%), sperm whale (2%), and unknown species (16%). Based on the records available, large whales have been struck by ships off almost every coastal state in the U. S., although ship strikes are most common along the Atlantic Coast. More than half (56%) of the recorded ship strikes from 1975-2002 occurred off the coasts of the northeastern U.S. and Canada, while the mid-Atlantic and southeastern areas each accounted for 22% (Jensen and Silber 2003). According to Waring et al. (2007), five fin whales were killed or injured as a result of ship strikes between January 2000 and December 2004. Between 1999-2005, there were 15 reports of fin whales strikes by vessels along the U.S. and Canadian Atlantic coasts (Cole et al. 2005a; Nelson et al. 2007a). Of these, 13 were confirmed, resulting in the deaths of 11 individuals. Of 123 humpback whales that stranded along the Atlantic coast of the U.S. between 1975 and 1996, 10 (8.1%) showed evidence of collisions with ships (Laist et al. 2001).

In the Bay of Fundy, recommendations for slower vessel speeds to avoid right whale ship strike appear to be largely ignored (Vanderlaan et al. 2008). However, new rules for seasonal (June through December) slowing of vessel traffic to 10 knots and changing shipping lanes by less than one nautical mile to avoid the greatest concentrations of right whales are expected to reduce the chance of humpback whales being hit by ships by 9%, fin whales by 42%, right whales by 62%, and sei whales by 17%; the same rule applies from November through April from Brunswick, Georgia to Jacksonville, Florida, where North Atlantic right whales go for calving and breeding. Speed rules also apply to medium and large ports along the eastern seaboard during this time frame when right whales migrate to and from northern feeding and southern breeding areas. Nearly a dozen shipping lanes transect through coastal waters of the southeastern U.S. from the North-South Carolina to Cape Canaveral, Florida. Modeling efforts suggest voluntary changes in "areas to be avoided" suggested by the International Maritime Organization will reduce right whale strikes over the Scotian Shelf from one lethal strike every 0.78-2.07 years to one every 41 years (Hoop et al. 2012). Part of the susceptibility of North Atlantic right whales to ship strike may be its propensity to remain just below the surface, invisible to vessels, but at significant risk to ship strike (Parks et al. 2011b).

We believe the vast majority of ship-strike mortalities go unnoticed, and that actual mortality is higher than currently documented; Kraus et al. (2005) estimated that 17% of ship strikes are actually detected. The magnitude of the risks commercial ship traffic pose to large whales in the proposed action areas has been difficult to quantify or estimate. We struggle to estimate the number of whales that are killed or seriously injured in ship strikes within the U.S. EEZ and have virtually no information on interactions between ships and commercial vessels outside of U.S.

waters. With the information available, we know those interactions occur but we cannot estimate their significance to whale species.

Ship strikes are the largest single contributor to North Atlantic right whale deaths, accounting for approximately 35% of all known mortalities, even though right whales should be able to hear the sound produced by vessels (Ketten 1998a; Knowlton and Kraus 2001a; Laist et al. 2001; Richardson et al. 1995a). Some information suggests right whales respond only within very close proximity to ships (Nowacek et al. 2004a). Various types and sizes of vessels have been involved in ship strikes with large whales, including container/cargo ships/freighters, tankers, steamships, U.S. Coast Guard vessels, Navy vessels, cruise ships, ferries, recreational vessels, fishing vessels, whale-watching vessels, and other vessels (Jensen and Silber 2004). Injury is generally caused by the rotating propeller blades, but blunt injury from direct impact with the hull also occurs. There have been 18 reports of North Atlantic right whales being struck by vessels between 1999 and 2005 (Cole et al. 2005b; Nelson et al. 2007b). Of the 17 reports that NMFS could confirm, right whales were injured in two of the ship strikes and killed in nine. Recent records show that from 2004-2008, there were 17 confirmed reports of North Atlantic right whales being struck with eight whales dying of their wounds and two additional right whales sustaining serious injuries (Glass et al. 2009). Deaths of females are especially deleterious to the ability of the North Atlantic right whale population to recover. For instance, in 2005, mortalities included six adult females, three of which were carrying near-term fetuses and four of which were just starting to bear calves, thereby representing a lost reproductive potential of as many as 21 individuals over the short term (Kraus et al. 2005). Between 1999 and 2006, ships are confirmed to have struck 22 North Atlantic right whales, killing 13 of these whales (Jensen and Silber 2003; Knowlton and Kraus 2001b; NMFS 2005c). From 1999 to 2003, an average of 2.6 right whales were killed per year from various types of anthropogenic factors, but mostly from ship-strike (Waring et al. 2010). From 2000 to 2004, this increased to 2.8 annually and increased again from 2001 to 2005 to an average of 3.2 right whales (Waring et al. 2010). The most recent estimate of anthropogenic mortality and serious injury available showed a rate of 3.8 right whales per year from 2002 to 2006. Of these, 2.4 were attributed to ship strikes (Glass et al. 2008). Based on records collected between 1970 and 1999, about 60% of the right whales struck by ships along the Atlantic Coast of the U. S., 20% occurred in waters off the northeast states and 20% occurred in waters off the mid-Atlantic or southeast states (Knowlton and Kraus 2001b). Over the same time interval (1970 to 1999), these authors identified 25 (45%) unconfirmed serious injuries and mortalities from ship strikes. Of these, 16 were fatal interactions; two possibly fatal; and seven nonfatal. Based on these confirmed mortalities, ships are responsible for more than one-third (16 out of 45, or 36%) of all confirmed right whale mortalities (a confirmed mortality is one observed under specific conditions defined by NMFS).[5] Part of the susceptibility of this species to ship strike may be its propensity to remain just below the surface, invisible to vessels, but at significant risk to ship strike (Parks et al. 2011b).

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5 There are four main criteria used to determine whether serious injury or mortality resulted from ship strikes: (1) propeller cut(s) or gashes that are more than approximately 8 cm in depth; (2) evidence of bone breakage determined to have occurred premortem; (3) evidence of hematoma or hemorrhaging; and (4) the appearance of poor health in the ship-struck animal

Knowlton, A. R., and S. D. Kraus. 2001b. Mortality and serious injury of northern right whales (Eubalaena glacialis) in the western North Atlantic Ocean. Journal of Cetacean Research and Management Special Issue 2:193-208..

Another study conducted over a similar period – 1970 to 2002 – examined 30 (18 adults and juveniles, and 12 calves) out of 54 reported right whale mortalities from Florida to Canada (Moore et al. 2005). Human interaction (ship strike or gear entanglement) was evident in 14 of the 18 adults examined, and trauma, presumably from vessel collision, was apparent in 10 out of the 14 cases. Trauma was also present in four of the 12 calves examined, although the cause of death was more difficult to determine in these cases. In 14 cases, the assumed cause of death was vessel collision; an additional four deaths were attributed to entanglement. In the remaining 12 cases, the cause of death was undetermined (Moore et al. 2005).

Sea turtle ship strikes are a poorly-studied threat to sea turtles, but has the potential to be highly-significant (Work et al. 2010). All sea turtles must surface to breath and several species are known to bask at the surface for long periods, including loggerhead sea turtles. Although sea turtles can move rapidly, sea turtles apparently are not well able to move out of the way of vessels moving at more than 4 km/hr; most vessels move far faster than this in open water (Hazel and Gyuris 2006; Hazel et al. 2007; Work et al. 2010). This, combined with the massive level of vessel traffic in the Gulf of Mexico and coastal Atlantic, has the potential to result in frequent injury and mortality to sea turtles in the region (MMS 2007). Hazel et al. (2007) suggested that green sea turtles may use auditory cues to react to approaching vessels rather than visual cues, making them more susceptible to strike as vessel speed increases. Overall, ship strike is likely highly underestimated as a source of injury or mortality to sea turtles in the action area.

5.25 Commercial whaling

Large whale population numbers in the action areas have historically been impacted by commercial exploitation, mainly in the form of whaling. Between 1969-1990, 14 fin whales were captured in coastal fisheries off Newfoundland and Labrador; of these seven are known to have died because of capture (Lien 1994; Perkins and Beamish 1979).

5.26 Scientific and research activities

Scientific research permits issued by the NMFS currently authorize studies of listed species in the North Atlantic Ocean, some of which extend into portions of the action area for the proposed project. Authorized research on ESA-listed whales includes close vessel and aerial approaches, biopsy sampling, tagging, ultrasound, and exposure to acoustic activities, and breath sampling. These research activities were not expected to jeopardize the survival or recovery of ESA-listed species and were largely anticipated to have short-term behavioral or stress effects to impacted individuals.

Authorized research on ESA-listed sea turtles includes capture, handling, and restraint, satellite, sonic, and passive integrated transponder tagging, blood and tissue collection, lavage, ultrasound, captive experiments, laparoscopy, and imaging. Research activities involve "takes" by harassment, with some resulting mortality. There have been numerous permits[6] issued since 2009 under the provisions of both the MMPA and ESA authorizing scientific research on marine mammals and sea turtles. The consultations which took place on the issuance of these ESA

6. See https://apps.nmfs.noaa.gov/index.cfm for additional details.

scientific research permits each found that the authorized activities would have no more than short-term effects and would not result in jeopardy to the species or adverse modification of designated critical habitat.

Additional “take” is likely to be authorized in the future as additional permits are issued. It is noteworthy that although the numbers tabulated below represent the maximum number of “takes” authorized in a given year, monitoring and reporting indicate that the actual number of “takes” rarely approach the number authorized. Therefore, it is unlikely that the level of exposure indicated below has or will occur in the near term. However, our analysis assumes that these “takes” will occur since they have been authorized. It is also noteworthy that these “takes” are distributed across the Atlantic Ocean, mostly from Florida to Maine, and in the eastern Gulf of Mexico. Although whales and sea turtles are generally wide-ranging, we do not expect many of the authorized “takes” to involve individuals who would also be “taken” under the proposed research.

Tables 15-24 describe the cumulative number of takes for each listed species in the action area authorized in scientific research permits.

Table 15. Blue whale takes in the North Atlantic.

Year	Approach	Biopsy	Suction cup tagging	Implantable tagging	Exhalation sampling	Acoustic playback
2009	655	25	90	45	0	2
2010	720	25	90	45	0	0
2011	620	25	90	45	0	0
2012	730	25	90	45	0	0
2013	6,300	630	1,255	540	80	0
2014	5,765	640	1,165	515	80	0
2015	5,765	640	1,165	515	80	0
2016	2,250	190	715	65	80	0
Total	22,805	2,200	4,660	1,815	320	2

Permit numbers: 633-1778, 775-1875, 1036-1744, 1058-1733, 10014, 14451, 14856, 15575, 16109, 16239, 16325, 16388, and 17355.

Table 16. Fin whale takes in the North Atlantic.

Year	Approach	Biopsy	Suction cup tagging	Implantable tagging	Exhalation sampling	Acoustic playback
2009	1,671	170	75	0	0	2
2010	1,876	170	45	0	0	0
2011	1,776	170	45	0	0	0
2012	2,846	170	45	0	0	0
2013	9,551	1,215	1,315	495	340	0
2014	9,282	1,180	1,290	535	340	0
2015	9,282	1,180	1,290	535	340	0
2016	5,477	730	840	85	340	0
Total	41,761	4,985	4,945	1,650	1,360	2

Permit numbers: 10014, 605-1904, 775-1875, 948-1692, 981-1707, 1036-1744, 1058-1733, 14118, 14451, 14586, 14856, 15575, 16109, 16239, 16325, 16388, 16473, and 17355.

Table 17. Humpback whale takes in the North Atlantic and Mediterranean.

Year	Approach	Biopsy	Suction cup tagging	Implantable tagging	Belt tag	Exhalation sampling	Acoustic playback
2009	5,260	415	173	45	0	0	624
2010	5,568	415	173	45	0	0	600
2011	8,653	1,040	723	95	0	0	600
2012	10,354	1,370	723	95	125	2,410	600
2013	17,555	1,980	1,465	395	125	2,410	600
2014	18,215	2,230	1,490	435	125	2,410	650
2015	17,570	2,230	1,490	435	125	2,410	50
2016	14,085	1,930	1,190	135	125	2,410	50
Total	97,260	11,610	7,427	1,680	625	12,050	3,774

Permit numbers: 605-1904, 633-1778, 775-1875, 948-1692, 981-1707, 1036-1744, 1058-1733, 1121-1900, 1128-1922, 10014, 13927, 14118, 14245, 14451, 14586, 14856, 15575, 15682, 16109, 16325, 16388, 16473, and 17355.

Table 18. North Atlantic right whale takes.

Year	Approach	Biopsy	Suction cup tagging	Implantable tagging	Exhalation sampling
2009	1,860	60	130	45	0
2010	6,875	110	230	45	80
2011	7,455	120	230	45	80
2012	7,640	170	230	45	80
2013	15,183	410	820	90	80
2014	14,118	330	690	65	80
2015	13,918	330	690	65	80
2016	8,903	300	590	65	0
Total	75,952	1,830	3,610	465	480

Permit numbers: 605-1904, 633-1778, 775-1875, 1058-1733, 10014, 14118, 14451, 14856, 15575, 16109, 16239, 16325, 16388, 16473, and 17355.

Table 19. Sei whale takes in the North Atlantic.

Year	Approach	Biopsy	Suction cup tagging	Implantable tagging	Exhalation sampling	Acoustic playback
2009	1,604	50	158	45	0	2
2010	1,604	50	158	45	0	0
2011	1,504	50	158	45	0	0
2012	1,824	110	158	45	160	0
2013	8,227	1,735	773	390	160	0
2014	6,978	1,750	640	365	160	0
2015	6,978	1,750	640	365	160	0
2016	4,628	450	340	65	160	0
Total	33,347	5,945	3,025	1,365	800	2

Permit numbers: 605-1904, 633-1778, 775-1875, 1058-1733, 10014, 14118, 14451, 14856, 15575, 16109, 16239, 16325, 16388, 16473, and 17355.

Table 20. Sperm whale takes in the North Atlantic.

Year	Approach	Biopsy	Suction cup tagging	Implantable tagging	Exhalation sampling	Acoustic playback
2009	5,560	375	820	0	0	920
2010	4,110	400	520	0	0	120
2011	4,010	425	520	0	0	120
2012	2,030	155	10	0	80	0
2013	8,789	990	720	450	80	0
2014	12,919	1,440	760	530	80	50
2015	12,919	1,440	760	530	80	50
2016	8,964	990	310	80	80	50
Total	59,301	6,215	4,420	1,590	240	1,310

Permit numbers: 633-1778, 775-1875, 909-1719, 948-1692, 981-1707, 1036-1744, 1121-1900, 10014, 14451, 14586, 14856, 15575, 16109, 16239, 16325, 16473, 17312, and 17355.

Table 21. Green sea turtle takes in the Atlantic Ocean.

Year	Capture/handling /restraint	Satellite,sonic, or pit tagging	Blood/tissue collection	Lavage	Ultrasound	Captive experiment	Laparoscopy	Imaging	Mortality
2009	3,093	3,093	3,009	1,860	555	66	74	72	6
2010	3,753	3,753	3,669	2,480	555	66	74	72	6
2011	4,255	4,255	3,505	2,990	564	66	74	72	20
2012	3,354	3,354	2,622	2,210	704	66	74	72	18.2
2013	5,001	5,001	4,325	3,654	1,903	91	398	396	4.2
2014	4,336	3,686	3,660	3,044	1,408	65	324	324	4.2
2015	4,280	3,630	3,610	3,044	1,408	65	324	324	4.2
2016	2,960	2,960	2,940	1,734	1,408	65	324	324	4.2
Total	31,032	29,732	27,340	21,016	8,505	550	1,666	1,656	67

Permit numbers: 1450, 1462, 1501, 1506, 1507, 1518, 1522, 1526, 1527, 1540, 1544, 1551, 1552, 1570, 1571, 1576, 10014, 10022, 13306, 13307, 13543, 13544, 13573, 14506, 14508,14622, 14655, 14726, 14949, 15112, 15135, 15552, 15556, 15575, 15606, 15802, 16134, 16146, 16174, 16194, 16253, 16556, 16598, 16733, 17183, 17304, 17355, 17381, 17506, and 18069.

Table 22. Kemp's ridley sea turtle takes in the Atlantic Ocean.

Year	Capture/handling /restraint	Satellite,sonic, or pit tagging	Blood/tissue collection	Lavage	Ultrasound	Captive experiment	Laparoscopy	Imaging	Mortality
2009	1,394	1,394	1,195	425	371	56	53	53	5
2010	1,402	1,402	1,203	426	371	56	53	53	5
2011	2,210	2,210	1,368	976	400	56	53	53	9
2012	2,229	2,219	1,561	972	450	56	53	53	7.2
2013	2,836	2,852	2,190	1,627	990	116	213	218	3.2
2014	2,010	2,026	1,964	706	619	60	160	165	3.2
2015	1,833	1,849	1,819	706	619	60	160	165	3.2
2016	1,420	1,436	1,406	300	264	40	125	125	3.2
Total	15,334	15,388	12,706	6,138	4,084	500	870	885	39

Permit numbers: 1462, 1501, 1506, 1507, 1526, 1527, 1540, 1544, 1551, 1552, 1570, 1571, 1576, 10014, 10022, 13306, 13543, 13544, 14508, 14726, 14506, 14622, 14655, 14726, 15112, 15135, 15552, 15566, 15575, 15606, 15802, 16134, 16194, 16253, 16556, 16598, 16733, 17183, 17304, 17355, 17381, 17506, and 18069.

Table 23. Leatherback sea turtle takes in the North Atlantic Ocean.

Year	Capture/handling/restraint	Satellite, sonic, or pit tagging	Blood/tissue collection	Lavage	Ultrasound	Imaging	Laparoscopy	Mortality
2009	1,357	1,357	1,331	197	188	0	0	2
2010	1,421	1,421	1,394	197	188	0	0	1
2011	1,709	1,709	1,682	197	189	0	0	3.4
2012	736	736	709	187	189	0	0	2.6
2013	842	835	808	312	254	65	65	1.6
2014	653	646	620	135	66	65	65	1.6
2015	647	640	620	135	66	65	65	1.6
2016	634	627	617	125	66	65	65	1.6
Total	7,999	7,971	7,781	1,485	1,206	260	260	15.4

Permit numbers: 1506, 1527, 1540, 1544, 1551, 1552, 1557, 1570, 1571, 1576, 10014, 13543, 14506, 14586, 14655, 14726, 15112, 15552, 15556, 15575, 15672, 15802, 16109, 16194, 16253, 16556, 16733, 17355, and 17506.

Table 24. Loggerhead sea turtle takes in the North Atlantic Ocean.

Year	Capture/handling /restraint	Satellite,sonic, or pit tagging	Blood/tissue collection	Lavage	Ultrasound	Captive experiment	Laparoscopy	Imaging	Mortality
2009	5,462	5,462	5,044	1,165	1,322	200	109	123	111
2010	5,464	5,464	5,046	1,205	1,322	200	109	116	111
2011	7,165	7,165	6,097	1,420	1,667	200	148	114	122.2
2012	4,791	4,791	3,741	1,370	1,429	200	161	114	29.8
2013	5,909	5,909	4,859	2,609	2,519	305	401	354	24.8
2014	4,052	3,912	3,862	1,460	1,543	105	292	240	24.8
2015	3,935	3,795	3,795	1,470	1,543	105	292	240	7.8
2016	3,510	3,510	3,510	1,255	1,543	105	292	240	7.8
Total	40,288	40,008	35,954	11,954	12,888	1,420	1,804	1,541	439.2

Permit numbers: 1450, 1462, 1501, 1506, 1507, 1522, 1526, 1527, 1540, 1544, 1551, 1552, 1570, 1571, 1576, 1599, 10014, 10022, 13306, 13307, 13543, 13544, 14249, 14622, 14506, 14508, 14622, 14655, 14726, 15112, 15552, 15566, 15575, 15606, 15802, 16134, 16146, 16194, 16253, 16556, 16598, 16733, 17183, 17304, 17355, 17381, 17506, and 18069.

5.27 Physical and oceanographic features

The presence of key habitat features, such as shelter or foraging opportunities, are the primary reasons why listed individuals occur where they do. In the marine environment, this is fundamentally built upon local physical and oceanographic features that influence the marine environment. As such, we describe the physical and oceanographic environment here to establish a rationale for why listed species occur in the action area at the levels we observe or expect. This does not represent a stressor, but is instead an underlying principle for establishing why effects are what we expect them to be.

The continental shelf through the action area is a nearly uniform, smooth seafloor with an evenly-carved continental shelf edge (Backus 1987). The continental shelf slopes gently and is relatively shallow. The continental shelf break is marked by an abrupt increase in the seafloor gradient and ranges in water depth from 100 to 150 m. The average width of the continental slope from Georges Bank to Cape Hatteras is approximately 30 km but varies in size from 10 to 50 km (Tucholke 1987). The only submarine canyon in the area is the Hudson Canyon and is the best developed canyon on the U.S. Atlantic continental margin. Submarine canyons are considered to be highly modified areas of the continental slope containing a much richer biodiversity; the abundance of nutrients introduced by the strong down flowing currents are factors leading to the biological richness found in canyons (Cooper et al. 1987). No seamounts exist within the action area.

The Gulf Stream Current is a powerful surface current, carrying warm water into the cooler North Atlantic just south of the action area (Pickard and Emery 1990; Verity et al. 1993). Surface velocities range from 2-5 nautical miles per hour and the temperature is generally 25° to 28° C (Mann and Lazier 1991). The Gulf Stream is usually sharply defined on its west and north side but much less so on its east or south sides (Pickard and Emery 1990).

In general, the Gulf Stream flows parallel to shore from the Florida Straits to Cape Hatteras, where it flows northeastward past the Grand Banks away from land. While stratification of the water column and other factors may play a role, climactic factors such as the North Atlantic Oscillation (NAO) likely cause its variation in position (Pershing et al. 2001; Schmeits and Dijkstra 2000). Wave-like meandering begins to occur at Cape Hatteras and increases as the current progresses offshore. North of Cape Hatteras, small gyres form that separate from the Gulf Stream as either warm- or cold-core rings (Mann and Lazier 1991). Between three and eleven warm-core rings are formed per year, each about 100 km across (García-Moliner and Yoder 1994), 1,000 m in height (Mann and Lazier 1991), and lasting 11-399 days (García-Moliner and Yoder 1994; Pickard and Emery 1990). Warm-core rings bring warm water and associated plankton to colder inshore areas. Cold-core rings form when a cyclonic loop pinches off from the Gulf Stream, resulting in a counterclockwise rotating ring of cool slope water in the warm Sargasso Sea (Pickard and Emery 1990). Twice as many cold-core rings are formed as warm-core rings every year (Pickard and Emery 1990). They are larger (100-300 km across) and longer lasting (months to years) than warm-core rings (Pickard and Emery 1990).

A persistent front exists from the Mid-Atlantic Bight into New England waters due to the intersection of the continental shelf and slope. This surface manifestation of a thermohaline front extends year round from the surface downward, where it intersects the seafloor just shoreward of the shelf break (Halliwell Jr. and Mooers 1979). Phytoplankton production is enhanced at this frontal boundary, often with twice the concentration of phytoplankton found in adjacent waters

(Ryan et al. 1999b).

An annual phenomenon in the Mid-Atlantic Bight is the formation of the “cold pool”. This mass of cooler water occurs over the continental shelf in summer and stretches from the Gulf of Maine to Cape Hatteras and is detectible from spring through fall (Linder et al. 2004). The cold pool usually exists near the seafloor between the 40 m and 100 m isobaths and extends up into the water column for about 35 m. Minimum temperatures for the cold pool occur in early spring and summer and range from 1.1º to 4.7º C.

The NAO affects sea surface temperatures, wind conditions, and ocean circulation throughout the North Atlantic Ocean (Stenseth et al. 2002b). The NAO is an intensity alteration of the atmospheric pressure between the semi-permanent high pressure center over the Azores Islands and the subpolar low-pressure center over Iceland (Curry and McCartney 2001; Stenseth et al. 2002b). Sea-level atmospheric pressure in the two regions tends to vary inversely, creating “positive” and “negative” phases. However, these phases are stable for years to decades. The NAO was generally positive from 1900 to 1950, mainly negative in the 1960s and 1970s, and mainly positive since 1970 (Hurrell et al. 2001).

The NAO also influences the latitude of the Gulf Stream Current and is largely responsible for its variable location. During positive NAO years, the Gulf Stream is farther east (Taylor and Stephens 1998). The flow rate of the Gulf Stream is also affected; during negative NAO years, the Gulf Stream System is not only shifted southward but weakened by up to 25-33% (Curry and McCartney 2001). The upper slope-water system off the U.S. east coast is affected by the NAO (Pershing et al. 2001). During low NAO periods, the Labrador Current intensifies, leading to the advance of cold slope water along the continental shelf as far south as the Mid-Atlantic Bight (Pershing et al. 2001). Intensity variability in another regionally important current, the Labrador Current, is linked to the effects of winter temperatures in Greenland and its surrounding waterways, sea-ice formation, and the relative balance between the formation of deep and intermediate water masses and surface currents. Although the NAO influences the northern North Atlantic most, its effects remain significant south through the Outer Banks (Hurrell et al. 2001).

The NAO strongly affects trophic groups in North Atlantic marine ecosystems (Drinkwater et al. 2003; Fromentin and Planque 1996). *Calanus* copepod temporal and spatial patterns are linked to the phases of the NAO (Fromentin and Planque 1996; Stenseth et al. 2002b); positive NAO indices are associated with increased *Calanus* copepod abundance in the Gulf of Maine and the corollary in negative NAO index years (Conversi et al. 2001a; Greene et al. 2003b). This has secondary effects, such as prey availability for North Atlantic right whales, which feeds principally on *Calanus finmarchicus*. High *Calanus finmarchicus* abundance is linked to increased North Atlantic right whale calving rates (Greene et al. 2003b). Negative NAO indices are associated with abundances of cod, herring, and sardines: species that are important to other listed mysticetes (Drinkwater et al. 2003).

Phytoplankton are single-celled organisms that form the base of marine food chains and whose occurrence and abundance are strongly driven by light, temperature, and nutrient conditions. As nutrients from river outflows near shore generally provide more nutrients than are present offshore, phytoplankton are generally more abundant nearshore. Although the North Atlantic is generally well mixed (nutrients are generally available), light levels tend to be low for phytoplankton, limiting their growth (Ryan et al. 1999a). However, spring time is a period with reduced mixing and increasing light levels, meaning that phytoplankton tend to stay at the surface and are better able to photosynthesize, grow, and reproduce at exponential rates (Mann and Lazier 1991; Parsons et al. 1984; Ryan et al. 1999a). However, nutrients are eventually exhausted in surface waters by May and seasonal progression into winter returns the region to a light-limiting condition. During spring and summer, nectophytoplankton are dominant but are replaced by nanophytoplankton during limiting conditions (Ryan et al. 1999b).

Not only the water conditions, but intersections between water bodies (frontal boundaries) are important factors in biological productivity. This is the case year-round between the shelf and slope waters of the mid-Atlantic, but particularly during winter and spring (Ryan et al. 1999a; Ryan et al. 1999b).

Zooplankton, the next higher level in the marine food chain from phytoplankton and the prey of several listed whales and sea turtles, are generally higher in slope water versus other locations (Wiebe et al. 1987). Spring is a time of higher abundance temporally, particularly within the upper 200 m of the water column (Wiebe et al. 1987). However, zooplankton biomass abundance can increase when shelf water intrudes over slope water, creating a stratified water column. High nutrients and a shallow mixed layer set conditions for enhanced phytoplankton production, which subsequently aids zooplankton biomass increases. Copepods are the primary zooplankters dominate in New England shelf waters, and whose abundance is highest in spring on the outer shelf but highest in summer on the inner shelf (Flagg et al. 1984). *Calanus finmarchicus* and *Pseudocalanus* sp. are the predominant copepods over the outer shelf while the inner shelf has *Centropages typicus* and *Temora longicornis* predominating. The relatively large size of *Calanus* species and its annual cycle in New England waters makes it a major driver of New England marine ecosystem during spring (Flagg et al. 1984).

5.28 Impacts of the Environmental Baseline on Listed Species

Listed resources are exposed to a wide variety of past and present state, Federal or private actions and other human activities that have already occurred or continue to occur in the action area. Federal projects in the action area that have already undergone formal or early section 7 consultation, and state or private actions that are contemporaneous with this consultation also impact listed resources. However, the impact of those activities on the status, trend, or the demographic processes of threatened and endangered species remains largely unknown. To the best of our ability, we summarize the effects we can determine based upon the information available to us in this section.

Cetaceans

Climate change has wide-ranging impacts, some of which can be experienced by ESA-listed whales in the action area. Climate change has been demonstrated to alter major current regimes and may alter those in the action area as they are studied further (Johnson et al. 2011; Poloczanska et al. 2009). Considering the sensitivity that North Atlantic right whales have to warm water temperatures during their southbound migration, warming water temperatures may delay their migratory movements. The availability and quality of prey outside the action area in northern feeding areas can also influence the body condition of individuals in the action area, and potentially reduce the number of individuals that undertake migration through the action area. Changes in the timing of North Atlantic right whales have been observed and may be partly or largely due to these climactic factors.

Effects from anthropogenic acoustic sources, whether they are vessel noise, seismic sound, military activities, oil and gas activities, construction, or wind energy, could also have biologically significant impacts to ESA-listed whales in the action area. These activities increase the level of background noise in the marine environment, making communication more difficult over a variety of ranges. We expect that this increased collective noise also reduces the sensory information that individuals can gather from their environment; an important consideration for species that gather information about their environment primarily through sound. At closer ranges to some of anthropogenic sound sources, behavioral responses also occur, including deflecting off migratory paths and changing vocalization, diving, and swimming patterns. At even higher received sound levels, physiological changes are likely to occur, including temporary or permanent loss of hearing and potential trauma of other tissues. Although this exposure is a small fraction of the total exposure individuals receive, it is believed expected to occur in rare instances.

High levels of morbidity and mortality occur as a result of shipstrike (particularly for North Atlantic right whales and humpback whales) and entanglement in fishing gear (right whales). Ship-strike and entanglement occur broadly along the U.S. East Coast, including (in all likelihood) in the action area itself. These two factors are the greatest known source of mortality and impairment to recovery for North Atlantic right whales and represent known mortality sources for all other ESA-listed whales in the action area. Reductions in speed through portions of the action area as well as seasonal or brief closings of areas to fishing are underway to reduce these impacts, but data are not yet available to demonstrate the long-term effectiveness of these strategies. However, these measures are likely reducing the severity and frequency of these interactions.

Authorized research on ESA-listed whales can have significant consequences for these species, particularly when viewed in the collective body of work that has been authorized. Researchers have noted changes in respiration, diving, swimming speed, social exchanges, and other behavior correlated with the number, speed, direction, and proximity of vessels. Responses were different depending on the age, life stage, social status of the whales being observed (i.e., males, cows with calves) and context (feeding, migrating, etc.). Beale and Monaghan (2004) concluded that the significance of disturbance was a function of the distance of humans to the animals, the number of humans making the close approach, and the frequency of the approaches. These results would suggest that the cumulative effects of the various human activities in the action area would be greater than the effects of the individual activity. Several investigators reported behavioral responses to close approaches that suggest that individual whales might experience stress responses. Baker et al. (1983) described two responses of whales to vessels, including: (1) “horizontal avoidance” of vessels 2,000 to 4,000 meters away characterized by faster swimming and fewer long dives; and (2) “vertical avoidance” of vessels from 0 to 2,000 meters away during which whales swam more slowly, but spent more time submerged. Watkins et al. (1981) found that both fin and humpback whales appeared to react to vessel approach by increasing swim speed, exhibiting a startled reaction, and moving away from the vessel with strong fluke motions. Other researchers have noted changes in respiration, diving, swimming speed, social exchanges, and other behavior correlated with the number, speed, direction, and proximity of vessels. Results were different depending on the social status of the whales being observed (single males when compared with cows and calves), but humpback whales generally tried to avoid vessels when the vessels were 0.5 to 1.0 kilometer from the whale. Smaller pods of whales and pods with calves seemed more responsive to approaching vessels (Bauer 1986; Bauer and Herman 1986). These stimuli are probably stressful to the humpback whales in the Action Area, but the consequences of this stress on the individual whales remains unknown (Baker and Herman 1987; Baker et al. 1983). Studies of other baleen whales, specifically bowhead and gray whales, document similar patterns of behavioral disturbance in response to a variety of actual and simulated vessel activity and noise (Malme et al. 1983; Richardson et al. 1985). For example, studies of bowhead whales revealed that these whales oriented themselves in relation to a vessel when the engine was on, and exhibited significant avoidance responses when the vessel's engine was turned on even at a distance of about 900 m (3,000 ft). Jahoda et al. (2003) studied the response of 25 fin whales in feeding areas in the Ligurian Sea to close approaches by inflatable vessels and to biopsy samples. They concluded that close vessel approaches caused these whales to stop feeding and swim away from the approaching vessel. The whales also tended to reduce the time they spent at surface and increase their blow rates, suggesting an increase in metabolic rates that might indicate a stress response to the approach. In their study, whales that had been disturbed while feeding remained disturbed for hours after the exposure ended. They recommended keeping vessels more than 200 meters from whales and having approaching vessels move at low speeds to reduce visible reactions in these whales. Although these responses are generally ephemeral and behavioral in nature, populations within the action area can be exposed to several thousand instances of these activities per year, with some species having so many authorized activities that if they were all conducted, every individual in the population would experience multiple events. This can collectively alter the habitat use of individuals, or make what would normally be rare, unexpected effects (such as severe behavioral responses or infection from satellite or biopsy work) occur on a regular basis.

Sea turtles

Several of the activities described in this *Environmental Baseline* have significant and adverse consequences for nesting sea turtle aggregations whose individuals occur in the Action Area. In particular, the commercial fisheries annually capture substantial numbers of green, Kemp's ridley, leatherback, and Northwest Atlantic loggerhead sea turtles.

Climate change has and will continue to impact sea turtles throughout the action area as well as throughout the range of the populations. Sex ratios of several species are showing a bias, sometimes very strongly, towards females due to higher incubation temperatures in nests. We expect this trend will continue and possibly may be exacerbated to the point that nests may become entirely feminized, resulting in severe demographic issues for affected populations in the future. Hurricanes may become more intense and/or frequent, impacting the nesting beaches of sea turtles and resulting in increased loss of nests over wide areas. Disease and prey distributions may well shift in response to changing ocean temperatures or current patterns, altering the morbidity and mortality regime faced by sea turtles and the availability of prey.

Although only small percentages of these sea turtles are estimated to have died as a result of their capture during research or incidental to fisheries, the actual number could be substantial if considered over the past 5 to 10 years. When we add the percentage of sea turtles that have suffered injuries or handling stress sufficient to have caused them to delay the age at which they reach maturity or the frequency at which they return to nesting beaches, the consequences of these fisheries on nesting aggregations of sea turtles would be greater than we have estimated.

Even with turtle excluder device measures in place, in 2002, NMFS (2002) expected these fisheries to capture about 323,600 sea turtles each year and kill about 5,600 (~1.7%) of the turtles captured. Loggerhead sea turtles account for most of this total: 163,000 captured, killing almost 4,000 (~2.5%) of them. Kemp’s ridleys account for the second-most interactions: 155,503 captures with 4,200 (~2.7%) deaths. These are followed by green sea turtles: about 18,700 captured with more than 500 (~2.7%) dying as a result of capture. Leatherback sea turtle interactions were estimated at 3,090 captures with 80 (~2.6%) deaths as a result (NMFS 2002b). Since 2002, however, effort in the Atlantic shrimp fisheries has declined from a high of 25,320 trips in 2002 to approximately 13,464 trips in 2009, roughly 47% less effort. Since sea turtle takes are directly linked to fishery effort, these takes are expected to decrease proportionately. However, hundreds to a possible few thousand sea turtle interactions are expected annually, with hundreds of deaths (NMFS 2012).

Recent data regarding the three largest subpopulations that comprise the Northwest Atlantic loggerhead DPS indicated either that these subpopulations do not show a nesting decline significantly different from zero (Peninsular Florida and The Greater Caribbean subpopulation) or are showing possible signs of stability in nest numbers (Northern subpopulation). These trends were recently declining. Additional mortalities each year along with other impacts remain a threat to the survival and recovery of this species and could slow recovery green, Kemp’s ridley, leatherback, and Northwest Atlantic loggerhead sea turtles.

6 EFFECTS OF THE PROPOSED ACTIONS

Pursuant to section 7(a)(2) of the ESA, Federal agencies must insure, in consultation with NMFS, that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. The proposed use of the *Langseth* and issuance of the IHA for "takes" of marine mammals during the seismic studies would expose listed species to seismic airgun pulses, as well as sound emitted from a multi-beam bathymetric echosounder and sub-bottom profiler and other stressors. In this section, we describe the potential physical, chemical, or biotic stressors associated with the proposed actions, the probability of individual ESA-listed species being exposed to these stressors, and the probable responses of those individuals (given probable exposures) based on the best scientific and commercial evidence available. As described in the *Approach to the Assessment* section, for any responses that would be expected to reduce an individual's fitness (i.e., growth, survival, annual reproductive success, or lifetime reproductive success), the assessment would consider the risk posed to the viability of the population(s) those individuals comprise and to the listed species those populations represent. The purpose of this assessment and, ultimately, of the Opinion is to determine if it is reasonable to expect the proposed action to have effects on listed species that would reasonably be expected to appreciably reduce their likelihood of surviving and recovering in the wild.

For this consultation, we are particularly concerned with behavioral and physiological disruptions that may result in animals that fail to feed or breed successfully or fail to complete their life history because these responses are likely to have population-level consequences. The proposed IHA action would authorize non-lethal "takes" by harassment as defined by the MMPA of listed species during seismic survey activities. The ESA does not define harassment nor has the NMFS defined the term pursuant to the ESA through regulation. The MMPA of 1972, as amended, defines harassment as any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal population in the wild or has the potential to disturb a marine mammal or marine mammal population in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [16 U.S.C. 1362(18)(A)]. The latter portion of this definition (that is, "...causing disruption of behavioral patterns including...migration, breathing, nursing, breeding, feeding, or sheltering") is similar to language in the USFWS's regulatory definition of "harass"[7] pursuant to the ESA. For this Opinion, we define harassment similarly: an intentional or unintentional human act or omission that creates the probability of injury to an individual animal by disrupting one or more behavioral patterns that are essential to the animal's life history or its contribution to the population the animal represents.

As described in the *Approach to the Assessment*, the universe of likely responses is considered in evaluating whether those responses lead to fitness consequences for the individual and (if appropriate), the affected population and species as a whole to determine the likelihood of

7 An intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3)

jeopardy.

6.1 Potential Stressors

The assessment for this consultation identified several possible stressors associated with the proposed seismic activities, including:

1. pollution by oil or fuel leakage;
2. acoustic interference from engine noise;
3. ship-strikes;
4. entanglement in towed hydrophone;
5. sound fields produced by airguns; and
6. sound fields produced by sub-bottom profiler or multibeam echosounder

Based on a review of available information, we determined which of these possible stressors would be likely to occur and which would be discountable or insignificant.

6.1.1 **Pollution by Oil or Fuel Leakage**

The potential for fuel or oil leakages is unlikely. Leaks would likely pose a significant risk to the vessel and its crew and actions to correct a leak should occur immediately, to the extent possible. In the event that a leak should occur, the amount of fuel and oil onboard the *Langseth* or its smaller counterparts is unlikely to cause widespread, high dose contamination (excluding the remote possibility of severe damage to the vessel) that would impact listed species directly or pose hazards to their food sources. Because the potential for fuel or oil leakage is extremely unlikely to occur, we find that the risk from this potential stressor is discountable. Therefore, we conclude that pollution by oil or fuel leakage is not likely to adversely affect ESA-listed marine mammals or sea turtles.

6.1.2 **Disturbance from Engine Noise**

The propulsion system of the *Langseth* and the chase vessel are designed to be very quiet compared to other vessels to reduce interference with seismic activities. Although noise originating from vessel propulsion will propagate into the marine environment, this amount of noise generated by the *Langseth* would be highly improbable. The *Langseth*'s passage past a whale or sea turtle would be brief and not likely to be significant in impacting any individual's ability to feed, reproduce, or avoid predators. Brief interruptions in communication via masking are possible, but unlikely given the habits of whales to move away from vessels, either as a result of engine noise, the physical presence of the vessel, or both (Lusseau 2006). The chase vessel would also not generate sufficient noise to significantly disturb ESA-listed marine mammals or sea turtles. Because the potential acoustic interference from engine noise would be undetectable or so minor that it could not be meaningfully evaluated, we find that the risk from this potential stressor is insignificant. Therefore, we conclude that acoustic interference from engine noise is not likely to adversely affect ESA-listed marine mammals or sea turtles.

6.1.3 **Ship Strike**

The *Langseth* and the chase vessel will be traveling at generally slow speeds, reducing the amount of noise produced by the propulsion system and the probability of a ship-strike (Kite-

Powell et al. 2007; Vanderlaan and Taggart 2007). Our expectation of ship strike is discountably small due to the hundreds of thousands of kilometers the *Langseth* has traveled without a ship strike, general expected movement of marine mammals away or parallel to the *Langseth*, as well as the generally slow movement of the *Langseth* during most of its travels (Hauser and Holst 2009; Holst 2009; Holst 2010; Holst and Smultea 2008a). The same can be said for the chase vessel to be utilized. All factors considered, we have concluded the potential for ship strike from the research vessel or the chase vessel is highly improbable. Because the potential for ship strike is extremely unlikely to occur, we find that the risk from this potential stressor is discountable. Therefore, we conclude that ship strike is not likely to adversely affect ESA-listed marine mammals or sea turtles.

6.1.4 **Entanglement**

ESA-listed species could interact directly with the towed hydrophone streamers and these interactions have been documented in the past. For example, a seismic survey in the eastern tropical Pacific during 2011 recovered a dead olive ridley sea turtle in the foil of towed seismic gear; it is unclear whether the sea turtle became lodged in the foil pre- or post mortem (Spring 2011). However, entanglement is highly unlikely due to the streamer design as well as observations of sea turtles investigating the streamer and not becoming entangled or operating in regions of high turtle density and entanglements not occurring (Hauser et al. 2008; Holst and Smultea 2008a; Holst et al. 2005a; Holst et al. 2005b). Although the towed hydrophone streamers could come in direct contact with a listed species, entanglements are highly unlikely and considered improbable based upon investigation into the use of these devices during the activities of other oceanographic activities. . Given this, we expect that the risk of entanglement in towed hydrophone cable or other oceanographic equipment so low as to be discountable. Therefore, it is not likely to adversely affected ESA-listed species and will not be considered further in this Opinion.

Accordingly, this consultation focused on the following stressors likely to occur from the proposed seismic activities that may adversely affect ESA-listed species: 1) acoustic energy introduced into the marine environment by the airgun array and 2) acoustic energy introduced by the sub-bottom profiler and multibeam echosounder sonars.

6.2 Exposure Analysis

Exposure analyses identify the physical, chemical, and biotic stressors produced by a proposed action that co-occur in space and time with ESA-listed species within the action area. The stressors identified for this proposed action that warrant further analysis are sound fields produced by airguns, and sound field produced by sub-bottom profiler or multibeam echosounder .

The *Exposure analysis* identifies, as possible, the number, age or life stage, and gender of the individuals likely to be exposed to the actions' effects and the population(s) or subpopulation(s) those individuals represent.

NMFS applies certain acoustic thresholds to help determine at what point during exposure to seismic airguns (and other acoustic sources) marine mammals are considered "harassed," under the MMPA. These thresholds are used to develop exclusion radii around a source and the necessary power-down or shut-down criteria to limit marine mammals and sea turtles' exposure to harmful levels of sound. Airguns contribute a massive amount of anthropogenic energy to the world's oceans ($3.9x10^{13}$ joules cumulatively), second only to nuclear explosions (Moore and Angliss 2006). Although most energy is in the low-frequency range, airguns emit a substantial amount of energy up to 150 kHz (Goold and Coates 2006). Seismic airgun noise can propagate substantial distances at low frequencies (e.g., Nieukirk et al. 2004).

The NSF provided an estimate of the number of marine mammals that would be exposed to levels of sound in which they would be considered "taken" during the proposed survey. Additionally, the Permits and Conservation Division conducted an independent exposure analysis that was informed by comments received during the public comment period that was required on the proposed IHA and draft environmental assessment prepared pursuant to NEPA. In this section we describe both of those analytical methods and our own analytical process to estimate the number of ESA-listed species that might be exposed to the sound field and considered "taken" as required under the ESA.

6.2.1 NSF Exposure Estimates

The NSF applied acoustic thresholds to determine at what point during exposure to seismic airguns (and other acoustic sources) marine mammals are "harassed," based on definitions provided in the MMPA (65 FR 16374). The NSF concluded that ESA-listed whales would be exposed to the seismic activities. These thresholds were also used to develop exclusion radii around the acoustic source to determine appropriate power-down and shut-down procedures. The acoustic thresholds are described in Table 25. The NSF did not provide estimates of sea turtle exposure.

The exposure analysis estimates the number of ESA-listed whales and sea turtles likely to be exposed to received levels greater than 160 dB re 1 μPa_{rms} and 166 dB re 1 μPa_{rms} for whales and sea turtles, respectively. These sound levels are the best estimates of sound exposure criteria above which we would expect an adverse response by listed whales and sea turtles. The NSF provided the predicted distances to which sound levels ≥180 and 160 dB re 1 μPa_{rms} would be received (Level A and Level B harassment under the MMPA) (Table 25).

Table 25. Predicted distances for received sound levels. Distances are for water depths <100m. Adapted from NSF Environmental Assessment 2014.

		Predicted RMS Radii (m)		
Source	**Tow Depth (m)**	**180 dB**	**166 dB**	**160 dB**
4-airgun subarray (700 in^3)	4.5	378	2,229	5,240
4-airgun subarray (700 in^3)	6	439	2,599	6,100
single bolt airgun (40 in^3)	6	73	424	995

In several decision points of the propagation modeling, an ideal path was not available or a "best" option was unclear. When faced with these decisions, assumptions were made that generally overestimate the distance sound will propagate or increase the likelihood of biologically-meaningful sound exposure to ESA-listed individuals. We agree with the NSF's assumption that individuals will move away if they experience sound levels high enough to cause significant stress or functional impairment (see *Response Analysis*). Isopleth modeling tends to overestimate the distance to which various isopleths will propagate. In addition, most exposures of listed species will likely occur at depths shallower than 2,000 m for the airguns used in the proposed survey, where received sound levels should be lower than at greater depths(see Figures 2 through 4). A recent study shows that in shallow water, measured power levels and signal length can vary based on bathymetric features (Crone 2014). As we are unable to know where individuals will be in the water column at the time of exposure, we accept that there is variance in the degree to which sound will reach the distances in Table 25, and we are unable to know for certain how local natural features will affect how the sound propagates. In addition, the 160 dB re 1 μPa_{rms} radius will not always reach the distances described in Table 25, as shorter radii will occur during the use of smaller numbers of airguns (e.g., the use of a single airgun during turns or power-down procedures). A received level of 166 dB re 1 μPa_{rms}, which would extend horizontally to 2.599 km for the four-airgun array at 6-m tow, is considered here to be the threshold for harassment for sea turtle response based upon the scant information available (McCauley et al. 2000a; McCauley et al. 2000b) (see sea turtle section below).

A major mitigation factor proposed by the NSF is visual monitoring along with power down and shut down, especially for marine mammals, which should reduce exposure of listed whales and sea turtles. However, visual monitoring has several limitations. Although areas ensonified by 160, 166, and 180 dB re 1 μPa_{rms} propagation distances are within the visual range of the *Langseth* and its observers, it is unlikely that all listed species are at the surface and visible at these distances. Vessel platforms are subject to some limitations such as that even under good sighting conditions, observers have limited ability to identify protected species during their brief time at the surface. On their own, power-down and shut-down procedures are unlikely to be completely effective at eliminating the co-occurrence of listed individuals within the sound field ≥160 dB re 1 μPa_{rms}. Other measures such as vessel turns and minimizing airgun source levels, seek to further minimize the exposure ESA-listed species will experience. Ramp-up was effective in reducing hearing-related effects in sonar systems (Von Benda-Beckmann et al. 2014) and we expect reduced or less intense exposure with application of airgun ramp-up.

When combined with the other proposed mitigation and monitoring measures, we conclude that the probability of ESA-listed individuals being exposed to the sound field ≥ 160dB re 1 μPa_{rms} is reduced by the use of ramp-ups and shut-downs. PAM will only detect the presence of marine mammals if they vocalize. Further ability to identify bearing, distance, and abundance is limited.

6.2.2 NMFS Exposure Calculations

During consultation, we discussed the approach for estimating exposure with the NSF and the Permits and Conservation Division. Different methods for calculating take estimates for ESA-listed whales were developed by NSF and the Permits and Conservation Division; both were considered during the consultation and are summarized in the record for this consultation. In order to fully account for all the factors we considered important in the exposure analysis, we developed our own methodology to calculate exposure.

--SERDP SDSS Density Estimates

The take estimates provided in the NSF and L-DEO draft EA were reviewed by NMFS. Those estimates were revised by NMFS using more recent species density data from the SERDP SDSS Duke Habitat Model[8]. Both the NMFS Interagency Cooperation Division and the Permits and Conservation Division believe that these more recent density estimates constitute the best available information. Review of the local survey data as well as knowledge of listed species life history and local oceanographic conditions supports these estimates as the best available information. We used mean density estimates obtained from SRDEP SDSS for each ESA-listed whale species during summer months (June through August—the months in which the proposed survey will occur) to calculate the number of individuals per 1,000 km^2 in the survey area.

NMFS Permits and Conservation Division Methodology

The NMFS Permits and Conservation Division developed a daily ensonified area to apply to the species density estimates. Assuming that the *Langseth* was traveling at its fastest speed (4.5 kts) and a sea state at Beaufort 3 or less, the maximum amount of line kilometers that could be traveled in 24 hours is 200 km. They selected the first grouping of consecutive tracklines that had a total length of 200 km to represent the daily area that could be ensonified during seismic activities. An exclusion zone representing the predicted RMS distances (6.1 km) was then applied to this area; this buffer distance was provided by L-DEO. The Permits and Conservation Division estimated the daily ensonified area to be 1,226 km^2; this estimate does not account for overlap of ensonified areas. To account for additional contingency effort (25%), the Permits and Conservation Division included a 25% increase in the number of days (increasing from 30 to 38).

Exposure for each species for a single day was calculated by multiplying the SERDP SDSS species density by the daily ensonified area, and then the sum of those exposures over 38 days resulted in the final Permits and Conservation Division estimated take numbers. This calculation assumes 100% turnover of individuals within the ensonified area on a daily basis—that is, each individual exposed to the seismic activities is a unique individual. For species where the instance of exposure was less than one (blue, fin, humpback, North Atlantic right, and sei whales), the number of individuals exposed was increased to the mean group size based upon CETAP and AMAPPS survey data. For sei and sperm whales, the Permits and Conservation Division adjusted the number of instances of exposure (35 and 796, respectively) to the mean group size for each species, calculated from AMAPPS survey data. The results of the Permits and Conservation Division's calculations and their proposed take numbers is in Table 26.

NMFS Interagency Cooperation Division Methodology

We estimated the daily ensonified area by dividing the total ensonified area (with overlap and plus 25% contingency) by 38 days to get 1,904 km^2.

To obtain a total number of exposures for a given ESA-listed marine mammal, we multiplied the SERDP SDSS summer density estimate for a given species by the amount of ensonified area, including contingency area and overlap (72,348 km^2).

We recognize a high degree of overlapping ensonified area from one trackline to former and

8 (http://seamap.env.duke.edu/serdp/serdp_map.php)

subsequent ones. The L-DEO and NSF provided a comparison of the area of overlap to the area of no overlap, which we used to determine the ensonified area that reflected repeated sound field exposure. The area including overlap is 35.5 (rounded up to 36) times the area with no overlap, and represents the average number of times a single point within the ensonified area could be "hit" during seismic activities. If a whale remained stationary at such a point (due to motivating factors such as forage or breeding opportunity), an individual could be ensonified to the 160 dB re 1 μPa_{rms} level up to 36 times.

Although we recognize that individuals do move in their environment and we have accounted for this based upon a 20% turnover rate for sperm whales and a 60% turnover rate for ESA-listed baleen whales, there are still individuals who may not move out of the study area. We expect that some individuals will not be displaced more than a few hundred meters to a few kilometers because of previous seismic survey exposure and therefore would be available to be re-exposed on subsequent passes of the airgun array as it progresses along closely-spaced parallel tracklines. We therefore divided the number of exposures (adjusted for natural turnover rate; 20% or 60% for sperm and baleen whales, respectively) by 36 to identify the number of individuals we expect would be exposed to at least 160 dB re 1 μPa_{rms}.

Based on review of observed effects of seismic sound exposure to marine mammals (see *response section*), some individuals will move a distance of several hundred meters to tens of kilometers away due to individual or situational sensitivity or other rationale for why whales move (ex. feeding or breeding opportunities unrelated to effects of the proposed action). As such, it is reasonable to expect that some individuals will receive a single exposure and vacate the action area. Other individuals may move, but move to locations where re-exposure could occur, either due to the direction or short distance of travel. Thus, it is possible that some individuals may be exposed up to the maximum number of transect lines that would be surveyed. This is unlikely unless the exposure does not represent a significant one, motivating the individual to vacate the area at least temporarily. Another possibility is that the motivation for an individual to stay in a specific area is high. This possibility is particularly significant given that marine mammals tend to return to specific areas for foraging and breeding, or use particular migratory corridors.

In our calculations, we also recognized that fin, humpback, North Atlantic right, and sei whales tend to travel in groups or cow/calf pairs during summer foraging periods. Therefore, if we can reasonably expect a single individual to be exposed, it is also reasonable to expect a group of individuals to be exposed. For North Atlantic right, humpback, fin and blue whales, the calculations provided an estimate of zero, and so the exposure estimates were increased based on probable group size.

To obtain group size estimates, we used regional abundance surveys conducted under CETAP and the AMAPPS summer surveys for the years 2010, 2011, and 2013. For North Atlantic right whales, we used Palka (2012) and Whitt et al. (2013). The Whitt et al. study focused specifically on North Atlantic right whales in the nearshore waters of New Jersey, so we consider this to be especially relevant to the action. These group size estimates were used as the number of exposed individuals. This number represents the proposed take estimates (**Table 26**). We still expect that each of these individuals could be exposed up to 36 times if they remained stationary or moved short distances in random directions.

Table 26. Comparisons of the proposed take estimates calculated by the NMFS Permits and Conservation Division, and the NMFS Interagency Cooperation Division for ESA-listed whales.

Whale species	NMFS Permits and Conservation Division	NMFS Interagency Cooperation Division
North Atlantic Right	3	3
Humpback	3	3
Sei	5	3
Fin	3	3
Blue	1	1
Sperm	31	27

We consider it important to account for areas of overlap in the survey area because during seismic activities, areas can be ensonified more than once by the airgun array because of the closely-spaced seismic survey tracklines. We believe that including the full area of overlap more accurately represents the action and/or individuals exposed to the action's acoustic stressors.

Sources of Variability

While there were differences in the approaches for calculating exposure for ESA-listed whales, the resulting exposure numbers either were the same or fell within bounds of variability and uncertainty inherent in both approaches. There are two primary sources of variability; 1) numeric variability from each input and 2) biological variability depending on natural behaviors of individuals.

Numeric Variability

Each input point of the exposure estimate calculations has a degree of numeric uncertainty. The two parameters common to both our calculations and the Permits and Conservation Division were the SERDP SDSS density estimates and the daily ensonified area. The differences in each of our respective daily ensonified area calculations represent a decision to consider the action area differently (and thus use a different number in the calculation)—that is, a conceptual difference. Numeric uncertainty is introduced through the SERDP SDSS density estimates. The AMAPPS surveys collected the sightings data, which in turn supported the SERDP SDSS density estimates. Each of these components had assumptions associated with the sighting methodology and the modelling, along with coefficient of variances and other information that we do not have access to, and thus cannot know. Even though we cannot quantify these mathematical components, we believe that they contributed to numeric variability, which influenced the resulting exposure estimates when we used the density estimates in our calculations.

Biological Variability

There are a few behaviors and natural conditions that we can expect to occur, and thus introduce variability in calculating exposure estimates for sperm and sei whales. These include variability in group size and natural movement of whales.

Based on what we know about the behavior of the sperm and sei whales, we expect there to be variation in how many whales we can expect to be present in a group at any one time, and thus how many are potentially exposed to the seismic activities.

Sperm whale groups are generally comprised of females and immature whales, with a global mean group size of 25 (Whitehead 2003). Data taken from the AMAPPS and CETAP surveys (i.e., from an area more specific to the action area), show that sperm whale group size varies from 1-3. It should also be noted that there was a degree of interannual variability in sperm whale sightings during the AMAPPS surveys. For instance, in 2010, 6 individual sperm whales were sighted, then 2 in 2011, and then in 2012 sightings increased to 112, and 154 in 2013. Sperm whales are especially challenging to count during surveys because they can dive for long periods of time and groups can be spread over large distances (e.g., several kilometers) (Whitehead 2003). Sei whale group size also varied from 1-3, according to the CETAP and AMAPPS surveys. The mean group size was 2.62 (rounded up to 3). Individual sei whale sightings also displayed interannual variability.

There is some uncertainty associated with this factor making it difficult to more finely account for the probability of movement (particularly horizontal movement in terms of latitudinal and longitudinal location). In addition, the regional abundance surveys conducted under CETAP and the AMAPPS (which the SERDP SDSS density estimates are based on) do not explicitly capture factors like physical oceanographic features, habitat, trophic-level data or prey distribution. These natural phenomenon are complex and variable, and represent significant drivers in species behavior and likelihood of being present in an area.

Summary

In conclusion, although our exposure estimate methodology was different, and we arrived at a different estimate for sperm and sei whales than the Permits and Conservation Division, we believe that the estimates fall within the bounds of biological and mathematical variability that we can reasonably expect from either approach.

Marine Mammals

Exposure of Listed Mammals to Airguns. Exposure estimates stem from the best available information on whale densities and a planned ensonified area of approximately 72,348 km^2 along survey track lines, including areas of repeated exposure and contingency estimates.

Our exposure estimates (**Table 27**) were calculated as described above to obtain the total number of exposures (rounded to the next whole number).

Table 27. Estimated exposure of ESA-listed whales to sound levels ≥160 dB re 1 μPa$_{rms}$ during the proposed seismic activities, based on a daily ensonified area of 1, 904 km^2.

Whale density per 1,000 km^2	# of exposures to listed whales	# of whales exposed to proposed activities	Population size	% of population exposed	Population/ location
Blue: 0	1	Up to1	440	Up to 0.23%	Northwest Atlantic[1]
Fin: 0.014	3	Up to 3	3,985	Up to 0.08%	Northwest Atlantic[1]
Sei: 0. 74	3	Up to 3	386	Up to 1.04%	Nova Scotia stock[1]
Humpback: 0	3	Up to 3	11,600	Up to 0.03%	Northwestern Atlantic[2]
North Atlantic right: 0	3	Up to 3	444	Up to 0.68%	North Atlantic[1]
Sperm: 17.07	27	Up to 27	13,190	Up to 0.20%	Northeast Atlantic, Faroe Islands, Iceland, and northeastern U.S. coast[3]
Total	40	--	--	--	--

[1] Waring et al. (2013)

[2] IWC (2014)

[3] Whitehead (2002)

Whales of all age classes are likely to be exposed. Listed whales are expected to be feeding, traveling, or migrating in the area and some females of all ESA-listed whale species would have young-of-the-year accompanying them. We would normally assume that sex distribution is even for whales and sexes are exposed at a relatively equal level. However, sperm whales in the area likely consist of groups of adult females and their offspring and generally consist of more females than males in the group. Therefore, we expect a female bias to sperm whale exposure. For sperm whales, exposure for adult male sperm whales is expected to be lower than to other age and sex class combinations.

Exposure of listed whales to multibeam echosounder and sub-bottom profiler.

Three additional acoustic systems will operate during the proposed *Langseth* cruise, as well as from the chase vessel: the multibeam echosounder and the sub-bottom profiler. These systems have the potential to expose listed species to sound above the 160 dB re 1 μPa$_{rms}$ threshold. All systems operate at generally higher frequencies than airgun operations (10.5-13 kHz for the multibeam echosounder, and 3.5 kHz for the sub-bottom profiler). As such, their frequencies will attenuate more rapidly than those from airgun sources. Listed individuals would experience higher levels of airgun noise well before either multibeam echosounder or sub-bottom profiler noise of equal amplitude would reach them.

As with the *Langseth*, the chase vessel is expected to avoid close whale approaches, which reduces the chance of exposure to sonars as well. While airguns are not operational, marine mammal observers will remain on duty to collect sighting data. If listed whales closely approached the vessel, the *Langseth* would take evasive actions to avoid a ship-strike and simultaneously avoid exposure to very high source levels. Ship strike has already been ruled out as a discountable effect, and we also rule out high-level ensonification of listed whales (multibeam echosounder source level = 242 dB re 1 μPa_{rms}; sub-bottom profiler source level = 204 dB re 1 μPa_{rms}). Boebel et al. (2006) and Lurton and DeRuiter (2011) concluded that multibeam echosounders and sub-bottom profilers similar to those to be used during the proposed activities presented a low risk for auditory damage or any other injury. An individual would require exposure to 250–1,000 consecutive pulses from a sub-bottom profiler to be at risk for a temporary threshold shift (TTS). To be susceptible to TTS, a whale would have to pass at very close range and match the vessel's speed; we expect a very small probability of this during the proposed study. An individual would have to be well within 100 m of the vessel to experience a single multibeam echosounder pulse that could result in TTS (LGL Ltd. 2008). The same result could only occur at even closer ranges for sub-bottom profiler signals, because the signals are weaker. Furthermore, we expect both multibeam echosounder and sub-bottom profiler systems to operate continuously with duty cycles of 1-20 s. It is possible, however, that some small number of listed whales (fewer than those exposed to airguns) could experience low-level multibeam echosounder and/or sub-bottom profiler sound exposure. We are unable to quantify the level of exposure, but do not expect any exposure at levels sufficient to cause more than behavioral responses in some species capable of hearing frequencies produced by these systems.

Sea Turtles

Exposure of listed turtles to airguns. NSF did not provide estimates of the expected number of ESA-listed turtles exposed to received levels ≥166 dB re 1 μPa_{rms}. Exposure estimates stem from the best available information on turtle densities and a planned ensonified area of approximately 2.599 km^2 along survey track lines, including areas of repeated exposure from adjacent track lines and turning legs. Exposures were developed by multiplying the ensonified area by the expected density. Based upon information presented in the *Response analysis*, we expect all exposures at the 166 dB re 1 μPa_{rms} level and above to constitute "take".

Loggerhead, Kemp's ridley, and leatherback sea turtle densities during summer in the action area were taken from the SERDP SDSS Marine Animal Model Mapper[9]. This online mapping program is designed to deliver density estimates based on a user-provided area. We used this program to enter a polygon representing the ensonified area (i.e., the action area). The SERDP

9 http://seamap.env.duke.edu/search/?app=serdp

SDSS provided an output containing the mean density (individuals per km^2) of turtle species for the action area. These densities were adjusted to represent density per 1,000 km^2.

The SERDP SDSS Marine Animal Model Mapper does not have density estimates available for green sea turtles. To obtain the number of green sea turtles exposed to the proposed action, we relied upon NOAA Fisheries survey data from the Atlantic Marine Assessment Program for Protected Species (AMAPPS). The NMFS Northeast and Southeast Fisheries Science Centers conduct the AMAPPS survey. The AMAPPS survey began in 2010 and results are available through 2013. The AMAPPS survey in 2012 took place in spring and fall; since the proposed action will take place in summer, the 2012 AMAPPS survey results were not included in this analysis. The AMAPPS summer surveys varied in their timing and duration, but generally lasted a month to seven weeks, and took place from June to late September. We used the results of the northern legs of each survey; the northern study area covered from the Gulf of St. Lawrence, Canada to Cape May, NJ. In 2010 and 2011, the southern leg of the AMAPPS aerial surveys covered the New Jersey coast, and the sea turtle sightings were also included in **Table 28**. The results of the Cetacean and Turtle Assessment Program conducted by the University of Rhode Island (CETAP 1982) were also incorporated. The CETAP survey took place year round throughout November 1978-January 1982.

Table 28. Number of sea turtles sighted during summer AMAPPS aerial and vessel surveys (2010-2013) and CETAP (1978-1982) surveys.

Turtle species (Number of individuals)	**AMAPPS Summer Surveys**						**CETAP Survey**	**Total**
	Aerial				**Vessel**			
	2010 North Leg	**2010 South Leg**	**2011 North Leg**	**2011 South Leg**	**2011 North Leg**	**2013 North Leg**	**1978-1982**	
Green	6	112	5	60	0	0	3	**186**
Kemp's Ridley	5	20	0	4	0	0	1	**30**
Leatherback	20	97	41	30	4	3	142	**337**
Loggerhead	30	742	34	228	10	34	2926	**4,004**
Unidentified Hardshell	8	531	6	154	7	29	0	**735**

In addition to the CETAP and AMAPPS survey data, we examined fisheries observer data collected from 2000-2014 in the statistical areas in and around the seismic survey area (612, 614, and 615). Similar to the AMAPPS and CETAP data, loggerheads were the most commonly encountered sea turtle, followed by leatherbacks. Only one Kemp's ridley was observed in fisheries bycatch. Two green turtles were observed in September (one in 2012, and one in 2014), captured in bottom trawls, and two were sighted swimming at the surface in August 2005. No hawksbill sea turtles were observed. The data shown in **Table 29** shows sea turtles, which were incidentally captured during fishing operations ("fisheries bycatch"), and sea turtles which were sighted in the water by the observer from the fishing vessel ("sighting").

Table 29: Observer data for sea turtles in statistical areas 612, 614, and 615 (2000-2014).

Species	Fisheries Bycatch	Sighting	Total
Green	2	2	4
Kemps Ridley	1	0	1
Loggerhead	41	10	51
Leatherback	1	4	5
Unknown/Hardshell	16	17	33

Based on the AMAPPS and CETAP survey results, and fisheries observer data, it is possible that a maximum of 190 green sea turtles could be present along the Atlantic coast when the seismic activities are taking place. However, this total is not a likely representation of the number of green turtles that we expect to be exposed to the seismic activities in the action area. These survey sightings of green turtles occurred over a much larger area than for the proposed seismic activities. The highest instances of green turtle sightings came from the southern legs of the 2010 and 2011 aerial AMAPPS surveys (112 and 60, respectively). These surveys focused on more southerly areas (from Cape Canaveral, Florida, to New Jersey). Due to their life history, we would expect more green turtles to be present in these areas. Data from a more discrete location (i.e., the fisheries observer data in the statistical areas surrounding the action area) indicate that it is more likely that fewer green turtles (>112 or 60) will be exposed to the seismic activities. In addition, the spread of green turtle sightings during the southern legs of the AMAPPS surveys is over the entire survey area, with concentrations near Cape Canaveral, Florida, Caper Hatteras, North Carolina, the Delmarva peninsula, and the coast of New Jersey. For the northern legs of the AMAPPS surveys (New Jersey to Nova Scotia), however, green turtle sightings occurred near New Jersey and Long Island, New York—that is, the southern portion of the survey area, and not further north. We are unable to parse out sightings of green turtles by specific location from the AMAPPS reports.

Taking the AMAPPS, CETAP, and observer data as the best information available to us, with the understanding of the broad spatial area that these surveys covered, we chose to take the average number of green turtle sightings as the likely number of individuals exposed. The average number of green turtles sighted during all surveys and observer activity is 27. This amount falls within what we would expect based on the relative proportion of all sea turtle species, and the areas we would expect green turtles to be (compared to other sea turtle species; see discussion below). Therefore, we expect that up to 27 green sea turtles may be exposed to the seismic activities.

The relatively large number of unknown hardshell turtles reflects the inherent difficulty in positively identifying sea turtles during surveys while being sighted from a vessel or airplane. During the 2014 seismic activities, PSOs aboard the *Langseth* sighted 3 unidentified sea turtles in addition to identifying 19 loggerheads. We have no reliable method to account for parsing out the species within these unidentified turtle sightings. However, these unidentified turtles will likely be one of the species known to be in the action area. A major mitigation factor proposed by the NSF is visual monitoring which should reduce exposure of sea turtles. Regions ensonified to 166 dB re 1 μPa_{rms} are within the visual range of the *Langseth* and its observers, and would allow other mitigation measures like power-down and shut-down procedures to occur if a sea turtle (identifiable or not) is sighted. On their own, power-down and shut-down procedures are unlikely to be completely effective at eliminating the co-occurrence of listed individuals within the sound field ≥166 dB re 1 μPa_{rms}. Other measures such as vessel turns and minimizing airgun source levels, seek to further minimize the exposure protected species will experience.

The mitigation measures in place would reduce the number of exposures (e.g., shut-down) before the sea turtle could be exposed or identified. Taking all this into account, we believe that the exposure estimates for each sea turtle species are sufficiently expansive to account for the unidentified turtles.

Our exposure estimates for loggerhead, Kemp's ridley and leatherback sea turtles (

Table 30) were calculated by using density estimates from the SERDP-SDSS multiplied by the daily ensonified area with overlap to obtain the total number of exposures (rounded to the next whole number). We expect that the potential amount of re-exposure (up to 35.5; rounded to 36) applies to sea turtles as described above for ESA-listed whales. The same justification described above for marine mammal exposure and "take" applies to sea turtles.

We believe that sea turtle species are likely to be mostly migratory in the action area, and that movements would be largely captured within the SERDP-SDSS density estimates (Wood 2012).

Based on abundance surveys conducted by the AMAPPS and CETAP during summer months (June-September), we expect that loggerheads would be the most commonly encountered sea turtle species. Loggerheads were the most frequently sighted species during the vessel and aerial surveys from 2010-2013. Nineteen loggerheads (along with 3 other unidentified sea turtles) were also sighted by protected species observers during the *Langseth's* survey in July 2014. Neritic zones (i.e., <200m deep, and depths where the action will take place) represent important foraging habitat for juvenile and adult loggerheads (Conant et al. 2009). Therefore, we recognize that movement in and out of the action area is a possibility, but we are unable to quantify it.

Table 30. Estimated exposure of ESA-listed sea turtles to sound levels $\geq$166 dB re 1 μPa_{rms} during the proposed seismic activities.

Sea turtle density per 1,000 km^2 SERDP-SDSS	# of exposures to listed turtles	# of turtles exposed to proposed activities	Population size	% of population exposed	Population/ location
Green*	27	Up to 27	Unknown	Unknown	North Atlantic
Kemp's ridley **12.4**	26	Up to 26	>189,000	0.01%	North Atlantic[1]
Leatherback **10.9**	23	Up to 23	34,000	0.07 %	North Atlantic[2]
Loggerhead **80.11**	164	Up to 164	>32,000	0.51%	Northwestern Atlantic[3]
Total	240	--	--	--	--

*SERDP SDSS density estimates were not available for green turtles; see text for explanation.

[1]Gallaway et al. (2013)

[2]TEWG (2007a)

[3](NMFS 2001b; TEWG 1998a)

Leatherback sea turtles spend the majority of their time in oceanic waters (see *Status of the Species*), and telemetry data indicate that while foraging, leatherbacks are in a "pattern of near continuous travel" (Hays et al. 2006). It should be noted that the action will take place closer to shore than leatherbacks are typically found (i.e., offshore); the SRDEP density estimate calculated for leatherbacks was the lowest of the turtle species. It is unlikely that leatherbacks would be found foraging in the action area, but should they be encountered during the proposed action, it is likely that they are moving through the area. Leatherbacks were the second-most frequently sighted sea turtle during the AMAPPS and CETAP surveys (after loggerheads).

Kemp's ridley and green sea turtles were sighted infrequently during the AMAPPS and CETAP surveys, and accounted for a lower proportion of the total sea turtle sightings. Green sea turtles are typically found inshore and nearshore, and are not expected to be a prominent species in the action area. However, even these relatively fewer sightings found in the surveys and fisheries observer data indicates that green (and Kemp's Ridley) sea turtles could be present in the action area.

As discussed in the *Status of listed resources* section, hawksbill sea turtles are circumtropical, and are not typically found in the action area. There is telemetry evidence demonstrating that hawksbill sea turtles migrate long distances (368-2,425km) between foraging and nesting sites (Miller et al. 1998), and hawksbills tagged in Costa Rica traveled to foraging grounds in Nicaragua and Honduras (Troëng et al. 2005). For the purposes of this action, we examined records closer to the proposed action area. Hawksbill sea turtles were not sighted during the AMAPPS or CETAP surveys. Density estimates were not calculated for the SERDP or the NMSDD. After examining fisheries observer data for records of hawksbill sea turtles found in and around the action area (Stat Areas 614, 615, and 612) during summer months, we found no records of hawksbills in the proposed action area. There are limited reports of hawksbills stranding in the mid-Atlantic (two in Virginia from 2001-2013, one in spring, and one in fall) (Barco 2014). Overall, we do not expect it is likely that hawksbill sea turtles will be exposed to the proposed action and this species will not be considered further.

We do not expect sound generated by the proposed action to expose eggs or hatchlings because we do not expect these life stages to be present in the action area. However the *Status of listed resources* section identifies the oceanic environment of the North Atlantic as an important developmental habitat for juveniles and subadults of all sea turtle species and we expect these to occur in the action area. In addition, adult life stages of all species are expected to be exposed to sound. For sea turtle species that have been studied, a skewed sex distribution biased towards females versus males exists. As such, we expect more female sea turtles of all species to be exposed than males.

Exposure of ESA-listed turtles to multibeam echosounder and sub-bottom profiler. Sea turtles hear in the low frequency range. The multibeam echosounder and the SBP operate at 10.5-13 kHz, which emit sounds outside the hearing frequency of sea turtles. Thus, sea turtles are not expected to respond to sounds emitted by multibeam echosounder or sub-bottom profiler.

6.3 Response Analysis

As discussed in the *Approach to the assessment* section of this Opinion, response analyses determine how listed resources are likely to respond after exposure to a stressor created by the action in the action area. Our response analysis attempts to detect potential lethal, sub-lethal (or physiological), or behavioral responses that might result in reducing the fitness of listed individuals. Ideally, response analyses would consider and weigh evidence of adverse consequences as well as evidence suggesting the absence of such consequences. Our primary concerns in this consultation revolve around exposure of listed individuals to anthropogenic sound sources, which can have a variety of effects that can have fitness consequences (Francis and Barber 2013; Nowacek and Tyack 2013).

6.3.1 **Potential Response of Marine Mammals to Acoustic Sources**

Response of marine mammals to airguns. A pulse of seismic airgun sound displaces water around the airgun and creates a wave of pressure, resulting in physical effects on the marine environment that can then affect marine organisms, such as listed whales and sea turtles considered in this Opinion. Possible responses considered in this analysis consist of:

- hearing threshold shifts,

- auditory interference (masking),
- behavioral responses, and
- non-auditory physical or physiological effects

The *Response analysis* also considers information on the potential for stranding and the potential effects on the prey of ESA-listed whales and sea turtles in the action area.

Marine mammals and threshold shifts. Exposure of marine mammals to very strong sound pulses can result in physical effects, such as changes to sensory hairs in the auditory system, which may temporarily or permanently impair hearing. Threshold shift depends upon the duration, frequency, sound pressure, and rise time of the sound. A temporary threshold shift (TTS) results in a temporary hearing change (Finneran and Schlundt 2013). TTSs can last minutes to days. Full recovery is expected. However, a recent mouse study has shown that although full hearing can be regained from TTS (i.e., the sensory cells actually receiving sound are normal), damage can still occur to nerves of the cochlear nerve leading to delayed but permanent hearing damage (Kujawa and Liberman 2009). At higher received levels, particularly in frequency ranges where animals are more sensitive, permanent threshold shift (PTS) can occur, meaning lost auditory sensitivity is unrecoverable. Either of these conditions can result from a single pulse or from the accumulated effects of multiple pulses, in which case each pulse need not be as loud as a single pulse to have the same accumulated effect. TTS and PTS are generally specific to the frequencies over which exposure occurs, but can extend to a half-octave above or below the center frequency of the source in tonal exposures (less evident in broadband noise such as the sound sources associated with the proposed action) (Kastak et al. 2005; Ketten 2012; Schlundt et al. 2000).

Few data are available to precisely define each listed species' hearing range, let alone its sensitivity and levels necessary to induce TTS or PTS. Based upon captive studies of odontocetes, our understanding of terrestrial mammal hearing, and extensive modeling, the best available information supports the position that sound levels at a given frequency would need to be ~186 dB SEL or ~196-201 dB re 1 μPa_{rms} in order to produce a low-level TTS from a single pulse (Southall et al. 2007b). PTS is expected at levels ~6 dB greater than TTS levels on a peak-pressure basis, or 15 dB greater on an SEL basis than TTS (Southall et al. 2007b). In terms of exposure to the *Langseth's* airgun array, an individual would need to be within a few meters of the largest airgun to experience a single pulse >230 dB re 1 μPa peak (Caldwell and Dragoset 2000). If an individual experienced exposure to several airgun pulses of ~190 dB re 1 μPa_{rms}, PTS could occur. A marine mammal would have to be within 100 m of the *Langseth's* airgun array to be within the 190 dB re 1 μPa_{rms} isopleth and risk a TTS. Estimates that are conservative for species impact evaluation are 230 dB re 1 μPa (peak) for a single pulse, or multiple exposures to ~198 dB re 1 μPa^2s.

Overall, we do not expect TTS or PTS to occur to any listed whale as a result of airgun exposure for several reasons. We expect that individuals will move away from the airgun array as it approaches. We further believe that as sound intensity increases, individuals will experience conditions (stress, loss of prey, discomfort, etc.) that prompt them to move away from the sound source and thus avoid exposures that would induce TTS. Ramp-ups would also reduce the probability of TTS-inducing exposure at the start of seismic surveys. Furthermore, mitigation measures would be in place to initiate a power-down if individuals enter or are about to enter the

180 dB isopleth or within 585 m during full airgun operations, which is below the levels believed to be necessary for potential TTS. As stated in the *Exposure analysis*, each individual is expected to be potentially be exposed dozens of times to 160 dB re 1 μPa_{rms} levels. We do not expect this to produce a cumulative TTS, PTS, or other injury for several reasons. We expect that individuals will recover between each of these exposures, we expect monitoring to produce some degree of mitigation such that exposures will be reduced, and (as stated above), we expect individuals to generally move away to at least a short distance as received sound levels increase, reducing the degree significance of any given exposure that is biologically meaningful.

Marine mammals and auditory interference (masking). Interference, or masking, generally occurs when the interfering noise is of a similar frequency and similar to or louder than the auditory signal received by an animal processing echolocation signals or listening for acoustic information from other individuals (Francis and Barber 2013). Masking can interfere with an individual's ability to gather acoustic information about its environment, such as predators, prey, conspecifics, and other environmental cues. Generally, noise will only mask a signal if it is sufficiently close to the signal in frequency. This can result in loss of environmental cues of predatory risk, mating opportunity, or foraging options (Francis and Barber 2013). Low frequency sounds are broad and tend to have relatively constant bandwidth, whereas higher frequency bandwidths are narrower (NMFS 2006h).

There is frequency overlap between airgun noise and vocalizations of listed whales, particularly baleen whales but also sperm whales. Any masking that might occur would likely be temporary because seismic sources are discontinuous and the seismic vessel would continue to transit. The proposed seismic surveys could mask whale calls at some of the lower frequencies. This could affect communication between individuals, affect their ability to receive information from their environment, or affect sperm whale echolocation (Evans 1998; NMFS 2006h). Most of the energy of sperm whales clicks is concentrated at 2 to 4 kHz and 10 to 16 kHz, and though the findings by Madsen et al. (2006) suggest frequencies of seismic pulses can overlap this range, the strongest spectrum levels of airguns are below 200 Hz (0-188 Hz for the *Langseth* airguns). Given the disparity between sperm whale echolocation and communication-related sounds with the dominant frequencies for seismic surveys, masking is not likely to be significant for sperm whales (NMFS 2006h). Overlap of the dominant low frequencies of airgun pulses with low-frequency baleen whale calls would be expected to pose a somewhat greater risk of masking. The *Langseth's* airguns will emit a 0.1 s pulse when fired every 5 sec. Therefore, pulses will not "cover up" the vocalizations of listed whales to a significant extent (Madsen et al. 2002). We address the response of listed whales stopping vocalizations as a result of airgun sound in the *Marine mammals and behavioral responses* section below.

Although seismic sound pulses begin as short, discrete sounds, they interact with the marine environment and lengthen through processes such as reverberation. This means that in some cases, such as shallow water environments, seismic sound can become part of the acoustic background. Few studies of how impulsive sound in the marine environment deforms from short bursts to lengthened waveforms exist, but can apparently add significantly to acoustic background (Guerra et al. 2011), potentially interfering with the ability of animals to hear otherwise detectible sounds in their environment.

Marine mammals and behavioral responses. We expect the greatest response to airgun sounds in terms of number of responses and overall impact to be in the form of changes in behavior.

Listed individuals may briefly respond to underwater sound by slightly changing their behavior or relocating a short distance, in which case the effects can equate to take but are unlikely to be significant at the population level. Displacement from important feeding or breeding areas over a prolonged period would likely be more significant. This has been suggested for humpback whales along the Brazilian coast as a result of increased seismic activity (Parente et al. 2007). Marine mammal responses to anthropogenic sound vary by species, state of maturity, prior exposure, current activity, reproductive state, time of day, and other factors (Ellison et al. 2012); this is reflected in a variety of aquatic, aerial, and terrestrial animal responses to anthropogenic noise that may ultimately have fitness consequences (Francis and Barber 2013). Although some studies are available which address responses of listed whales considered in this opinion directly, additional studies to other related whales (such as bowhead and gray whales) are relevant in determining the responses expected by species under consideration. Therefore, studies from non-listed or species outside the action area are also considered here. Individual differences in responding to stressful stimuli also appear to exist and appear to have at least a partial genetic basis in trout (Laursen et al. 2011). Animals generally respond to anthropogenic perturbations as they would predators, increasing vigilance and altering habitat selection (Reep et al. 2011). Habitat abandonment due to anthropogenic noise exposure has been found in terrestrial species (Francis and Barber 2013).

Several studies have aided in assessing the various levels at which whales may modify or stop their calls in response to airgun sound. Whales continue calling while seismic surveys are operating locally (Greene Jr et al. 1999; Jochens et al. 2006; Madsen et al. 2002; McDonald et al. 1993; McDonald et al. 1995a; Nieukirk et al. 2004; Richardson et al. 1986; Smultea et al. 2004; Tyack et al. 2003). However, humpback whale males increasingly stopped vocal displays on Angolan breeding grounds as received seismic airgun levels increased (Cerchio et al. 2014). Some blue, fin, and sperm whales stopped calling for short and long periods apparently in response to airguns (Bowles et al. 1994; Clark and Gagnon 2006; McDonald et al. 1995a). Fin whales (presumably adult males) engaged in singing in the Mediterranean Sea moved out of the area of a seismic survey while airguns were operational as well as for at least a week thereafter (Castellote et al. 2012). A blue whale discontinued calls in response to received airgun sound of 143 dB re 1 μPa for one hour before resuming (McDonald et al. 1995a). Blue whales may also attempt to compensate for elevated ambient sound by calling more frequently during seismic surveys (Iorio and Clark 2009). Sperm whales, at least under some conditions, may be particularly sensitive to airgun sounds, as they have been documented to cease calling in association with airguns being fired hundreds of kilometers away (Bowles et al. 1994). Other studies have found no response by sperm whales to received airgun sound levels up to 146 dB re 1 μPa_{p-p} (Madsen et al. 2002; McCall Howard 1999). Some exposed individuals may cease calling in response to the *Langseth's* airguns. If individuals ceased calling in response to the *Langseth's* airguns during the course of the proposed survey, the effect would likely be temporary.

There are numerous studies of the responses of some baleen whale to airguns. Although responses to lower-amplitude sounds are known, most studies seem to support a threshold of ~160 dB re 1 μPa_{rms} as the received sound level to cause behavioral responses other than vocalization changes (Richardson et al. 1995c). Activity of individuals seems to influence response (Robertson et al. 2013), as feeding individuals respond less than mother/calf pairs and migrating individuals (Harris et al. 2007; Malme and Miles 1985; Malme et al. 1984; Miller et al.

1999; Miller et al. 2005; Richardson et al. 1995c; Richardson et al. 1999). Surface duration decreased markedly during seismic sound exposure, especially while individuals were engaged in traveling or non-calf social interactions (Robertson et al. 2013). Migrating bowhead whales show strong avoidance reactions to received 120–130 dB re 1 μPa_{rms} exposures at distances of 20-30 km, but only changed dive and respiratory patterns while feeding and showed avoidance at higher received sound levels (152–178 dB re 1 μPa_{rms}) (Harris et al. 2007; Ljungblad et al. 1988; Miller et al. 1999; Miller et al. 2005; Richardson et al. 1995c; Richardson et al. 1999; Richardson et al. 1986). Responses such as stress may occur and the threshold for displacement may simply be higher while feeding. Bowhead calling rate was found to decrease during migration in the Beaufort Sea as well as temporary displacement from seismic sources (Nations et al. 2009). Calling rates decreased when exposed to seismic airguns at received levels of 116-129 dB re 1 μPa (possibly but not knowingly due to whale movement away from the airguns), but did not change at received levels of 99-108 dB re 1 μPa (Blackwell et al. 2013). Despite the above information and exposure to repeated seismic surveys, bowheads continue to return to summer feeding areas and when displaced, appear to reoccupy areas within a day (Richardson et al. 1986). We do not know whether the individuals exposed in these ensonified areas are the same returning or whether individuals that tolerate repeat exposures may still experience a stress response.

Gray whales respond similarly. Gray whales discontinued feeding and/or moved away at received sound levels of 163 dB re 1 μPa_{rms} (Bain and Williams 2006; Gailey et al. 2007; Johnson et al. 2007a; Malme and Miles 1985; Malme et al. 1984; Malme et al. 1986; Malme et al. 1988; Würsig et al. 1999; Yazvenko et al. 2007a; Yazvenko et al. 2007b). Migrating gray whales began to show changes in swimming patterns at ~160 dB re 1 μPa and slight behavioral changes at 140-160 dB re 1 μPa_{rms} (Malme and Miles 1985; Malme et al. 1984). As with bowheads, habitat continues to be used despite frequent seismic survey activity, but long-term effects have not been identified, if they are present at all (Malme et al. 1984). Johnson et al. (2007b) reported that gray whales exposed to seismic airguns off Sakhalin Island, Russia, did not experience any biologically significant or population level effects, based on subsequent research in the area from 2002–2005.

Humpback whales exhibit a pattern of lower threshold responses when not occupied with feeding. Migrating humpbacks altered their travel path (at least locally) along Western Australia at received levels as low as 140 dB re 1 μPa_{rms} when females with calves were present, or 8-12 km from the seismic source (McCauley et al. 2000a; McCauley et al. 1998). A startle response occurred as low as 112 dB re 1 μPa_{rms}. Closest approaches were generally limited to 3-4 km, although some individuals (mainly males) approached to within 100 m on occasion where sound levels were 179 dB re 1 μPa_{rms}. Changes in course and speed generally occurred at estimated received level of 157–164 dB re 1 μPa_{rms}.

Natural sources of sound also influence humpback behavior. Migrating humpbacks showed evidence of a Lombard effect in Australia, increasing vocalization in response to wind-dependent background noise ((Dunlop et al. 2014a)). Since natural sources of noise alone can influence whale behavior, additional anthropogenic sources could also add to these effects.

Multiple factors may contribute to the degree of response exhibited by migrating humpbacks. In a preliminary study examining the responses by migrating humpbacks of exposure to a 20in^3 air gun, researchers found that the whales' behavior seemed to be influenced by social effects;

"whale groups decreased dive time slightly and decreased speed towards the source, but there were similar responses to the control" (i.e., a towed air gun, not in operation) (Dunlop et al. 2014b). Whales in groups may pick up on responses by other individuals in the group and react. The results of this continued study are still pending, and will examine the effects of a full size commercial air gun array on humpback behavior (Dunlop et al. 2014b).

Feeding humpbacks appear to be somewhat more tolerant. Humpback whales along Alaska startled at 150–169 dB re 1 μPa and no clear evidence of avoidance was apparent at received levels up to 172 re 1 μPa_{rms} (Malme et al. 1984; Malme et al. 1985). Potter et al. (2007) found that humpbacks on feeding grounds in the Atlantic did exhibit localized avoidance to airguns. Among humpback whales on Angolan breeding grounds, no clear difference was observed in encounter rate or point of closest approach during seismic versus non-seismic periods (Weir 2008).

Observational data are sparse for specific baleen whale life histories (breeding and feeding grounds) in response to airguns. Available data support a general avoidance response. Some fin and sei whale sighting data indicate similar sighting rates during seismic versus non-seismic periods, but sightings tended to be further away and individuals remained underwater longer (Stone 2003; Stone and Tasker 2006). Other studies have found at least small differences in sighting rates (lower during seismic activities) as well as whales being more distant during seismic operations (Moulton et al. 2006a; Moulton et al. 2006b; Moulton and Miller 2005). When spotted at the average sighting distance, individuals would have likely been exposed to ~169 dB re 1 μPa_{rms} (Moulton and Miller 2005).

Sperm whale response to airguns has thus far included mild behavioral disturbance (temporarily disrupted foraging, avoidance, cessation of vocal behavior) or no reaction. Several studies have found Atlantic sperm whales to show little or no response (Davis et al. 2000b; Madsen et al. 2006; Miller et al. 2009; Moulton et al. 2006a; Moulton and Miller 2005; Stone 2003; Stone and Tasker 2006; Weir 2008). Detailed study of Gulf of Mexico sperm whales suggests some alteration in foraging from <130-162 dB re 1 μPa_{p-p}, although other behavioral reactions were not noted by several authors (Gordon et al. 2006; Gordon et al. 2004; Jochens et al. 2006; Madsen et al. 2006; Winsor and Mate 2006). This has been contradicted by other studies, which found avoidance reactions by sperm whales in the Gulf of Mexico in response to seismic ensonification (Jochens and Biggs 2003; Jochens and Biggs 2004; Mate et al. 1994). Johnson and Miller (2002) noted possible avoidance at received sound levels of 137 dB re 1 μPa. Other anthropogenic sounds, such as pingers and sonars, disrupt behavior and vocal patterns (Goold 1999; Watkins et al. 1985; Watkins and Schevill 1975). Miller et al. (2009) found sperm whales to be generally unresponsive to airgun exposure in the Gulf of Mexico, with possible but inconsistent responses that included delayed foraging and altered vocal behavior. Displacement from the area was not observed. Winsor and Mate (2013) did not find a nonrandom distribution of satellite-tagged sperm whales at and beyond five kilometers from seismic airgun arrays, suggesting individuals were not displaced or move away from the array at and beyond these distances in the Gulf of Mexico (Winsor and Mate 2013). However, no tagged whales within five kilometers were available to assess potential displacement within five kilometers (Winsor and Mate 2013). The lack of response by this species may in part be due to its higher range of hearing sensitivity and the low-frequency (generally <188 Hz) pulses produced by seismic airguns (Richardson et al. 1995c). Sperm whales are exposed to considerable energy above 500 Hz during the course of seismic surveys (Goold and Fish 1998), so even though this species generally hears at higher frequencies, this does not mean that it cannot hear airgun sounds. Breitzke et al. (2008) found that source levels were ~30 dB re 1 μPa lower at 1 kHz and 60 dB re 1 μPa lower at 80 kHz compared to dominant frequencies during a seismic source calibration. Another odontocete, bottlenose dolphins, progressively reduced their vocalizations as an airgun array came closer and got louder (Woude 2013). Reactions to impulse noise likely vary depending on the activity at time of exposure – e.g., in the presence of abundant food or during breeding encounters toothed whales sometimes are extremely tolerant of noise pulses (NMFS 2006b).

For whales exposed to seismic airguns during the proposed activities, behavioral changes stemming from airgun exposure may result in loss of feeding opportunities. We expect listed whales exposed to seismic airgun sound will exhibit an avoidance reaction, displacing individuals from the area at least temporarily. We also expect secondary foraging areas to be available that would allow whales to continue feeding. Although breeding may be occurring, we are unaware of any habitat features that whales would be displaced from that is essential for breeding if whales depart an area as a consequence of the *Langseth*'s presence. We expect breeding may be temporarily disrupted if avoidance or displacement occurs, but we do not expect the loss of any breeding opportunities. Individuals engaged in travel or migration would continue with these activities, although potentially with a deflection of a few kilometers from the route they would otherwise pursue.

Marine mammals and physical or physiological effects. Individual whales exposed to airguns (as well as other sound sources) could experience effects not readily observable, such as stress, that can significantly affect life history.

Stress is an adaptive response and does not normally place an animal at risk. Distress involves a stress response resulting in a biological consequence to the individual. The mammalian stress response involves the hypothalamic-pituitary-adrenal axis being stimulated by a stressor, causing a cascade of physiological responses, such as the release of the stress hormones cortisol, adrenaline (epinephrine), glucocorticosteroids, and others (Busch and Hayward 2009; Gregory and Schmid 2001; Gulland et al. 1999; St. Aubin and Geraci 1988; St. Aubin et al. 1996; Thomson and Geraci 1986). These hormones subsequently can cause short-term weight loss, the liberation of glucose into the blood stream, impairment of the immune and nervous systems, elevated heart rate, body temperature, blood pressure, and alertness, and other responses (Busch and Hayward 2009; Cattet et al. 2003; Dickens et al. 2010; Dierauf and Gulland 2001b; Elftman et al. 2007; Fonfara et al. 2007; Kaufman and Kaufman 1994; Mancia et al. 2008; Noda et al. 2007; Thomson and Geraci 1986). In some species, stress can also increase an individual's susceptibility to gastrointestinal parasitism (Greer et al. 2005). In highly-stressful circumstances, or in species prone to strong "fight-or-flight" responses, more extreme consequences can result, including muscle damage and death (Cowan and Curry 1998; Cowan and Curry 2002; Cowan and Curry 2008; Herraez et al. 2007). The most widely-recognized indicator of vertebrate stress, cortisol, normally takes hours to days to return to baseline levels following a significantly stressful event, but other hormones of the hypothalamic-pituitary-adrenal axis may persist for weeks (Dierauf and Gulland 2001a). Mammalian stress levels can vary by age, sex, season, and health status (Gardiner and Hall 1997; Hunt et al. 2006; Keay et al. 2006; Romero et al. 2008; St. Aubin et al. 1996). Stress is lower in immature right whales than adults and mammals with poor diets or undergoing dietary change tend to have higher fecal cortisol levels (Hunt et al. 2006; Keay et al. 2006).

Loud noises generally increase stress indicators in mammals (Kight and Swaddle 2011). Romano et al. (2004) found beluga whales and bottlenose dolphins exposed to a seismic water gun (up to 228 dB re 1 μPa · m_{p-p}) and single pure tones (up to 201 dB re 1 μPa) had increases in stress chemicals, including catecholamines, which could affect an individual's ability to fight off disease. During the time following September 11, 2001, shipping traffic and associated ocean noise decreased along the northeastern U.S.; this decrease in ocean noise was associated with a significant decline in fecal stress hormones in North Atlantic right whales, providing evidence that chronic exposure to increased noise levels, although not acutely injurious, can produce stress (Rolland et al. 2012b). These levels returned to baseline after 24 hours of traffic resuming. As whales use hearing as a primary way to gather information about their environment and for communication, we assume that limiting these abilities would be stressful. Stress responses may also occur at levels lower than those required for TTS (NMFS 2006g). Therefore, exposure to levels sufficient to trigger onset of PTS or TTS are expected to be accompanied by physiological stress responses (NMFS 2006g; NRC 2003). As we do not expect individuals to experience TTS or PTS, (see *Marine mammals and threshold shifts*), we also do not expect any listed individual to experience a stress response at high levels. We assume that a stress response could be associated with displacement or, if individuals remain in a stressful environment, the stressor (sounds associated with the airgun, multibeam echosounder, or sub-bottom profiler) will dissipate in a short period as the vessel (and stressors) transects away without significant or long-term harm to the individual via the stress response.

Exposure to loud noise can also adversely affect reproductive and metabolic physiology (Kight and Swaddle 2011). Premature birth and indicators of developmental instability (possibly due to disruptions in calcium regulation) have been found in embryonic and neonatal rats exposed to loud sound. In fish eggs and embryos exposed to sound levels only 15 dB greater than background, increased mortality was found and surviving fry had slower growth rates (a similar effect was observed in shrimp), although the opposite trends have also been found in sea bream. Dogs exposed to loud music took longer to digest food. The small intestine of rats leaks additional cellular fluid during loud sound exposure, potentially exposing individuals to a higher risk of infection (reflected by increases in regional immune response in experimental animals). Exposure to 12 hours of loud noise can alter elements of cardiac tissue. In a variety of factors, including behavioral and physiological responses, females appear to be more sensitive or respond more strongly than males (Kight and Swaddle 2011). It is noteworthy that although various exposures to loud noise appear to have adverse results, exposure to music largely appears to result in beneficial effects in diverse taxa; the impacts of even loud sound are complex and not universally negative (Kight and Swaddle 2011).

It is possible that an animal's prior exposure to seismic sounds influences its future response. We have little information available to us as to what response individuals would have to future exposures to seismic sources compared to prior experience. If prior exposure produces a learned response, then this subsequent learned response would likely be similar to or less than prior responses to other stressors where the individual experienced a stress response associated with the novel stimuli and responded behaviorally as a consequence (such as moving away and reduced time budget for activities otherwise undertaken) (Andre and Jurado 1997; André et al. 1997; Gordon et al. 2006). We do not believe sensitization would occur based upon the lack of severe responses previously observed in marine mammals and sea turtles exposed to seismic sounds that would be expected to produce a more intense, frequent, and/or earlier response to subsequent exposures (see *Response Analysis*).

Marine mammals and strandings. There is some concern regarding the coincidence of marine mammal strandings and proximal seismic surveys. No conclusive evidence exists to causally link stranding events to seismic surveys.

Suggestions that there was a link between seismic surveys and strandings of humpback whales in Brazil (Engel et al., 2004) were not well founded (IAGC, 2004; IWC, 2007). In September 2002, two Cuvier's beaked whales stranded in the Gulf of California, Mexico. The *R/V Ewing* had been operating a 20-airgun, 8,490-in^3 airgun array 22 km offshore the general area at the time that strandings occurred. The link between the stranding and the seismic surveys was inconclusive and not based on any physical evidence (Hogarth, 2002; Yoder, 2002) as some vacationing marine mammal researchers who happened upon the stranding were ill-equipped to perform an adequate necropsy. Furthermore, the small numbers of animals involved and the lack of knowledge regarding the spatial and temporal correlation between the beaked whales and the sound source underlies the uncertainty regarding the linkage between seismic sound sources and beaked whale strandings (Cox et al., 2006). At present, the factors of seismic airguns that may contribute to marine mammal strandings are unknown and we have no evidence to lead us to believe that aspects of the airgun array proposed to for use will cause marine mammal strandings. We do not expect listed whales to strand as a result of the proposed seismic survey.

Responses of marine mammal prey. Seismic surveys may also have indirect, adverse effects on prey availability through lethal or sub-lethal damage, stress responses, or alterations in their behavior or distribution. Studies described herein provide extensive support for this, which is the basis for later discussion on implications for listed whales. Unfortunately, species-specific information on the prey of listed whales is not generally available. Until more specific information is available, we expect that teleost, cephalopod, and krill prey of listed whales to react in manners similar to those fish and invertebrates described herein.

Some support has been found for fish or invertebrate mortality resulting from airgun exposure, and this is limited to close-range exposure to high-amplitudes (Bjarti 2002; Falk and Lawrence 1973; Hassel et al. 2003; Holliday et al. 1987; Kostyuchenko 1973; La Bella et al. 1996a; McCauley et al. 2000a; McCauley et al. 2000b; McCauley et al. 2003; Popper et al. 2005; Santulli et al. 1999). Lethal effects, if any, are expected within a few meters of the airgun array (Buchanan et al. 2004; Dalen and Knutsen 1986). We expect fish to be capable of moving away from the airgun array if it causes them discomfort.

More evidence exists for sub-lethal effects. Several species at various life stages have been exposed to high-intensity sound sources (220-242 dB re 1 μPa) at close distances, with some cases of injury (Booman et al. 1996; McCauley et al. 2003). TTS was not found in whitefish at received levels of ~175 dB re 1 $\mu Pa^2 \cdot s$, but pike did show 10-15 dB of hearing loss with recovery within 1 day (Popper et al. 2005). Caged pink snapper have experienced PTS when exposed over 600 times to received seismic sound levels of 165-209 dB re 1 $\mu Pa_{p\text{-}p}$. Exposure to airguns at close range were found to produce balance issues in exposed fry (Dalen and Knutsen 1986). Exposure of monkfish and capelin eggs at close range to airguns did not produce differences in mortality compared to control groups (Payne et al. 2009). Salmonid swim bladders were reportedly damaged by received sound levels of ~230 dB re 1 μPa (Falk and Lawrence 1973).

By far the most common response by fishes is a startle or distributional response, where fish react momentarily by changing orientation or swimming speed, or change their vertical distribution in the water column. Although received sound levels were not reported, caged *Pelates* spp., pink snapper, and trevally generally exhibited startle, displacement, and/or grouping responses upon exposure to airguns (McCauley and Fewtrell 2013a). This effect generally persisted for several minutes, although subsequent exposures to the same individuals did not necessarily elicit a response (McCauley and Fewtrell 2013a). Startle responses were observed in rockfish at received airgun levels of 200 dB re 1 $\mu Pa_{0\text{-}p}$ and alarm responses at >177 dB re 1 $\mu Pa_{0\text{-}p}$ (Pearson et al. 1992). Fish also tightened schools and shifted their distribution downward. Normal position and behavior resumed 20-60 minutes after seismic firing ceased. A downward shift was also noted by Skalski et al. (1992) at received seismic sounds of 186–191 re 1 $\mu Pa_{0\text{-}p}$. Caged European sea bass showed elevated stress levels when exposed to airguns, but levels returned to normal after 3 days (Skalski et al. 1992). These fish also showed a startle response when the survey vessel was as much as 2.5 km away; this response increased in severity as the vessel approached and sound levels increased, but returned to normal after about two hours following cessation of airgun activity. Whiting exhibited a downward distributional shift upon exposure to 178 dB re 1 $\mu Pa_{0\text{-}p}$ airgun sound, but habituated to the sound after one hour and returned to normal depth (sound environments of 185-192 dB re 1 μPa) despite airgun activity (Chapman and Hawkins 1969). Whiting may also flee from airgun sound (Dalen and Knutsen 1986). Hake may redistribute downward (La Bella et al. 1996a). Lesser sandeels exhibited initial startle responses and upward vertical movements before fleeing from the survey area upon approach of an active seismic vessel (Hassel et al. 2003; Hassel et al. 2004). McCauley et al. (2000; 2000a) found smaller fish show startle responses at lower levels than larger fish in a variety of fish species and generally observed responses at received sound levels of 156–161 dB re 1 μPa_{rms}, but responses tended to decrease over time suggesting habituation. As with previous studies, caged fish showed increases in swimming speeds and downward vertical shifts. Pollock did not respond to airgun sounds received at 195–218 dB re 1 $\mu Pa_{0\text{-}p}$, but did exhibit continual startle responses and fled from the seismic source when visible (Wardle et al. 2001). Blue whiting and mesopelagic fishes were found to redistribute 20–50 m deeper in response to airgun ensonification and a shift away from the survey area was also found (Slotte et al. 2004). Startle responses were infrequently observed from salmonids receiving 142–186 dB re 1 $\mu Pa_{p\text{-}p}$ sound levels from an airgun (Thomsen 2002). Cod and haddock likely vacate seismic survey areas in response to airgun activity and estimated catchability decreased starting at received sound levels of 160–180 dB re 1 $\mu Pa_{0\text{-}p}$ (Dalen and Knutsen 1986; Engås et al. 1996; Engås et al. 1993; Løkkeborg 1991; Løkkeborg and Soldal 1993; Turnpenny et al. 1994). Increased swimming activity in response to airgun exposure, as well as reduced foraging activity, is supported by data collected by Lokkeborg et al. (2012). Bass did not appear to vacate during a shallow-water seismic survey with received sound levels of 163–191 dB re 1 $\mu Pa_{0\text{-}p}$ (Turnpenny and Nedwell 1994). Similarly, European sea bass apparently did not leave their inshore habitat during a 4-5 month seismic survey (Pickett et al. 1994). La Bella et al. (1996b) found no differences in trawl catch data before and after seismic operations and echosurveys of fish occurrence did not reveal differences in pelagic biomass. However, fish kept in cages did show behavioral responses to approaching airguns.

Squid responses to airguns have also been studied, although to a lesser extent than fishes. In response to airgun exposure, squid exhibited both startle and avoidance responses at received sound levels of 174 dB re 1 μPa_{rms} by first ejecting ink and then moving rapidly away from the area (McCauley and Fewtrell 2013b; McCauley et al. 2000a; McCauley et al. 2000b). The authors also noted some movement upward. During ramp-up, squid did not discharge ink but alarm responses occurred when received sound levels reached 156–161 dB re 1 μPa$_{rms}$. Guerra et al. (2004) suggested that giant squid mortalities were associated with seismic surveys based upon coincidence of carcasses with the surveys in time and space, as well as pathological information from the carcasses. Lobsters did not exhibit delayed mortality, or apparent damage to mechanobalancing systems after up to eight months post-exposure to airguns fired at 202 or 227 dB peak-to-peak pressure (Payne et al. 2013). However, feeding did increase in exposed individuals (Payne et al. 2013).

The overall response of fishes and squids is to exhibit startle responses and undergo vertical and horizontal movements away from the sound field. We do not expect krill (the primary prey of most listed baleen whales) to experience effects from airgun sound. Although humpback whales consume fish regularly, we expect that any disruption to their prey will be temporary, if at all. Therefore, we do not expect any adverse effects from lack of prey availability to baleen whales. Sperm whales regularly feed on squid and some fishes and we expect individuals to feed while in the action area during the proposed survey. Based upon the best available information, fishes and squids ensonified by the ~160 dB isopleths could vacate the area and/or dive to greater depths, and be more alert for predators. We do not expect indirect effects from airgun activities through reduced feeding opportunities for listed whales to be sufficient to reach a significant level. Effects are likely to be temporary and, if displaced, both sperm whales and their prey would re-distribute back into the area once survey activities have passed.

Marine mammal response to multibeam echosounder and sub-bottom profiler. We expect listed whales to experience ensonification from not only airguns, but also seafloor and ocean current mapping systems. Multibeam echosounder and sub-bottom profiler frequencies are much higher than frequencies used by all listed whales except blue, humpback, North Atlantic right and sperm whales. We expect that these systems will produce harmonic components in a frequency range above and below the center frequency similar to other commercial sonars (Deng et al. 2014). However, we do not expect these sub-harmonic frequencies in these systems to be audible to these species. Although Todd et al. (1992) found that mysticetes reacted to sonar sounds at 3.5 kHz within the 80-90 dB re 1 μPa range, it is difficult to determine the significance of this because the source was a signal designed to be alarming and the sound level was well below typical ambient noise. Goldbogen et al. (2013) found blue whales to respond to 3.5-4.0 kHz mid-frequency sonar at received levels below 90 dB re 1 μPa. Responses included cessation of foraging, increased swimming speed, and directed travel away from the source (Goldbogen et al. 2013). Hearing is poorly understood for listed baleen whales, but it is assumed that they are most sensitive to frequencies over which they vocalize, which are much lower than frequencies emitted by the multibeam echosounder and sub-bottom profiler systems (Ketten 1997; Richardson et al. 1995c). Thus, if fin or sei, whales are exposed, they are unlikely to hear these frequencies well (if at all) and a response is not expected.

Assumptions for blue, humpback, and sperm whale hearing are much different than for other listed whales. Humpback and sperm whales vocalize between 3.5-12.6 kHz and an audiogram of a juvenile sperm whale provides direct support for hearing over this entire range (Au 2000a; Au et al. 2006; Carder and Ridgway 1990; Erbe 2002a; Frazer and Mercado 2000; Goold and Jones 1995; Levenson 1974; Payne and Payne 1985; Payne 1970; Richardson et al. 1995c; Silber 1986; Thompson et al. 1986; Tyack 1983; Tyack and Whitehead 1983; Weilgart and Whitehead 1993;

Weilgart and Whitehead 1997; Weir et al. 2007; Winn et al. 1970). The response of a blue whale to 3.5 kHz sonar supports this species ability to hear this signal as well (Goldbogen et al. 2013). Maybaum (1990; 1993) observed that Hawaiian humpbacks moved away and/or increased swimming speed upon exposure to 3.1-3.6 kHz sonar. Kremser et al. (2005) concluded the probability of a cetacean swimming through the area of exposure when such sources emit a pulse is small, as the animal would have to pass at close range and be swimming at speeds similar to the vessel. Sperm whales have stopped vocalizing in response to 6-13 kHz pingers, but did not respond to 12 kHz echo-sounders (Backus and Schevill 1966; Watkins 1977; Watkins and Schevill 1975). Sperm whales exhibited a startle response to 10 kHz pulses upon exposure while resting and feeding, but not while traveling (Andre and Jurado 1997; André et al. 1997).

Investigations stemming from a 2008 stranding event in Madagascar suggest a 12 kHz multibeam echosounder, similar in operating characteristics as that proposed for use aboard the *Langseth*, suggest that this sonar played a significant role in the mass stranding of a large group of melon-headed whales (Southall et al. 2013). Although pathological data to suggest a direct physical affect are lacking and the authors acknowledge that although the use of this type of sonar is widespread and common place globally without noted incidents like the Madagascar stranding, all other possibilities were either ruled out or believed to be of much lower likelihood as a cause or contributor to stranding compared to the use of the multibeam echosounder (Southall et al. 2013). This incident highlights the caution needed when interpreting effects that may or may not stem from anthropogenic sound sources, such as the *Langseth*'s multibeam echosounder and that of the chase vessel. Although effects such as this have not been documented for ESA-listed species, the combination of exposure to this stressor with other factors, such as behavioral and reproductive state, oceanographic and bathymetric conditions, movement of the source, previous experience of individuals with the stressor, and other factors may combine to produce a response that is greater than would otherwise be anticipated or has been documented to date (Ellison et al. 2012; Francis and Barber 2013).

Stranding events associated with the operation of naval sonar suggest that mid-frequency sonar sounds may have the capacity to cause serious impacts to marine mammals. The sonars proposed for use by L-DEO differ from sonars used during naval operations, which generally have a longer pulse duration and more horizontal orientation than the more downward-directed multibeam echosounder and sub-bottom profiler. The sound energy received by any individuals exposed to the multibeam echosounder and sub-bottom profiler sources during the proposed activities is lower relative to naval sonars, as is the duration of exposure. The area of possible influence for the multibeam echosounder and sub-bottom profiler is also much smaller, consisting of a narrow zone close to and below the source vessel. Although navigational sonars are operated routinely by thousands of vessels around the world, strandings have been correlated to use of these sonars. Because of these differences, we do not expect these systems to contribute to a stranding event.

We do not expect masking of blue, sperm, or humpback whale communications to appreciably occur due to multibeam echosounder or sub-bottom profiler signal directionality, low duty cycle, and the brief period when an individual could be within its beam. These factors were considered when Burkhardt et al. (2013) estimated the risk of injury from multibeam echosounder was less than 3% that of ship strike.

6.3.2 Potential Responses of Sea Turtles to Acoustic Sources

Sea turtle response to airguns. As with marine mammals, sea turtles may experience

- hearing threshold shifts
- behavioral responses
- non-auditory physical or physiological effects

Sea turtles and threshold shifts. Although leatherback sea turtles detect low frequency sound, the potential effects on sea turtle biology remain largely unknown (Samuel et al. 2005). Few data are available to assess sea turtle hearing, let alone the effects seismic equipment may have on their hearing potential. The only study which addressed sea turtle TTS was conducted by Moein et al. (1994), in which a loggerhead experienced TTS upon multiple airgun exposures in a shallow water enclosure, but recovered within one day.

As with marine mammals, we assume that sea turtles will not move towards a source of stress or discomfort. Some experimental data suggest sea turtles may avoid seismic sources (McCauley et al. 2000a; McCauley et al. 2000b; Moein et al. 1994), but monitoring reports from seismic surveys in other regions suggest that some sea turtles do not avoid airguns and were likely exposed to higher levels of seismic airgun pulses (Smultea and Holst 2003). For this reason, mitigation measures are also in place to limit sea turtle exposure. Although data on the precise levels that can result in TTS or PTS are lacking, we do not expect either of these to occur to any sea turtle as a result of the proposed action.

Sea turtles and behavioral responses. As with listed whales, it is likely that sea turtles will experience behavioral responses in the form of avoidance. O'Hara and Wilcox (1990) found loggerhead sea turtles exhibited an avoidance reaction at an estimated sound level of 175–176 dB re 1 µPa $_{rms}$ (or slightly less) in a shallow canal. Green and loggerhead sea turtles avoided airgun sounds at received sound levels of 166 dB re 1 µPa and 175 dB re 1 µPa, respectively (McCauley et al. 2000a; McCauley et al. 2000b). Sea turtle swimming speed increased and becomes more erratic at 175 dB re 1 µPa, with individuals becoming agitated. Loggerheads also appeared to move towards the surface upon airgun exposure (Lenhardt 1994b; Lenhardt et al. 1983). However, loggerheads resting at the ocean surface were observed to startle and dive as active seismic source approached them (DeRuiter and Larbi Doukara 2012). Responses decreased with increasing distance of closest approach by the seismic array (DeRuiter and Larbi Doukara 2012). The authors developed a response curve based upon observed responses and predicted received exposure level. Recent monitoring studies show that some sea turtles move away from approaching airguns, although sea turtles may approach active seismic arrays within 10 m (Holst et al. 2006; LGL Ltd 2005a; LGL Ltd 2005b; LGL Ltd 2008; NMFS 2006e; NMFS 2006h).

Observational evidence suggests that sea turtles are not as sensitive to sound as are marine mammals and behavioral changes are only expected when sound levels rise above received sound levels of 166 dB re 1 µPa. This corresponds with previous reports of sea turtle hearing thresholds being generally higher than for marine mammals (DFO 2004). At 166 dB re 1 µPa. We anticipate some change in swimming patterns and a stress response of exposed individuals. Some turtles may approach the active seismic array to closer proximity, but we expect them to eventually turn away. We expect temporary displacement of exposed individuals from some portions of the action area while the *Langseth* transects through.

Sea turtles and stress. Direct evidence of seismic sound causing stress is lacking in sea turtles. However, we expect sea turtles to generally avoid high-intensity exposure to airguns in a fashion similar to predator avoidance. As predators generally induce a stress response in their prey (Dwyer 2004; Lopez and Martin 2001; Mateo 2007), we assume that sea turtles experience a stress response to airguns when they exhibit behavioral avoidance or when they are exposed to sound levels apparently sufficient to initiate an avoidance response (~166 dB re 1 μPa). We expect breeding adult females may experience a lower stress response, as female loggerhead and green sea turtles appear to have a physiological mechanism to reduce or eliminate hormonal response to stress (predator attack, high temperature, and capture) in order to maintain reproductive capacity at least during their breeding season; a mechanism apparently not shared with males (Jessop 2001; Jessop et al. 2000; Jessop et al. 2004). Individuals may experience a stress response at levels lower than ~166 dB re 1 μPa, but data are lacking to evaluate this possibility. Therefore, we follow the best available evidence identifying a behavioral response as the point at which we also expect a significant stress response.

Sea turtle response to multibeam echosounder and sub bottom profiler. Sea turtles do not possess a hearing range that includes frequencies emitted by these systems. Therefore, listed sea turtles will not hear these sounds even if they are exposed and are not expected to respond to them.

7 CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered by this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

We expect that those aspects described in the *Environmental Baseline* will continue to impact listed resources into the foreseeable future. We expect climate change, habitat degradation, dredging, seismic surveys, military activities, entrapment and entanglement, invasive species impacts, wind energy projects, entrainment in power plants, ship-strikes, pollution, scientific research, and harvests to continue into the future. Movement towards bycatch reduction and greater foreign protections of sea turtles are generally occurring throughout the Atlantic Ocean, which may aid in abating the downward trajectory of sea turtle populations.

8 INTEGRATION AND SYNTHESIS OF EFFECTS

As explained in the *Approach to the Assessment* section, risks to listed individuals are analyzed using changes to an individual's "fitness" – i.e., the individual's growth, survival, annual reproductive success, as well as lifetime reproductive success. When ESA-listed animals exposed to an action's effects are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the population(s) those individuals represent or the species those populations comprise (Anderson 2000; Brandon 1978; Mills and Beatty 1979; Stearns 1992). As a result, if the assessment indicates that ESA-listed animals are not likely to experience reductions in their fitness, we conclude our assessment. If reductions in individuals' fitness are likely to occur, the assessment considers the risk posed to population(s) to which those individuals belong, and then to the species those population(s) represent.

ESA-Listed whales. The NSF proposes to allow the use of its vessel, the *Langseth*, to conduct a seismic survey by L-DEO that could incidentally harass several ESA-listed marine mammal species; and PR1 proposes to authorize the incidental take of marine mammals. These species include: blue whales, fin whales, humpback whales, North Atlantic right whales, sei whales, and sperm whales, all of which are endangered throughout their ranges.

The *Status of Listed Resources* section identified commercial whaling as the primary reason for reduced populations, many of whom are a small fraction of their former abundance (Tables 3-7). Although large-scale commercial harvests no longer occur for these species, some harvests from subsistence and scientific research in regional and worldwide populations still occur. Other worldwide threats to the survival and recovery of ESA-listed whale species include: altered prey base and habitat quality as a result of global warming, ship strike, entanglement in fishing gear, toxic chemical burden and biotoxins, ship noise, competition with commercial fisheries, and killer whale predation. Populations of whales inhabiting the North Atlantic face area-specific threats identified in the *Environmental Baseline*.

Despite these pressures, available trend information indicates most local populations of ESA-listed whales are stable or increasing. As previously mentioned, the *Cumulative Effects* section identifies actions in the *Environmental Baseline* we expect to generally continue for the foreseeable future.

The *Effects Analysis* supports the conclusion of harassment to listed whales by proposed seismic activities. As discussed in the exposure analysis, we expect up to 1 blue, 3 fin, 5 sei, 3 humpback, 3 North Atlantic right, and 31 sperm whales could be exposed to airgun sounds which will elicit a behavioral response of temporarily moving out of the area. We expect a low-level, transitory stress response to accompany this behavior. The number of individuals exposed is a small fraction of the populations, with some individual re-exposure and reactions. These exposures should not limit the fitness of any single individual. The other actions we considered in the Opinion, the operation of multibeam echosounder and sub-bottom profiler systems, are not expected to be audible to fin or sei whales and consequently are not expected to have any direct effects on these species. However, blue, humpback, North Atlantic right and sperm whales could hear sounds produced by these systems. Responses could include cessation of vocalization by sperm whales and/or movement out of the survey area by these species. Behavioral harassment caused by exposure to sound sources associated with the proposed seismic survey are expected to cause some individuals to cease these activities temporarily and possibly move out of the immediate area. However, we expect that individuals will either resume foraging in a secondary location or reoccupy the habitat from which they were displaced within a period of days (or less). We do not expect these effects to have fitness consequences for any individual. The *Effects Analysis* also found that, although sperm whales may experience temporarily reduced feeding opportunities; this indirect effect would be transient and not reduce individual fitness of any whale. Based upon these findings, the risk of fitness consequences to any single individual is not expected to translate to population or species-level consequences. Overall, we do not expect a fitness reduction to any individual whale from the survey or IHA. As such, we do not expect fitness consequences to populations or listed whale species as a whole.

ESA-Listed turtles. ESA-Listed turtles that are expected to occur within the action area include green sea turtles, leatherback sea turtles, loggerhead sea turtles, and Kemp's ridley sea turtles, which are either threatened or endangered. The *Status of Listed Resources* section found that most sea turtle populations have undergone significant to severe reduction by human harvesting of both eggs and turtles, as well as severe bycatch pressure in worldwide fishing industries. As previously mentioned, the *Cumulative Effects* section identified actions in the *Environmental Baseline* to generally continue for the foreseeable future.

From the *Effects Analysis*, we expect that 27 green, 26 Kemp's ridley, 23 leatherback, and 164 loggerhead sea turtles could experience exposure to airgun sounds and be harassed by these sounds. These sounds may induce a temporary increase stress levels, swimming patterns, and movement out of the action area. Population size is not available to calculate the subset of all population affected. However, those that are available suggest a very small proportion of each population would be affected. We expect transient responses that do not affect the fitness of any one individual. We do not expect impairment of local nesting by the proposed survey. As we do not expect any sea turtle to be capable of hearing signals produced by the multibeam echosounder and sub-bottom profiler systems, we do not expect direct effects from these systems on sea turtle fitness. We do not anticipate any indirect effects from the proposed actions to influence sea turtles. Overall, we do not expect any individual sea turtle to undergo a fitness consequence. Based upon these findings, the risk of fitness consequences to any single individual is not expected to translate to population or species-level consequences. Because we do not expect individual sea turtles to experience fitness reductions, we also do not expect reductions in the viability of the populations these individuals belong or the viability of the species those populations comprise.

9 CONCLUSION

After reviewing the current status of the ESA-listed species, the environmental baseline within the action area, the effects of the proposed actions and cumulative effects, it is NMFS' biological opinion that the proposed seismic survey off the New Jersey coast and NMFS' Permits and Conservation Division's issuance of an IHA is not likely to jeopardize the continued existence of blue, fin, sei, humpback, North Atlantic right, and sperm whales as well as green, leatherback, loggerhead, and Kemp's ridley sea turtles. The proposed action would have no effect on critical habitat.

10 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the "take" of endangered and threatened species, respectively, without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the NMFS as an act which actually kills or injures wildlife, which may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of sections 7(b)(4) and 7(o)(2), taking that is incidental and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

10.1 Amount or Extent of Take

Section 7 regulations require NMFS to specify the impact of any incidental take of endangered or threatened species; that is, the amount or extent of such incidental taking on the species (50 CFR § 402.14(i)(1)(i)). The amount of take represents the number of individuals that are expected to be taken by actions while the extent of take or "the extent of land or marine area that may be affected by an action" may be used if we cannot assign numerical limits for animals that could be incidentally taken during the course of an action (51 FR 19953).

Section 7(b)(4)(C) of the ESA specifies that in order to provide an incidental take statement for an endangered or threatened species of marine mammal, the taking must be authorized under section 101(a)(5) of the MMPA. One of the federal actions considered in this Opinion is the Permits and Conservation Division's proposed authorization of the incidental taking of fin, blue, sei, humpback, North Atlantic right, and sperm whales pursuant to section 101(a)(5)(D) of the MMPA. The final authorization would be issued and its mitigation and monitoring measures incorporated in this Incidental Take Statement as Terms and Conditions. With this authorization, the incidental take of listed whales would be exempt from the taking prohibition of section 9(a), pursuant to section 7(o) of the ESA as long as such take occurs consistent with this statement.

The NMFS anticipates the proposed seismic survey along offshore New Jersey is likely to result in the incidental take of ESA-listed species by harassment. The proposed action is expected to take by harassment 1 blue, 3 fin, 5 sei, 3 humpback, 3 North Atlantic right, and 31 sperm whales as well as 27 green, 26 Kemp's ridley, 23 leatherback, and 164 loggerhead sea turtles by exposing individuals to received seismic sound levels greater than 160 dB re 1 μPa by harassment (166 dB re 1 μPa for sea turtles) (**Table 31**). For sei and sperm whales, we are adopting the numbers presented by the Permits and Conservation Division in their IHA as the number of sei and sperm whales takes authorized in the incidental take statement. For the reasons discussed above in the *Exposure analysis* section, we believe that this amount of take is as reasonably likely to occur to sei and sperm whales despite the differences in analytical methods.

These estimates are based on the best available information of densities in the area to be ensonified above 160 dB re 1 μPa for whales during the proposed activities and 166 dB re 1 μPa for sea turtles. This incidental take would result primarily from exposure to acoustic energy during seismic operations and would be in the form of harassment, and is not expected to result in the death or injury of any individuals that are exposed.

Table 31. Number of individual ESA-listed whales and sea turtles authorized for incidental take.

Species	Number of Individuals Authorized for Incidental Take
Blue whale	1
Fin whale	3
Sei whale	5
Humpback whale	3
North Atlantic right whale	3
Sperm whale	31
Green sea turtle	27
Kemp's ridley sea turtle	26
Leatherback sea turtle	23
Loggerhead sea turtle	164

Harassment of blue, fin, humpback, North Atlantic right, sei, and sperm whales exposed to seismic studies at levels less than 160 dB re 1 μPa, or of leatherback, loggerhead, green, and Kemp's ridley sea turtles at levels less than 166 dB re 1 μPa, is not expected. During airgun operation, if overt adverse reactions (for example, startle responses, dive reactions, or rapid departures from the area) by ESA-listed whales or sea turtles are observed at less intense levels than 160 dB or 166 dB re 1 μPa, respectively, incidental take may be exceeded. The NSF and NMFS' Permits and Conservation Division must contact the ESA Interagency Cooperation Division to determine whether reinitiation of consultation is required because of such responses.

Any incidental take of blue, fin, humpback, North Atlantic right, sei, and sperm whales or leatherback, loggerhead, green, and Kemp's ridley sea turtles is restricted to the permitted action as proposed. If the actual incidental take exceeds the predicted level or type, the NSF and NMFS' Permits and Conservation Division must reinitiate consultation. All anticipated takes would be "takes by harassment", as described previously, involving temporary changes in behavior.

10.2 Effect of the Take

In the accompanying Opinion, NMFS has determined that the amount of incidental take, coupled with other effects of the proposed actions, is not likely to jeopardize the continued existence of any listed species.

10.3 Reasonable and Prudent Measures

The measures described below are nondiscretionary, and must be undertaken by the NSF and the Permits Division so that they become binding conditions for L-DEO for the exemption in section 7(o)(2) to apply. Section 7(b)(4) of the ESA requires that when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA and the proposed action may incidentally take individuals of listed species, NMFS will issue a statement that specifies the impact of any incidental taking of endangered or threatened species. To minimize such impacts, reasonable and prudent measures and terms and conditions to implement the measures, must be provided. Only incidental take resulting from the agency actions and any specified reasonable and prudent measures and terms and conditions identified in the incidental take statement are exempt from the taking prohibition of section 9(a), pursuant to section 7(o) of the ESA.

NMFS believes the reasonable and prudent measure described below is necessary and appropriate to minimize the amount of incidental take of listed whales and sea turtles resulting from the proposed actions. This measure is non-discretionary and must be a binding condition of the NSF and NMFS' authorization for the exemption in section 7(o)(2) to apply. If the NSF or NMFS fail to ensure compliance with this term and conditions and its implementing terms and conditions, the protective coverage of section 7(o)(2) may lapse.

- The Permits and Conservation Division and the NSF must ensure that the L-DEO implements and monitors the effectiveness of mitigation measures incorporated as part of the proposed authorization of the incidental taking of blue, fin, sei, humpback, North Atlantic right, and sperm whales pursuant to section 101(a)(5)(D) of the MMPA and as specified below for green, Kemp's ridley, leatherback, and loggerhead sea turtles. In addition, the Permits and Conservation Division must ensure that the provisions of the IHA are carried out, and to inform the ESA Interagency Cooperation Division if take is exceeded.

10.4 Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the NSF, L-DEO, and Permits and Conservation Division must comply with the following terms and conditions, which implement the reasonable and prudent measure described above and outlines the mitigation, monitoring and reporting measures required by the section 7 regulations (50 CFR 402.14(i)). These terms and conditions are non-discretionary. If NSF, L-DEO, and/or the Permits and Conservation Division fail to ensure compliance with these terms and conditions and their implementing reasonable and prudent measures, the protective coverage of section 7(o)(2) may lapse.

To implement the Reasonable and Prudent Measures, the L-DEO and the NMFS' Permits and Conservation Division shall ensure that:

Mitigation and Monitoring Requirements

A. Establish a safety radius corresponding to the anticipated 180-dB isopleth for full (700 in^3) and single (40 in^3) airgun operations.

B. Use two, NMFS-approved, vessel-based PSVOs to watch for and monitor marine mammal or sea turtle species near the seismic source vessel during daytime airgun operations, start-ups of airguns at night, and while the seismic array and streamers are being deployed and retrieved. Vessel crew will also assist in detecting marine mammals or sea turtles, when practical. Observers will have access to reticle binoculars (7 X 50 Fujinon), big-eye binoculars (25 X 150), optical range finders, and night vision devices. PSVOs shifts will last no longer than 4 hours at a time. PSVOs will also observe during daytime periods when the seismic system is not operating for comparisons of animal abundance and behavior, when feasible.

C. Record the following information when a marine mammal or sea turtle is sighted:

i. Species, group size, age/size/sex categories (if determinable), behavior when first sighted and after initial sighting, heading (if consistent), bearing and distance from seismic vessel, sighting cue, apparent reaction to the airguns or vessel (e.g., none, avoidance, approach, paralleling, etc., and including responses to ramp-up), and behavioral pace.

ii. Time, location, heading, speed, activity of the vessel (including number of airguns operating and whether in state of ramp-up or power-down), Beaufort sea state and wind force, visibility, cloud cover, and sun glare.

iii. The data listed under ii. would also be recorded at the start and end of each observation watch and during a watch whenever there is a change in one or more of the variables.

D. Visually observe the entire extent of the safety radius using PSVOs, for at least 30 min prior to starting the airgun (day or night). If PSVOs find a marine mammal or sea turtle within the safety zone, L-DEO must delay the seismic survey until the marine mammal or sea turtle has left the area. If the PSVO sees a marine mammal or sea turtle that surfaces, then dives below the surface, the observer shall wait 30 minutes. If the PSVO sees no marine mammals or sea turtles during that time, they should assume that the animal has moved beyond the safety zone. If for any reason the entire radius cannot be seen for the entire 30 min (e.g., rough seas, fog, darkness), or if marine mammals or sea turtles are near, approaching or in the safety radius, the airguns may not be started up. If one airgun is already running at a source level of at least 180 dB, L-DEO may start subsequent guns without observing the entire safety radius for 30 min prior, provided no marine mammals or sea turtles are known to be near the safety radius. In the event a North Atlantic right whale is visually sighted, the airgun array will be shut-down regardless of the distance of the animal(s) to the sound source. The array will not resume firing until 30 min after the last documented whale visual sighting. If concentrations (six or more individuals) of blue, fin, humpback, sei, or sperm whales are observed, then the array will be powered down and the group avoided if possible if they do not appear to be traveling.

E. Use the passive acoustic monitoring system (PAM) to detect marine mammals around the *Langseth* during all airgun operations and during most periods when airguns are not operating. One PSVO and/or bioacoustician will monitor the PAM at all times in shifts of up to six hours. A bioacoustician shall design and set up the PAM system and be present to operate or oversee PAM, and available when technical issues occur during the survey.

F. Record the following when an animal is detected by the PAM:

i. Contact the PSVO immediately (and initiate power or shut-down, if required);

ii. Enter the information regarding the vocalization into a database. The data to be entered include an acoustic encounter identification number, whether it was linked with a visual sighting, date, time when first and last heard and whenever any additional information was recorded, position and water depth when first detected, bearing if determinable, species or species group, types and nature of sounds heard (e.g., clicks, continuous, sporadic, whistles, creaks, burst pulses, strength of signal, etc.), and any other notable information.

G. Apply a "ramp-up" procedure when starting up at the beginning of seismic operations or any time after the entire array has been shut down for more than 8 min, which means start the smallest gun first and add airguns in a sequence such that the source level of the array will increase in steps not exceeding approximately 6 dB per 5-min period. During ramp-up, the PSVOs will monitor the safety radius, and if marine mammals or sea turtles are sighted, a course/speed alteration, power-down, or shut-down will occur as though the full array were operational.

H. Alter speed or course during seismic operations if a marine mammal or sea turtle, based on its position and relative motion, appears likely to enter the safety zone. If speed or course alteration is not safe or practical, or if after alteration the marine mammal or sea turtle still appears likely to enter the safety zone, further mitigation measures, such as power-down or shut-down, will be taken.

I. Shut-down or power-down the airguns upon marine mammal or sea turtle detection within, approaching, or entering the safety radius. A power-down means shutting down one or more airguns and reducing the safety radius to the degree that the animal is outside of it. Following a power-down, if the marine mammal or sea turtle approaches the smaller designated safety radius, the airguns must completely shut down. Airgun activity will not resume until the marine mammal or sea turtle has cleared the safety radius, which means it was visually observed to have left the safety radius, or has not been seen within the radius for 15 min (small odontocetes) or 30 min (sea turtle, mysticetes, and large odontocetes). The array will not resume firing until 30 min after the last documented whale visual sighting. The *Langseth* may operate a small-volume airgun (*i.e*., mitigation airgun) during turns and maintenance at approximately one shot per minute. During turns or brief transits between seismic tracklines, one airgun would continue to operate.

J. To the maximum extent practicable, schedule seismic operations (i.e., shooting airguns) during daylight hours. Marine seismic surveys may continue into night and low-light hours if such segment(s) of the survey is initiated when the entire relevant exclusion zones are visible and can be effectively monitored. No initiation of airgun array operations is permitted from a shut-down position at night or during low-light hours (such as in dense fog or heavy rain) when the entire relevant exclusion zone cannot be effectively monitored by the PSVO(s) on duty.

Reporting Requirements

A. NSF is required to submit a report on all activities and monitoring results to the Office of Protected Resources, NMFS, within 90 days after the expiration of the IHA. NSF shall provide this report to the ESA Interagency Cooperation Division. This report must contain and summarize the following information:

i. Dates, times, locations, heading, speed, weather, and associated activities during all seismic operations.

ii. Species, number, location, distance from the vessel, and behavior of any marine mammals or sea turtles, as well as associated seismic activity (number of power-downs and shutdowns), observed throughout all monitoring activities.

iii. An estimate of the number (by species) of marine mammals or sea turtles that:

a. Are known to have been exposed to the seismic activity (visual observation) at received levels greater than or equal to 160 dB re 1 microPa (rms) (marine mammals), 166 dB re 1 microPa (rms) (sea turtles), and/or 180 dB re 1 microPa (rms) for cetaceans with a discussion of any specific behaviors those individuals exhibited.

b. May have been exposed (modeling results) to the seismic activity at received levels greater than or equal to 160 dB re 1 microPa (rms) (marine mammals), 166 dB re 1 microPa (rms) (sea turtles), and/or 180 dB re 1 microPa (rms) with a discussion of the nature of the probable consequences of that exposure on the individuals that have been exposed.

iv. A description of the implementation and effectiveness of the:

a. Terms and conditions of the Opinion's Incidental Take Statement.

b. Mitigation measures of the IHA. For the Opinion, the report will confirm the implementation of each term and condition and describe the effectiveness, as well as any conservation measures, for minimizing the adverse effects of the action on listed whales and sea turtles.

B. In the unanticipated event that any taking of an ESA-listed marine mammal or sea turtle in a manner not considered in this biological opinion, such as an injury, serious injury or mortality, and is judged to result from these activities, L-DEO will immediately cease operating all authorized sound sources and report the incident to Cathy Tortorici, ESA Interagency Cooperation Division Chief, at Cathy.Tortorici@noaa.gov as well as the NMFS Greater Atlantic Region Marine Mammal Stranding Network at 866-755-6622 (Mendy.Garron@noaa.gov) immediately. L-DEO will postpone the research activities until NMFS is able to review the circumstances of the take. NMFS will work with L-DEO to determine whether modifications in the activities are appropriate and necessary, and notify L-DEO that they may resume the seismic survey operations.

The report must include the following information:

- Time, date, and location (latitude/longitude) of the incident;
- Name and type of vessel involved;
- Vessel's speed during and leading up to the incident;
- Description of the incident;
- Status of all sound sources used in the 24 hours preceding the incident;
- Water depth;
- Environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, and visibility);
- Description of all marine mammal observations in the 24 hours preceding the incident;
- Species identification or description of the animal(s) involved;
- Fate of the animal(s); and

- Photographs or video footage of the animal(s) (if equipment is available).

C. In the unanticipated event that any cases of marine mammal or sea turtle injury or mortality are judged to result from these activities (e.g., ship-strike, gear interaction, and/or entanglement), L-DEO will cease operating seismic airguns and report the incident to Cathy Tortorici ESA Interagency Cooperation Division Chief at Cathy.Tortorici@noaa.gov as well as the NMFS Greater Atlantic Region Marine Mammal Stranding Network at 866-755-6622 (Mendy.Garron@noaa.gov) immediately. Airgun operation will then be postponed until NMFS is able to review the circumstances and work with L-DEO to determine whether modifications in the activities are appropriate and necessary. If the lead observer judged that the injury or mortality is not a result of the authorized activities, operations may continue.

11 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

We recommend the following conservation recommendations, which would provide information for future consultations involving seismic surveys and the issuance of incidental harassment authorizations that may affect endangered large whales as well as endangered or threatened sea turtles and fishes:

1. *Effects of seismic noise on sea turtles.* The NSF should promote and fund research examining the potential effects of seismic surveys on listed sea turtle species.
2. The NSF should develop a more robust propagation model that incorporates environmental variables into estimates of how far sound levels reach from airgun sources.

In order for the ESA Interagency Cooperation Division to be kept informed of actions minimizing or avoiding adverse effects on, or benefiting ESA-listed species or their habitats, NMFS' Permits and Conservation Division should notify the ESA Interagency Cooperation Division of any conservation recommendations they implement in their final action.

12 REINITIATION NOTICE

This concludes formal consultation on the proposed seismic source survey to be funded by the NSF and conducted by the L-DEO on board the *R/V Langseth* in the Atlantic Ocean off the New Jersey coast, and NMFS Permits and Conservation Division's issuance of an incidental harassment authorization for the proposed studies pursuant to section 101(a)(5)(D) of the MMPA. As provided in 50 CFR §402.16, reinitiation of consultation will be required where discretionary Federal involvement or control over the action has been retained or is authorized by law, and: (1) if the amount or extent of incidental take is exceeded; (2) if new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) if the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) if a new species is listed or critical habitat designated that may be affected by the action.

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APPENDIX D
INCIDENTAL HARASSMENT AUTHORIZATION

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

MAY - 7 2015

Sean Higgins
Marine Environmental & Safety Coordinator
Department of Marine Operations
Lamont-Doherty Earth Observatory
P.O. Box 1000
Palisades, New York 10964-8000

Dear Mr. Higgins:

Enclosed is an Incidental Harassment Authorization (IHA) issued to the Lamont-Doherty Earth Observatory, under the authority of Section 101(a)(5)(D) of the Marine Mammal Protection Act (16 U.S.C. 1361 *et seq.*), to harass small numbers of marine mammals, by Level B harassment, incidental to the R/V *Marcus G. Langseth*'s marine seismic survey in the Atlantic Ocean during June through August, 2015.

Lamont-Doherty, the National Science Foundation and Rutgers are required to comply with the conditions contained in the IHA. The taking of any marine mammal in a manner prohibited under this Authorization must be reported immediately to the Office of Protected Resources, National Marine Fisheries Service (NMFS), at 301-427-8401.

In addition, you must submit a report to the NMFS' Office of Protected Resources within 90 days of the completion of the cruise. The IHA requires monitoring of marine mammals by qualified individuals before, during, and after seismic activities and reporting of marine mammal observations, including species, numbers, and behavioral modifications potentially resulting from this activity.

If you have any questions concerning the IHA or its requirements, please contact J, Office of Protected Resources, NMFS, at 301-427-8401.

Sincerely,

Perry Gayaldo

Dr. Perry F. Gayaldo
Deputy Director
Office of Protected Resources

Enclosures

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE

INCIDENTAL HARASSMENT AUTHORIZATION

We hereby authorize the Lamont-Doherty Earth Observatory (Lamont- Doherty) Columbia University, P.O. Box 1000, 61 Route 9W, Palisades, New York 10964–8000, and/or its designees (*i.e.*, the National Science Foundation and Rutgers, the State University of New Jersey, the Holders of the Authorization) under section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA; 16 U.S.C. 1361 *et seq.*) and 50 CFR 216.107, to take marine mammals, by harassment, incidental to a marine geophysical survey conducted by the R/V *Marcus G. Langseth* (*Langseth*) marine geophysical survey in the Atlantic Ocean offshore New Jersey, June through August, 2015.

1. Effective Dates

This Authorization is valid from June 1, 2015 through August 31, 2015.

2. Specified Geographic Region

This Authorization is valid only for specified activities associated with the *Langseth's* seismic operations as specified in Lamont-Doherty's Incidental Harassment Authorization (Authorization) application and environmental analysis in the following specified geographic area:

a. In the Atlantic Ocean bounded by the following coordinates: in the Atlantic Ocean, approximately 25 to 85 km (15.5 to 52.8 mi) off the coast of New Jersey between approximately 39°38.00'N, 73°44.36'W; 39°43.12'N, 73°41.00'W; 39°25.30'N, 73°06.12'W; and 39°20.06'N, 73°10.06'W, as specified in Lamont-Doherty's application and the National Science Foundation's Amended Environmental Assessment.

3. Species Authorized and Level of Take

a. This Authorization limits the incidental taking of marine mammals, by Level B harassment only, to the species listed in Table 1in the area described in Condition 2(a):

   i. During the seismic activities, if the Holder of this Authorization encounters any marine mammal species that are not listed in Condition 3 for authorized taking and are likely to be exposed to sound pressure levels greater than or equal to 160 decibels (dB) re: 1 μPa, then the Holder of the Authorization must alter speed or course or shut-down the airguns to avoid take.

b. This Authorization prohibits the taking by injury (Level A harassment), serious injury, or mortality of any of the species listed in Condition 3 or the taking of any other kind of species of marine mammal. Thus, if this were to occur, it may result in the modification, suspension, or revocation of this Authorization.

c. This Authorization limits the methods authorized for taking by Level B harassment to the following acoustic sources without an amendment to this Authorization:

    i. An airgun array with a total capacity of 700 cubic inches (in^3) (or smaller).

d. Lamont-Doherty will not operate the multi-beam echosounder or the sub-bottom profiler during transit to or from the survey area.

4. Reporting Prohibited Take

The Holder of this Authorization must report the taking of any marine mammal in a manner prohibited under this Authorization immediately to the Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, at 301-427-8401 and/ or by email to Jolie.Harrison@noaa.gov.

5. Cooperation

We require the Holder of this Authorization to cooperate with the Office of Protected Resources, National Marine Fisheries Service, and any other Federal, state or local agency monitoring the impacts of the activity on marine mammals.

6. Mitigation and Monitoring Requirements

We require the Holder of this Authorization to implement the following mitigation and monitoring requirements when conducting the specified activities to achieve the least practicable adverse impact on affected marine mammal species or stocks:

Visual Observers

a. Use two, National Marine Fisheries Service-qualified, vessel-based Protected Species Visual Observers (visual observers) to watch for and monitor marine mammals near the seismic source vessel during daytime airgun operations (from civil twilight- dawn to civil twilight-dusk) and before and during start-ups of airguns day or night.

    i. At least one visual observer will be on watch during meal times and restroom breaks.

    ii. Visual observer shifts will last no longer than four hours at a time.

    iii. Visual observers will also conduct monitoring while the *Langseth* crew deploy and recover the airgun array and streamers from the water.

    iv. When feasible, visual observers will conduct observations during daytime periods when the seismic system is not operating for comparison of sighting rates and behavioral reactions during, between, and after airgun operations.

    v. The *Langseth's* vessel crew will also assist in detecting marine mammals, when practicable.

    vi. Visual observers will have access to reticle binoculars (7×50 Fujinon), and big-eye binoculars (25×150), optical range finders, and night vision devices.

Exclusion Zones

b. Establish a 180-dB and 190-dB exclusion zone before starting the airgun subarray (700 in^3 or smaller); and a 180-dB and 190-dB exclusion zone for the single airgun (40 in^3). Observers will use the predicted radius distance for the 180-dB and 190-dB exclusion zones for mitigation shown in Table 2 (attached).

Visual Monitoring at the Start of Airgun Operations

c. Monitor the entire extent of the exclusion zones for at least 30 minutes (day or night) prior to the ramp-up of airgun operations after a shutdown.

d. Delay airgun operations if the visual observer sees a cetacean within the 180-dB exclusion zone (as defined in Table 2) until the marine mammal(s) has left the area.

   Delay airgun operations if the visual observer sees a pinniped within the 190-dB exclusion zone (as defined in Table 2) until the marine mammal(s) has left the area.

   i. If the visual observer sees a marine mammal that surfaces, then dives below the surface, the observer shall wait 15 minutes for species with shorter dive durations (*i.e.*, small odontocetes or pinnipeds), or 30 minutes for species with longer dive durations (*i.e.*, mysticetes and large odontocetes, including sperm (*Physeter macrocephalus*), pygmy sperm (*Kogia breviceps*), dwarf sperm (*Kogia sima*), killer (*Orcinus orca*), and beaked whales (*Ziphius* and *Mesoplodon spp.*). If the observer sees no marine mammals during that time, he/she should assume that the animal has moved beyond the relevant exclusion zone (as defined in Table 2).

   ii. If, for any reason the visual observer cannot see the full relevant exclusion zone (as defined in Table 2) for the entire 30 minutes (*i.e.*, rough seas, fog, darkness), or if marine mammals are near, approaching, or within zone, the *Langseth* may not resume airgun operations.

   iii. If one airgun is already running at a source level of at least 180 dB re: 1 μPa, the *Langseth* may start the second gun–and subsequent airguns–without observing relevant exclusion zones for 30 minutes, provided that the observers have not seen any marine mammals near the relevant exclusion zones (in accordance with Condition 6(b)).

Passive Acoustic Monitoring

e. Utilize the passive acoustic monitoring (PAM) system, to the maximum extent practicable, to detect and allow some localization of marine mammals around the *Langseth* during all airgun operations and during most periods when airguns are not operating. One visual observer and/or bioacoustician will monitor the PAM at all times in shifts no longer than 6 hours. A bioacoustician shall design and set up the PAM system and be present to operate or oversee PAM, and available when technical issues occur during the survey.

f. Do and record the following when an observer detects an animal by the PAM:

   i. Notify the visual observer immediately of a vocalizing marine mammal so a power-down or shut-down can be initiated, if required;

ii. Enter the information regarding the vocalization into a database. The data to be entered include an acoustic encounter identification number, whether it was linked with a visual sighting, date, time when first and last heard and whenever any additional information was recorded, position, and water depth when first detected, bearing if determinable, species or species group (*e.g.*, unidentified dolphin, sperm whale), types and nature of sounds heard (*e.g.*, clicks, continuous, sporadic, whistles, creaks, burst pulses, strength of signal, etc.), and any other notable information.

Ramp-Up Procedures

g. Implement a ''ramp-up'' procedure when starting the airguns at the beginning of seismic operations or any time after the entire array has shutdown, which means starting the smallest gun first and adding airguns in a sequence such that the source level of the array will increase in steps not exceeding approximately 6 dB per 5-minute period. During ramp-up, the observers will monitor the exclusion zones, and if the observers sight marine mammals, the *Langseth* will implement a course/speed alteration, power-down, or shutdown as though the full array were operational.

Recording Visual Detections

h. Visual observers must record the following information when they detect a marine mammal:

  i. Species, group size, age/size/sexcategories (if determinable), behavior when first sighted and after initial sighting, heading (if consistent), bearing and distance from seismic vessel, sighting cue, apparent reaction to the airguns or vessel (*e.g.*, none, avoidance, approach, paralleling, etc., and including responses to ramp-up), and behavioral pace; and

  ii. Time, location, heading, speed, activity of the vessel (including number of airguns operating and whether in state of ramp-up or shut-down), Beaufort sea state and wind force, visibility, cloud cover, and sun glare; and

  iii. The data listed under 6(h)(ii) at the start and end of each observation watch and during a watch whenever there is a change in one or more of the variables.

Speed or Course Alteration

i. Alter speed or course during seismic operations if a marine mammal, based on its position and relative motion, appears likely to enter the relevant exclusion zone. If speed or course alteration is not safe or practicable, or if after alteration the marine mammal still appears likely to enter the relevant exclusion zone, Lamont-Doherty will implement further mitigation measures, such as a power-down or shutdown.

Power-Down Procedures

j. Power down the airguns if a visual observer detects a marine mammal within, approaching, or entering the relevant exclusion zone (as defined in Table 2). A power-down means reducing the number of operating airguns to a single operating 40 in^3 airgun. This would reduce the relevant exclusion zone to the degree that the animal(s) is/are outside of that zone. When appropriate or possible, power-down of the airgun array shall also occur when the vessel is moving from the end of one trackline to the start of the next trackline.

Resuming Airgun Operations after a Power-Down

k. Following a power-down, if the marine mammal approaches the smaller exclusion zone (as defined in Table 2), then the *Langseth* must completely shut down the airguns. Airgun activity will not resume until the observer has visually observed the marine mammal(s) exiting the exclusion zone and is not likely to return, or the observer has not seen the animal within the relevant exclusion zone for 15 minutes for species with shorter dive durations (*i.e.*, small odontocetes) or 30 minutes for species with longer dive durations (*i.e.*, mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, killer, and beaked whales.

l. Following a power-down and subsequent animal departure, the *Langseth* may resume airgun operations at full power. Initiation requires that the observers can effectively monitor the full exclusion zones described in Condition 6(b). If the observer sees a marine mammal within or about to enter the relevant zones then the *Langseth* will implement a course/speed alteration, power-down, or shutdown.

Shutdown Procedures

m. Shutdown the airgun(s) if a visual observer detects a marine mammal within, approaching, or entering the relevant exclusion zone (as defined in Table 2). A shutdown means that the *Langseth* turns off all operating airguns.

n. If an observer visually detects a North Atlantic right whale (*Eubalaena glacialis*), the *Langseth* will shut-down the airgun array regardless of the distance of the animal(s) to the sound source. The array will not resume firing until 30 minutes after the last documented North Atlantic right whale visual sighting.

Resuming Airgun Operations after a Shutdown

o. Following a shutdown, if the observer has visually confirmed that the animal has departed the relevant exclusion zone within a period of less than or equal to 8 minutes after the shutdown, then the *Langseth* may resume airgun operations at full power.

p. Else, if the observer has not seen the animal depart the relevant exclusion zone (with buffer), the *Langseth* shall not resume airgun activity until 15 minutes has passed for species with shorter dive times (*i.e.*, small odontocetes and pinnipeds) or 30 minutes has passed for species with longer dive durations (*i.e.*, mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, killer, and beaked whales). The *Langseth* will follow the ramp-up procedures described in Conditions 6(g).

Survey Operations

q. The *Langseth* may continue marine geophysical surveys into night and low-light hours if the Holder of the Authorization initiates these segment(s) of the survey when the observers can view and effectively monitor the full relevant exclusion zones.

r. This Authorization does not permit the Holder of this Authorization to initiate airgun array operations from a shut-down position at night or during low-light hours (such as in dense fog or heavy rain) when the visual observers cannot view and effectively monitor the full relevant exclusion zones.

s. To the maximum extent practicable, the Holder of this Authorization should schedule seismic operations (*i.e.*, shooting the airguns) during daylight hours.

Mitigation Airgun

t. The *Langseth* may operate a small-volume airgun (*i.e.*, mitigation airgun) during turns and maintenance at approximately one shot per minute. During turns or brief transits between seismic tracklines, one airgun would continue to operate. The *Langseth* would not operate the small-volume airgun for longer than three hours in duration during turns.

Special Procedures for Large Whale Concentrations

u. The *Langseth* will avoid concentrations of humpback (*Megaptera novaeangliae*), sei (*Balaenoptera borealis*), fin (*Balaenoptera physalus*), blue (*Balaenoptera musculus*), minke (*Balaenoptera acutorostrata*) and/or sperm whales (*Physeter macrocephalus*) if possible (*i.e.*, exposing concentrations of animals to 160 dB re: 1 µPa), and powered-down the array. For purposes of the survey, a concentration or group of whales will consist of six or more individuals visually sighted that do not appear to be traveling (*e.g.*, feeding, socializing, etc.). The *Langseth* will follow the procedures described in Conditions 6(k) for resuming operations after a power down.

7. Reporting Requirements

This Authorization requires the Holder of this Authorization to:

a. Submit a draft report on all activities and monitoring results to the Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, within 90 days of the completion of the *Langseth's* cruise. This report must contain and summarize the following information:

   i. Dates, times, locations, heading, speed, weather, sea conditions (including Beaufort sea state and wind force), and associated activities during all seismic operations and marine mammal sightings.

   ii. Species, number, location, distance from the vessel, and behavior of any marine mammals, as well as associated seismic activity (number of shutdowns), observed throughout all monitoring activities.

   iii. An estimate of the number (by species) of marine mammals with known exposures to the seismic activity (based on visual observation) at received levels greater than or equal to 160 dB re: 1 µPa and/or 180 dB or 190-dB re: 1 µPa for cetaceans and pinnipeds, respectively and a discussion of any specific behaviors those individuals exhibited.

   iv. An estimate of the number (by species) of marine mammals with estimated exposures (based on modeling results) to the seismic activity at received levels greater than or equal to 160 dB re: 1 µPa and/or 180 dB or 190-dB re: 1 µPa with a discussion of the nature of the probable consequences of that exposure on the individuals.

   v. A description of the implementation and effectiveness of the: (A) Terms and Conditions of the Biological Opinion's Incidental Take Statement; and (B) mitigation measures of the Incidental Harassment Authorization. For the Biological Opinion, the report will confirm the implementation of each Term and Condition, as well as any conservation recommendations, and describe their effectiveness, for minimizing the adverse effects of the action on Endangered Species Act listed marine mammals.

b. Submit a final report to the Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, within 30 days after receiving comments from us on the draft report. If we decide that the draft report needs no comments, we will consider the draft report to be the final report.

8. Reporting Prohibited Take

In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner not permitted by the Authorization, such as an injury, serious injury, or mortality (*e.g.*, ship-strike, gear interaction, and/or entanglement), Lamont-Doherty shall immediately cease the specified activities and immediately report the take to the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to Jolie.Harrison@noaa.gov.

Lamont-Doherty must also contact the NMFS Greater Atlantic Region Marine Mammal Stranding Network at 866-755-6622 (Mendy.Garron@noaa.gov).

The report must include the following information:

- Time, date, and location (latitude/longitude) of the incident;
- Name and type of vessel involved;
- Vessel's speed during and leading up to the incident;
- Description of the incident;
- Status of all sound sources used in the 24 hours preceding the incident;
- Water depth;
- Environmental conditions (*e.g.*, wind speed and direction, Beaufort sea state, cloud cover, and visibility);
- Description of all marine mammal observations in the 24 hours preceding the incident;
- Species identification or description of the animal(s) involved;
- Fate of the animal(s); and
- Photographs or video footage of the animal(s) (if equipment is available).

Lamont-Doherty shall not resume its activities until we are able to review the circumstances of the prohibited take. We shall work with Lamont-Doherty to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. Lamont-Doherty may not resume their activities until notified by us via letter, email, or telephone.

9. Reporting an Injured or Dead Marine Mammal with an Unknown Cause of Death

In the event that Lamont-Doherty discovers an injured or dead marine mammal, and the lead visual observer determines that the cause of the injury or death is unknown and the death is relatively recent (*i.e.*, in less than a moderate state of decomposition as we describe in the next section), Lamont-Doherty will immediately report the incident to the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to Jolie.Harrison@noaa.gov.

Lamont-Doherty must also contact the NMFS Greater Atlantic Region Marine Mammal Stranding Network at 866-755-6622 (Mendy.Garron@noaa.gov).

The report must include the same information identified in Condition 8. Activities may continue while we review the circumstances of the incident. We would work with Lamont-Doherty to determine whether modifications in the activities are appropriate.

10. Reporting an Injured or Dead Marine Mammal Unrelated to the Activities

In the event that Lamont-Doherty discovers an injured or dead marine mammal, and the lead visual observer determines that the injury or death is not associated with or related to the authorized activities (*e.g.*, previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), Lamont-Doherty would report the incident to the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to Jolie.Harrison@noaa.gov.

Lamont-Doherty must also contact the NMFS Greater Atlantic Region Marine Mammal Stranding Network at 866-755-6622 (Mendy.Garron@noaa.gov).

Lamont-Doherty would provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS.

11. Endangered Species Act Biological Opinion and Incidental Take Statement

Lamont-Doherty must comply with the Terms and Conditions of the Incidental Take Statement corresponding to the Endangered Species Act Biological Opinion issued to the National Science Foundation and NMFS' Office of Protected Resources, Permits and Conservation Division.

A copy of this Authorization and the Incidental Take Statement must be in the possession of all contractors and protected species observers operating under the authority of this Incidental Harassment Authorization.

Perry Gayaldo — MAY - 7 2015

for Donna S. Wieting, Director, Office of Protected Resources, National Marine Fisheries Service — Date

Table 1 – Authorized Level B harassment take numbers for each marine mammal species during Lamont-Doherty's marine seismic survey in the Atlantic Ocean, June 1, 2015 through August 31, 2015.

ESA Listed Species	Authorized Level B Take
North Atlantic right whale	3
Humpback whale	3
Sei whale	5
Fin whale	3
Blue whale	1
Sperm whale	31
Non-Listed Species	**Authorized Level B Take**
Minke whale	2
Dwarf sperm whale	2
Pygmy sperm whale	2
Cuvier's beaked whale	27
Gervais' beaked whale	27
Sowerby's beaked whale	27
True's beaked whale	27
Blainville's beaked whale	27
Bottlenose dolphin	12,532
Pantropical spotted dolphin	6
Atlantic spotted dolphin	4,067
Striped dolphin	52
Short-beaked common dolphin	36
White-beaked dolphin	16
Atlantic white-sided dolphin	53
Risso's dolphin	1,532
Clymene dolphin	27
Pygmy killer whale	2
False killer whale	7
Killer whale	7
Long-finned pilot whale	21
Short-finned pilot whale	21
Harbor porpoise	4
Gray seal	2
Harbor seal	2
Harp seal	2

Table 2 –Exclusion Zones

Source and Volume (in^3)	Tow Depth (m)	Water Depth (m)	Predicted RMS Distances (m)[1]		
			190 dB	180 dB	160 dB
Single Bolt airgun (40 in^3)	6	< 100	21	73	995
4-Airgun subarray (700 in^3)	4.5	<100	101	378	5,240
4-Airgun subarray (700 in^3)	6	<100	118	439	6,100

APPENDIX E

NMFS ENVIRONMENTAL ASSESSMENT AND FONSI

PROPOSED ACTION: Proposed Issuance of an Incidental Harassment Authorization to Lamont-Doherty Earth Observatory to Take Marine Mammals by Harassment Incidental to a Marine Geophysical Survey in the Northwest Atlantic Ocean, June – August, 2015.

TYPE OF STATEMENT: Environmental Assessment

LEAD AGENCY: U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

RESPONSIBLE OFFICIAL: Donna S. Wieting, Director
Office of Protected Resources,
National Marine Fisheries Service

FOR FURTHER INFORMATION: Jeannine Cody
National Marine Fisheries Service
Office of Protected Resources
Permits and Conservation Division
1315 East West Highway
Silver Spring, MD 20910
301-427-8401

LOCATION: The Northwest Atlantic Ocean, approximately 25 to 85 kilometers (15.5 to 52.8 miles) off the coast of New Jersey.

ABSTRACT: This Environmental Assessment analyzes the environmental impacts of the National Marine Fisheries Service, Office of Protected Resources proposal to issue an Incidental Harassment Authorization to Lamont-Doherty Earth Observatory, for the taking, by Level B harassment, of marine mammals, incidental to a marine geophysical survey in the Atlantic Ocean, June - August, 2015.

DATE: May 2015

CONTENTS

LIST OF ABBREVIATIONS OR ACRONYMS

ACRC	U.S. Navy's Atlantic City Range Complex
Authorization	Incidental Harassment Authorization
CFR	Code of Federal Regulations
Commission	Marine Mammal Commission
CZMA	Coastal Zone Management Act (16 U.S.C. §§ 1451 *et seq*.)
dB	decibel
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ESA	Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq*.)
EZ	exclusion zone
FONSI	Finding of No Significant Impact
FR	*Federal Register*
ft	feet
Hz	hertz
IHA	Incidental Harassment Authorization
ITA	Incidental Take Authorization
ITS	Incidental Take Statement
kHz	kilohertz
km	kilometer
km^2	square kilometer
m	meter
mi	mile
mi^2	square mile
MMPA	Marine Mammal Protection Act of 1972, as amended (16 U.S.C. 1631 *et seq*.)
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
µPa	micropascal
NAO	NOAA Administrative Order
NEPA	National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq*.)
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
NSF	National Science Foundation
OMB	Office of Management and Budget
Opinion	Biological Opinion
UME	Unusual Mortality Event
USFWS	U.S. Fish and Wildlife Service

CHAPTER 1 – INTRODUCTION AND PURPOSE AND NEED

1.1 DESCRIPTION OF PROPOSED ACTION

The Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. 1631 *et seq*.) generally prohibits the incidental taking of marine mammals. The MMPA defines take as "…to harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill any marine mammal..."; and further defines harassment as any act of pursuit, torment, or annoyance which: (1) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (2) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment).

There are exceptions, however, to the MMPA's prohibition on take. The National Marine Fisheries Service, Office of Protected Resources (NMFS, hereinafter, we) may authorize the incidental but not intentional taking of marine mammals by harassment upon the request of a U.S. citizen provided NMFS follows certain statutory and regulatory procedures and make determinations. We discuss this exception in more detail in section 1.2.

Lamont-Doherty Earth Observatory of Columbia University (Lamont-Doherty) has requested an Incidental Harassment Authorization (Authorization) to take marine mammals, by harassment incidental to conducting a marine geophysical (seismic) survey in the Atlantic Ocean off the coast of New Jersey. In response to Lamont-Doherty's request, NMFS proposes to issue an Incidental Harassment Authorization (Authorization) to Lamont-Doherty under Section 101(a)(5)(D) of the MMPA, which would allow Lamont-Doherty to take marine mammals, incidental to the conduct of a marine geophysical (seismic) survey in federal waters in the northwest Atlantic Ocean approximately 25 to 85 kilometers (km) (15.5 to 52.8 miles [mi]) offshore New Jersey, June through August, 2015. NMFS does not have the authority to permit, authorize, or prohibit Lamont-Doherty's research seismic activities under Section 101(a)(5)(D) of the MMPA, as that authority lies with the National Science Foundation (NSF).

NMFS' proposed issuance of an Authorization to Lamont-Doherty is a major federal action under the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq*.), the Council on Environmental Quality (CEQ) regulations in 40 CFR §§ 1500-1508, and NOAA Administrative Order (NAO) 216-6. Thus, NMFS is required to analyze the effects of our proposed action on the human environment.

This Environmental Assessment (EA) addresses the potential environmental impacts of the following choices available to us under section 101(a)(5)(D) of the MMPA, namely:

- Issue the proposed Authorization[1] to Lamont-Doherty for take, by Level B harassment, of marine mammals during the seismic survey, taking into account the prescribed means of take, mitigation measures, and monitoring requirements;
- Do not issue the proposed Authorization to Lamont-Doherty, in which case, the survey activities would not proceed[2];

[1] NMFS may issue an Authorization region if, after NMFS provides a notice of a proposed authorization to the public for review and comment: (1) NMFS makes certain findings; and (2) the taking is limited to harassment.
[2] NMFS would not issue an Authorization if it cannot make certain findings.

- Issue the proposed Authorization to Lamont-Doherty for take, by Level B harassment, of marine mammals during the seismic survey by incorporating additional required mitigation measures in addition to Lamont-Doherty's or our proposed mitigation and monitoring measures; or
- Do not issue the proposed Authorization to Lamont-Doherty, in which case, NMFS assumes that the survey activities would proceed and cause incidental take without the mitigation and monitoring measures prescribed in the Authorization[3].

1.1.1 Background on Lamont-Doherty's MMPA Application

Lamont-Doherty proposes to use the R/V *Marcus G. Langseth* (*Langseth*) to track the geologic record of sea-level changes from the time of the last Ice Age to as far back as 60 million years ago and understand how these changes have caused the New Jersey coastline to advance and retreat. The three-dimensional (3-D) seismic reflection survey would make acoustic images of sediment layers below the seafloor using seismic airguns the sound source to investigate the sediments beneath the Jersey coast, which contain a long record of shoreline response to the earth's natural cycles.

NSF, which owns and operates the *Langseth* under a cooperative agreement with Lamont-Doherty, supports basic scientific research in the mathematical, physical, medical, biological, social, and other sciences pursuant to the National Science Foundation Act of 1950, as amended (NSF Act; 42 U.S.C. 1861-75). NSF considers proposals submitted by organizations and makes contracts and/or other arrangements (*i.e.*, grants, loans, and other forms of assistance) to support research activities. A Foundation-expert panel recommended a research proposal titled, *Collaborative Research: Community-Based 3D Imaging That Ties Clinoform Geometry to Facies Successions and Neogene Sea-Level Change* (NSF Award #1260237) for funding and ship time on the *Langseth*. As the federal action agency for this award, NSF has funded the proposed seismic survey in the Atlantic Ocean, June through August, 2015 as a part of the NSF Act of 1950.

Acoustic stimuli generated by the seismic airgun array have the potential to cause behavioral disturbances to marine mammals in the proposed project area. We describe the NSF-supported seismic survey in more detail in section 2.2.

1.1.2 Marine Mammals in the Action Area

There are 37 marine mammal species with confirmed or potential occurrence off the coast of New Jersey, Tables 1(a), 1(b), and 1(c) in this section. Of the 37 species listed in these tables, 32 species would most likely to be harassed incidental to conducting the seismic survey (See Table 6, Section 3.2.1 Affected Environment, Marine Mammals).

[3] NSF's draft amended EA (NSF, 2014a) states that Lamont-Doherty would not conduct the proposed survey without an Authorization under the MMPA. NMFS presents this alternative for the purposes of NEPA analyses only to show the effect of an MMPA Authorization's requirements,

Table 1(a) – Mysticetes with possible/confirmed occurrence in the proposed activity area.

Mysticetes		
1	North Atlantic right whale*	*Eubalaena glacialis*
2	Humpback whale*	*Megaptera novaeangliae*
3	Common minke whale	*Balaenoptera acutorostrata*
4	Sei whale*	*Balaenoptera borealis*
5	Fin whale*	*Balaenoptera physalus*
6	Blue whale*	*Balaenoptera musculus*

Table 1(b) – Odontocetes with possible/confirmed occurrence in the proposed activity area.

Odontocetes		
1	Sperm whale*	*Physeter macrocephalus*
2	Dwarf sperm whale	*Kogia sima*
3	Pygmy sperm whale	*K. breviceps*
4	Blainville's beaked whale	*Mesoplodon densirostris*
5	Cuvier's beaked whale	*Ziphius cavirostris*
6	Gervais' beaked whale	*M. europaeus*
7	Sowerby's beaked whale	*M. bidens*
8	True's beaked whale	*M. mirus*
9	Northern bottlenose whale	*Hyperoodon ampullatus*
10	Rough-toothed dolphin	*Steno bredanensis*
11	Bottlenose dolphin	*Tursiops truncatus*
12	Pantropical spotted dolphin	*Stenella attenuate*
13	Atlantic spotted dolphin	*S. frontalis*
14	Spinner dolphin	*S. longirostris*
15	Striped dolphin	*S. coeruleoalba*
16	Short-beaked common dolphin	*Delphinus delphis*
17	White-beaked dolphin	*Lagenorhynchus albirostris*
18	Atlantic white-sided-dolphin	*L. acutus*
19	Risso's dolphin	*Grampus griseus*
20	Clymene dolphin	*Stenella clymene*
21	Fraser's dolphin	*Lagenodelphis hosei*
22	Melon-headed whale	*Peponocephala electra*
23	False killer whale	*Pseudorca crassidens*
24	Pygmy killer whale	*Feresa attenuate*
25	Killer whale	*Orcinus orca*
26	Long-finned pilot whale	*Globicephala melas*
27	Short-finned pilot whale	*G. macrorhynchus*
28	Harbor porpoise	*Phocoena phocoena*

Table 1(c) – Pinnipeds with possible/confirmed occurrence in the proposed activity area.

Pinnipeds		
1	Gray seal	*Halichoerus grypus*
2	Harbor seal	*Phoca vitulina*
3	Harp seal	*Pagophilus groenlandicus*

* Listed as threatened or endangered under the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq*.).

1.1.3 Species Not Considered Due to Rarity in the Action Area

NMFS does not consider the following species in this EA because their range does not overlap with the proposed survey area or the species are so rarely present in the proposed survey area (LGL, 2014; NSF, 2014c). Therefore, take is unlikely for the species shown in Table 2.

Table 2 – Species with rare occurrence in the proposed activity area.

Species Not Considered Further in this EA		
1	Beluga whale	*Delphinapterus leucas*
2	Hooded seal	*Cystophora cristata*
3	Bryde's whale	*Balaenoptera brydei*
4	West Indian manatee[1]	*Trichechus manatus*

[1] This species is under the jurisdiction of the U.S. Fish and Wildlife Service.

1.2 Purpose and Need

The MMPA prohibits "takes" of marine mammals with only a few specific exceptions. The applicable exception in this case is an authorization for incidental take of marine mammals in section 101(a)(5)(D) of the MMPA.

Section 101(a)(5)(D) of the MMPA directs the Secretary of Commerce (Secretary) to authorize, upon request, the incidental, but not intentional, taking of small numbers of marine mammals of a species or population stock, by United States citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if, after NMFS provides a notice of a proposed authorization to the public for review and comment: (1) NMFS makes certain findings; and (2) the taking is limited to harassment.

We have issued regulations to implement the Incidental Take Authorization provisions of the MMPA (50 CFR § 216) and have produced Office of Management and Budget (OMB)-approved application instructions (OMB Number 0648-0151) that prescribe the procedures necessary to apply for authorizations. All applicants must comply with the regulations at 50 CFR § 216.104 and submit applications requesting incidental take according to the provisions of the MMPA.

Purpose: The primary purpose of NMFS' proposed action is to authorize the take of marine mammals incidental to Lamont-Doherty's proposed seismic survey. The Authorization would exempt Lamont-Doherty from the take prohibitions contained in the MMPA.

To authorize the take of marine mammals incidental to a specified activity under the MMPA, NMFS must evaluate the best available information to determine whether the take would have a negligible impact on marine mammal species or stock and have an unmitigable impact on the availability of affected marine mammal species for certain subsistence uses.

In addition, NMFS must prescribe, where applicable, the permissible methods of taking and other means of effecting the least practicable adverse impact on the species or stocks of marine mammals and their habitat (*i.e.*, mitigation), paying particular attention to rookeries, mating grounds, and other areas of similar significance.

If appropriate and where relevant, NMFS must also prescribe the means of effecting the least practicable impact on the availability of the species or stocks of marine mammals for subsistence uses. Authorizations must also include requirements or conditions pertaining to the monitoring and reporting of such taking.

Need: On December 29, 2014, Lamont-Doherty submitted an adequate and complete application demonstrating both the need and potential eligibility for issuance of an Authorization in connection with the activities described in section 1.1.1. NMFS now has a corresponding duty to determine whether and how we can authorize take by Level B harassment incidental to the activities described in Lamont-Doherty's application (LGL, 2014) and NSF's draft amended EA titled, *Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Atlantic Ocean off New Jersey, Summer 2015 (NSF, 2014a).* NMFS' responsibilities under section 101(a)(5)(D) of the MMPA and its implementing regulations establish and frame the need for this proposed action.

Any alternatives considered under NEPA must meet the agency's statutory and regulatory requirements. NMFS' described purpose and need guide us in developing reasonable alternatives for consideration, including alternative means of mitigating potential adverse effects.

1.3 The Environmental Review Process

NEPA compliance is necessary for all "major" federal actions with the potential to significantly affect the quality of the human environment. Major federal actions include activities fully or partially funded, regulated, conducted, authorized, or approved by a federal agency. Because our issuance of an Authorization would allow for the taking of marine mammals consistent with provisions under the MMPA, NMFS considers this as a major federal action subject to NEPA.

Under the requirements of NAO 216-6 section 6.03(f)(2)(b) for incidental harassment authorizations, NMFS prepared this EA to determine whether the direct, indirect and cumulative impacts related to the proposed issuance of an Authorization for incidental take of marine mammals during the conduct of Lamont-Doherty's seismic survey activities could be significant. If NMFS deems the potential impacts to be not significant, this analysis, in combination with other analyses incorporated by reference, may support the issuance of a Finding of No Significant Impact (FONSI) for the proposed Authorization.

1.3.1 Laws, Regulations, or Other NEPA Analyses Influencing the EA's Scope

NMFS has based the scope of the proposed action and nature of the four alternatives considered in this EA on the relevant requirements in section 101(a)(5)(D) of the MMPA and our related purpose and need. Thus, our authority under the MMPA bounds the scope of our alternatives. This analysis–combined with the analyses in the following documents–fully describes the potential impacts associated with the proposed seismic survey program, including any required mitigation and monitoring measures for marine mammals.

After conducting a review of the information and analyses for sufficiency and adequacy, NMFS incorporates by reference the relevant analyses on Lamont-Doherty's proposed action as well as a discussion of the affected environment and environmental consequences within the following documents per 40 CFR 1502.21 and NAO 216-6 § 5.09(d):

- NMFS' notice of the proposed Authorization in the *Federal Register* (80 FR 13961, March 17, 2015);

- *Request for an Incidental Harassment Authorization to Allow the Incidental Take of Marine Mammals during a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Atlantic Ocean off New Jersey, Summer, 2015* (LGL, 2014);
- *Final Environmental Assessment of a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Atlantic Ocean off New Jersey, June–July 2014* (NSF, 2014c);
- *Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Atlantic Ocean off New Jersey, Summer 2015* (NSF, 2014a);
- *Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey* (NSF, 2011); and
- *Record of Decision for Marine Seismic Research Funded by the National Science Foundation. June, 2012* (NSF, 2012).

MMPA Application and Notice of the Proposed IHA

The CEQ regulations (40 CFR § 1502.25) encourage federal agencies to integrate NEPA's environmental review process with other environmental review laws. NMFS relies substantially on the public process for developing proposed Authorizations and evaluating relevant environmental information and provide a meaningful opportunity for public participation as we develop corresponding EAs. We fully consider public comments received in response to our publication of the notice of proposed Authorization during the corresponding NEPA review process.

On March 17, 2015, NMFS published a notice of a proposed Authorization in the *Federal Register* (80 FR 13961, March 17, 2015) which included the following:

- A detailed description of the proposed action and an assessment of the potential impacts on marine mammals and their habitat;
- Proposed mitigation and monitoring measures to avoid and minimize potential adverse impacts to affected marine mammal species or stocks and their habitat and proposed reporting requirements; and
- Our preliminary findings under the MMPA.

NMFS considered Lamont-Doherty's proposed seismic survey and associated mitigation and monitoring measures and preliminarily determined that the proposed 3-D seismic survey in the Atlantic Ocean, from June through August 2015, would have a negligible impact on the affected species or stocks of marine mammals, resulting at worst in a modification in behavior and/or low-level physiological effects (Level B harassment). In addition, NMFS preliminarily determined that the activity would not have an unmitigable adverse impact on the availability of marine mammals for subsistence uses. The notice afforded the public a 30-day comment period on our proposed MMPA Authorization, including the proposed mitigation, monitoring, and reporting requirements.

1.3.2 Scope of Environmental Analysis

Given the limited scope of the decision for which NMFS is responsible, this EA intends to provide more focused information on the primary issues and impacts of environmental concern related specifically to the proposed issuance of the Authorization. This EA does not further evaluate effects to the elements of the human environment listed in Table 3 because previous environmental reviews for Lamont-Doherty's seismic survey, incorporated by reference (NSF, 2011, 2014a, 2014c), have evaluated the effects of these activities on other elements of the human environment.

NSF's draft amended EA for this activity (NSF, 2014a) which tiers off of a final EA for this activity (NSF, 2014c); their *Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey* (hereafter refered as the PEIS, NSF, 2011); and Record of Decision (NSF, 2012) concluded that the impact of the action:

- would have minor and transitory effects on the marine environment or marine resources;
- would not significantly impact marine invertebrate populations, recreational and commercial fisheries, seabirds, and associated Essential Fish Habitat;
- would not significantly impact archaeological and traditional cultural resources; and
- would not significantly impact recreational dive sites and shipwrecks.

Table 3 – Components of the human environment not affected by our issuance of an Authorization.

Biological	Physical	Socioeconomic / Cultural
Amphibians	Air Quality	Commercial Fishing
Humans	Essential Fish Habitat	Military Activities
Non-Indigenous Species	Geography	Oil and Gas Activities
Seabirds	Land Use	Recreational Fishing
	Oceanography	Shipping and Boating
	State Marine Protected Areas	Recreational Diving
	Federal Marine Protected Areas	National Historic Preservation Sites
	National Estuarine Research Reserves	National Trails and Nationwide Inventory of Rivers
	National Marine Sanctuaries	Low Income Populations
	Park Land	Minority Populations
	Prime Farmlands	Indigenous Cultural Resources
	Wetlands	Public Health and Safety
	Wild and Scenic Rivers	Historic and Cultural Resources
	Ecologically Critical Areas	

In addition, previous environmental reviews for similar Authorizations for seismic survey activities in the Atlantic Ocean, incorporated by reference, have shown that NMFS' action would not affect those components of the human environment listed in Table 3. They include:

- *Environmental Assessment for the Issuance of an Incidental Harassment Authorization to Lamont-Doherty Earth Observatory to Take Marine Mammals by Harassment Incidental to a Marine Geophysical Survey in the Atlantic Ocean, April - June, 2013* (NMFS, 2013a);
- *Environmental Assessment: Issuance of an Incidental Harassment Authorization to Lamont-Doherty Earth Observatory to Take Marine Mammals by Harassment Incidental to a Marine Geophysical Survey in the Northeast Atlantic Ocean, June to July 2013* (NMFS, 2013b); and

- *Environmental Assessment on the Issuance of an Incidental Harassment Authorization to Lamont Doherty Earth Observatory to Take Marine Mammals by Harassment Incidental to a Marine Geophysical Survey in the Northwest Atlantic Ocean, June – August, 2014* (NMFS, 2014b).

In each case, NMFS concluded that the proposed issuance of an Authorization for each seismic survey would not significantly affect the quality of the human environment and issued findings of no significant impact (FONSI).

1.3.3 NEPA Public Scoping Summary

NAO 216-6 established agency procedures for complying with NEPA and the implementing NEPA regulations issued by the CEQ. Consistent with the intent of NEPA and the clear direction in NAO 216-6 to involve the public in NEPA decision-making, NMFS requested comments on the potential environmental impacts described in Lamont-Doherty's MMPA application and in the *Federal Register* notice of the proposed Authorization (80 FR 13961, March 17, 2015). The CEQ regulations further encourage agencies to integrate the NEPA review process with review under the environmental statutes. Consistent with agency practice NMFS integrated our NEPA review and preparation of this EA with the public process required by the MMPA for the proposed issuance of an Authorization.

The *Federal Register* notice of the proposed Authorization, combined with our preliminary determinations, supporting analyses, and corresponding public comment periods are instrumental in providing the public with information on relevant environmental issues and offering the public a meaningful opportunity to provide comments to us for consideration in both the MMPA and NEPA decision-making processes.

The *Federal Register* notice of the proposed Authorization summarized NMFS' proposed action and any potential impacts to marine mammals and their habitat, and included a statement that we would evaluate NSF's draft amended EA (NSF, 2014a) and determine whether or not to adopt it or prepare a separate NEPA analysis and incorporate relevant portions of NSF's draft amended EA by reference. NMFS invited interested parties to submit written comments concerning the application and our preliminary analyses and findings including those relevant to consideration in the draft EA. The public comment period for the notice of the proposed Authorization began on March 17, 2015 and ended on April 16, 2015. The NSF will finalize their amended EA at the conclusion of environmental reviews conducted under various statutes, including the MMPA and ESA.

We posted Lamont-Doherty's application on our website concurrently with the release of the *Federal Register* notice of the proposed Authorization. We base this EA on the information included in our *Federal Register* notice, the documents it references, and the public comments provided in response. At the conclusion of this process, we will post the final EA, and, if appropriate, FONSI, on the same website.

1.3.4 RELEVANT COMMENTS ON OUR *FEDERAL REGISTER* NOTICE

During the 30-day public comment period on the notice of the proposed Authorization, we received comment letters from the following:

Table 4a – Members of the U.S. Congress who submitted comments on our proposed action.

Congressional	
Representative Tom MacArthur	Senator Cory Booker

Table 4b – Federal or state agencies who submitted comments on our proposed action.

Federal / State Agencies	
U.S. Marine Mammal Commission	NJ Department of Environmental Protection

Table 4c – Organizations and individuals who submitted comments on our proposed action.

Organizations and Private Citizens	
Anonymous (1)	Kathleen Maher
Dr. Nathan Bangs	Edward G. Mitchell
Tracy Basile	Marcus Langseth Science Oversight Committee
John Bell	NJ Marine Fisheries Council
Dr. Jonathan R. Childs	New York Whale and Dolphin Action League
Clean Ocean Action	Dr. Terry L. Pavlis
Dr. Ronald Clowes	Dr. Mary Jo Richardson
Dr. Sean Gulick	Sally Shore
Dr. Wilford D. Gardner	SandyHook SeaLife Foundation
Dr. Marsha Green	Dr. Dale Sawyer
Joan Fitzsimmons	Dr. David Scholl
Amy Harlib	Denise Sprague
Charles and Kathleen Hansen	Imogen Taylor
Dr. Lincoln S. Hollister	Donald Widmyer
James H. Knapp	Mary C. Wilding
Dr. Mitch Lyle	

The substantive public comments related to the potential environmental impacts associated with NMFS' action of issuing an Authorization for Lamont-Doherty's action include:

- Re-evaluating our preliminary determinations for impacts on marine mammals;
- Providing justification that our determination that Level A harassment would not occur during the conduct of the seismic survey is based on the best available science;
- Considering and incorporating the latest information on species present in the area;
- Consideration of additional mitigation measures such as establishing larger exclusion zones; lowering the acoustic thresholds for take estimates; suspending activities at night; conducting the survey at an alternative time; and using additional methods to detect marine mammals;
- Ensuring consideration of cumulative effects of other anthropogenic sound producing activities in the action area, including future seismic exploration activities and the use of active acoustic sources; and
- Evaluating the impacts to North Atlantic right whales and bottlenose dolphins.

The Marine Mammal Commission (Commission) provides comments on all proposed incidental take authorizations as part of their established role under the MMPA (§ 202 (a)(2)). The Commission submitted the following recommendations:

- Require Lamont-Doherty to take in-situ measurements at the survey location to verify, refine, and if needed, recalculate exclusion zone estimates;
- Require Lamont-Doherty to revise their take estimates; and
- Consult with the NSF and Lamont-Doherty to develop, validate, and implement a monitoring program that provides a scientifically sound, reasonably accurate assessment of the types of marine mammal takes and the actual numbers of marine mammals taken.

NMFS fully considered all of the public comments, including any pertinent and substantive information, as part of our MMPA and NEPA decision-making process and crafted our final Authorization and this EA accordingly. We have also provided responses to the public comments in the *Federal Register* notice announcing our issuance of the Authorization.

Where appropriate, we have modified the proposed Authorization based on public comments. Modifications include:

- Revising the take estimates in response to the Commission's comments to account for enumerating takes within a small area over the entire duration of the survey.
- NMFS reviewed the preliminary analysis of in-situ source data collected in 2014 at the same survey site (Crone, 2015) to confirm the accuracy of Lamont-Doherty's modeled exclusion zones. The preliminary data demonstrated that the mitigation radii proposed for use in the survey were conservative and precautionary..

1.4 Other Permits, Licenses, or Consultation Requirements

This section summarizes federal, state, and local permits, licenses, approvals, and consultation requirements necessary to implement the proposed action. NMFS incorporates those descriptions by reference in this EA and briefly summarize them in this section.

1.4.1 Endangered Species Act

Section 7 of the ESA and implementing regulations at 50 CFR § 402 require federal agencies to consult with the appropriate federal agency (either NMFS or the U.S. Fish and Wildlife Service) for federal actions that "may affect" a listed species or critical habitat. Accordingly, the ESA requires federal agencies to ensure that the proposed action would not likely jeopardize the continued existence of any threatened or endangered species or result in destruction or adverse modification of critical habitat for such species. There are six marine mammal species listed as endangered under the ESA with confirmed or possible occurrence in the proposed project area: blue, fin, humpback, North Atlantic right, sei, and sperm whales.

Under section 7 of the ESA, the Foundation, the lead Federal agency which owns and operates the *Langseth*, initiated formal consultation on their action with the National Marine Fisheries Service, Office of Protected Resources, Endangered Species Act Interagency Cooperation Division. The NSF requested authorization for the incidental take of four species of marine mammals listed as endangered under the ESA under NMFS' jurisdiction: fin, humpback, sei, and sperm whales.

NMFS' proposed issuance of an Authorization is also a federal action also subject to the section 7 ESA consultation requirements. For the proposed survey, NMFS requested authorization for two additional species of marine mammals listed as endangered under the ESA under NMFS' jurisdiction: North Atlantic right and blue whales. There is no designated critical habitat for any of the ESA-listed species within the action area; thus, our proposed Authorization would not affect any of these species' critical habitats.

The formal consultation under section 7 of the ESA will conclude with a single Biological Opinion for NSF's Division of Ocean Sciences and NMFS' Office of Protected Resources, Permits and Conservation Division for the seismic survey and proposed Authorization under the MMPA.

1.4.2 Marine Mammal Protection Act

We discuss the MMPA and its provisions that pertain to the proposed action described within section 1.2.

1.4.3 Magnuson-Stevens Fishery Conservation and Management Act

Under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA; 16 U.S.C. 1801 *et seq*.), Federal agencies are required to consult with the Secretary of Commerce with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency which may adversely affect essential fish habitat (EFH) identified under the MSFCMA.

Table 4 (page 30) of NSF's draft amended EA (NSF, 2014a) identifies marine species with EFH overlapping the proposed survey area. As the federal action agency funding Lamont-Doherty's activities, the NSF completed consultation with the NMFS Greater Atlantic Regional Office on EFH on February 11, 2015.

NMFS determined that mitigation and monitoring measures required by the proposed Authorization for the action would not result in adverse effects to EFH. Thus, the proposed issuance of an Authorization for the taking of marine mammals, incidental to Lamont-Doherty's seismic survey would not impact EFH and would not require an EFH consultation.

1.4.4 Coastal Zone Management Act

Congress enacted the Coastal Zone Management Act (CZMA) (16 U.S.C. §§ 1451 *et seq.*) to encourage coastal and Great Lakes states and territories to develop NOAA-approved comprehensive state management programs. These programs work to conserve and manage coastal resources and uses and make decisions designed to balance the competing demands placed on these uses and resources. An incentive to join the National Coastal Zone Management Program is the federal consistency provision, which gives states a voice in all federal activities that may impact a state's coastal uses or resources.

Once state coastal management programs and the policies within them receive federal approval from NOAA, federal agencies that undertake activities that may have reasonably foreseeable effects on coastal uses or resources are required to be consistent to the maximum extent practicable with those enforceable policies.

Where a federal agency is conducting a project, as is the case with the NSF, the agency is obligated to provide an affected coastal state with a consistency determination analyzing the reasonably foreseeable effects of the project and its consistency with the enforceable policies of the state. In such instances, the review by the state is of the project not any authorizations which are incidental to the federally conducted project.

The NSF submitted a consistency determination to the State of New Jersey for the proposed survey. Although the state issued a CZMA objection to the survey project, this has no bearing on NMFS' review of the application by NSF for an Authorization which is not subject to state review. NSF may proceed over the objection of the state if it determines that the project meets the CZMA standard of consistent to the maximum extent practicable.

Chapter 2 – Alternatives

2.1 Introduction

The NEPA and the implementing CEQ regulations (40 CFR §§ 1500-1508) require consideration of alternatives to proposed major federal actions and NAO 216-6 provides agency policy and guidance on the consideration of alternatives to our proposed action. An EA must consider all reasonable alternatives, including the No Action Alternative. This provides a baseline analysis against which we can compare the other alternatives.

To warrant detailed evaluation as a reasonable alternative, an alternative must meet our purpose and need. In this case, and as we previously explained, an alternative meets the purpose and need if it satisfies the requirements under section 101(a)(5)(D) the MMPA. We evaluated each potential alternative against these criteria; identified two action alternatives along with the No Action Alternative; and carried these forward for evaluation in this EA.

Alternatives 1 and 3 include a suite of mitigation measures intended to minimize any potential adverse effects to marine mammals. This chapter describes both alternatives and compares them in terms of their environmental impacts and their achievement of objectives.

2.2 Description of the Observatory's Proposed Activities

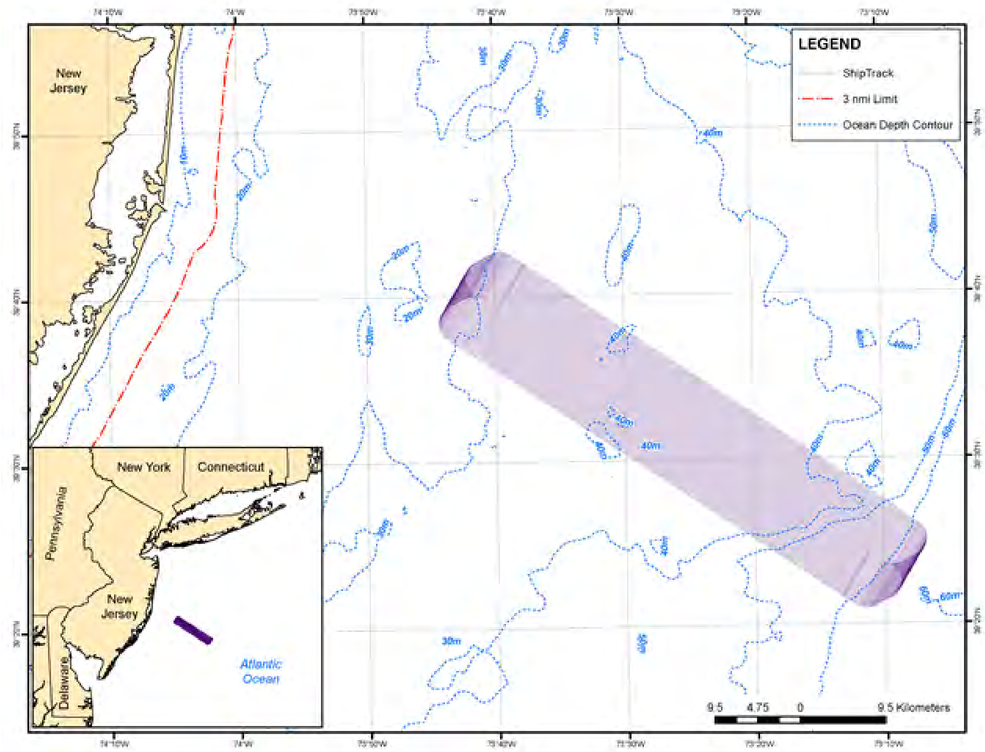
We presented a general overview of the Observatory's proposed 3-D seismic survey operations in our *Federal Register* notice of the proposed Authorization (80 FR 13961, March 17, 2015). Also, Lamont-Doherty's application (LGL, 2014) and NSF's draft amended EA (NSF, 2014a), describe the survey protocols in detail. We incorporate those descriptions by reference in this EA and briefly summarize them here.

2.2.1 Specified Time and Specified Area

Lamont-Doherty proposes to conduct the seismic survey from the period of June 1 through August 31, 2015. The proposed study (*e.g.*, equipment testing, startup, line changes, repeat coverage of any areas, and equipment recovery) would include approximately 720 hours of airgun operations (*i.e.*, 30 days over 24 hours). Lamont-Doherty would not conduct the proposed survey after August 31, 2014 to avoid exposing North Atlantic right whales to sound at the during their migration season.

Lamont-Doherty proposes to conduct the seismic survey in the Atlantic Ocean, approximately 25 to 85 km (15.5 to 52.8 mi) off the coast of New Jersey between approximately 39.3–39.7° N and approximately 73.2–73.8° W (Figure 1). Water depths in the survey area are approximately 30 to 75 meters (m) (98.4 to 246 feet (ft)). They would conduct the proposed survey outside of New Jersey state waters and within the U.S. Exclusive Economic Zone.

Figure 1 – Proposed location of the seismic survey in the Atlantic Ocean off the coast of New Jersey during June through August, 2015.



2.2.2 3-D Seismic Survey Operations

Source Vessel: The *Langseth* is 71.5 m (235 ft) long vessel with a gross tonnage of 3,834 pounds. The vessel's speed during operations would be approximately 4.5 knots (kt) (8.3 km/hour (hr); 5.1 miles per hour (mph)). It has an observation tower that is 21.5 m (71 ft) above sea level providing protected species observers an unobstructed view around the entire vessel.

Transit: The *Langseth* would transit for approximately eight hours to the proposed survey area. Setup, deployment, and streamer ballasting would occur over approximately one day and seismic acquisition would take approximately 30 days. At the conclusion of the proposed survey, the *Langseth* would take approximately one day to retrieve gear and would conclude the survey.

Transects: The proposed survey would cover approximately 4,900 km (3,045 mi) of transect lines within a 12 by 50 km (7.5 by 31 mi) area. Each transect line would have a spacing interval of 150 m (492 ft) in two 6-m (19.7-ft) wide race-track patterns.

Seismic Airguns: During the survey, the *Langseth* would deploy two pairs of subarrays of four airguns as an energy source. The airguns are a mixture of Bolt 1500LL and Bolt 1900LLX airguns ranging in size from 40 to 220 cubic inches (in^3), with a firing pressure of 1,950 pounds per square inch. The dominant frequency components range from zero to 188 Hertz (Hz). The nominal source levels of the airgun subarrays on the *Langseth* range from 246 to 253 dB re: 1 μPa (peak-to-peak). The subarrays would fire alternately, with a total volume of approximately 700 cubic inches (in^3). In this configuration, the source volume would not exceed 700 in^3 (*i.e.*, the four-string subarray) at any time during acquisition. The *Langseth* would tow each subarray at a depth of either 4.5 or 6 m (14.8 or 19.7 ft) resulting in a shot interval of approximately 5.4 seconds (12.5 m; 41 ft). During acquisition the airguns would emit a brief (approximately 0.1 second) pulse of sound. During the intervening periods of operations, the airguns would be silent.

Hydrophones: The receiving system would consist of four 3,000-m (1.9-mi) hydrophone streamers with a spacing interval of 75 m (246 ft) between each streamer; a combination of two 3,000-m (1.9-mi) hydrophone streamers, and a P-Cable system. As the *Langseth* tows the airgun subarrays along the survey lines, the hydrophone streamers would receive the returning acoustic signals and transfer the data to the on-board processing system.

Multibeam Echosounder: The *Langseth* would operate a Kongsberg EM 122 multibeam echosounder concurrently during airgun operations to map characteristics of the ocean floor. The *Langseth* would not operate the multibeam echosounder during transits to and from the survey area, (*i.e.*, when the airguns are not operating). The hull-mounted echosounder emits brief pulses of sound (also called a ping) (10.5 to 13.0 kilohertz (kHz) in a fan-shaped beam that extends downward and to the sides of the ship. The nominal source level for the multibeam echosounder is 242 dB re: 1 μPa.

Sub-bottom Profiler: The *Langseth* would also operate a Knudsen Chirp 3260 sub-bottom profiler concurrently during airgun and echosounder operations to provide information about the sedimentary features and bottom topography. The *Langseth* would not operate sub-bottom profiler during transits to and from the survey area, (*i.e.*, when the airguns are not operating). The hull-mounted profiler emits a ping with a dominant frequency component at 3.5 kHz. The nominal source level for the profiler is 204 dB re: 1 μPa.

Support Vessel: Lamont-Doherty would use a support vessel to prevent the *Langseth's* streamer entangling with fixed fishing gear. The vessel would be a multi-purpose offshore utility vessel similar to the *Northstar Commander*, which is 28 m (91.9 ft) long with a beam of 8 m (26.2 ft) and a draft of 2.6 m (8.5 ft).

Ballast Water Requirements: The proposed seismic research would not result in discharges of any pollutants or non-indigenous species or into ocean waters. The operation of the *Langseth* would only result in discharges incidental to normal operations of a surface vessel (NSF, 2011).

2.2.3 Approach to Developing Mitigation Exclusion Zones

Lamont-Doherty's application (LGL, 2014), Appendix A in the Foundation's draft amended EA (NSF, 2014a), and Section 2.2.2 in NMFS 2014 EA (NMFS, 2014b) describe the approach to establishing mitigation exclusion zones in detail. We incorporate those descriptions by reference in this EA and briefly summarize them here.

In summary, Lamont-Doherty acquired sound propagation measurements for several array configurations at shallow- and deep-water depths during acoustic verification studies conducted in the northern Gulf of Mexico in 2003 (Tolstoy et al., 2004) and in 2007 and 2008 (Tolstoy et al., 2009). Based on the empirical data from those studies, Lamont-Doherty developed a sound propagation modeling approach[4] that conservatively predicts received sound levels as a function of distance from a particular airgun array configuration in deep water (Crone, 2015; Crone et al., 2014; Diebold et al., 2010).

[4] The modeling approach uses ray tracing (*i.e.*, a graphical representation of the effects of refracting sound waves) for the direct wave traveling from the array to the receiver and its associated source ghost (reflection at the air-water interface in the vicinity of the array), in a constant-velocity half-space (infinite homogeneous ocean layer, unbounded by a seafloor).

To estimate the proposed exclusion and buffer zones for the survey off New Jersey, Lamont-Doherty used extrapolations and scaling factors. In summary, they obtained propagation measurements in shallow water of the Gulf of Mexico for the Langseth's 3,300-in^3 array towed at 6 m depth, in both cross-line (athwartship) and in-line (foreward and aft) directions. They used a 95^{th} percentile fit to the cross-line measurements (obtained at ranges approximately 2–14.5 km from the source) to extrapolate the near-field measurements at less than 2 km and far-field measurements at more than 14.5 km. The cross-line measurements and extrapolations were more conservative than the in-line measurements and extrapolations. Lamont-Doherty used this information to derive the mitigation radii for the proposed survey off New Jersey. Lamont-Doherty accounted for the differences in array volumes, airgun configurations, and tow depths between the Gulf of Mexico and New Jersey surveys by various scaling factors calculated based on the radii obtained from the modeling approach for deep water.

Lamont-Doherty used a similar process to develop mitigation radii (*i.e*., exclusion and buffer zones) for a shallow-water seismic survey in the northeast Pacific Ocean offshore Washington in 2012. Lamont-Doherty conducted the shallow-water survey using an airgun configuration that was approximately 78 percent larger than the total discharge volumes proposed for this shallow-water survey (*i.e*., 6,600 in^3) compared to 700 in^3 and recorded the received sound levels on the shelf and slope off Washington using the Langseth's 8-km hydrophone streamer. Crone et al. (Crone, et al., 2014; 2013) analyzed those received sound levels from the 2012 survey and reported that the actual distances for the exclusion and buffer zones were smaller than what Lamont-Doherty's modeling approach predicted.

In 2010 and 2014, Lamont-Doherty assessed the accuracy of their modeling approach by comparing the sound levels of the field measurements in the Gulf of Mexico study to their model predictions (Crone, 2015; Crone, et al., 2014). They reported that the observed sound levels from the field measurements fell almost entirely below the predicted mitigation radii curve (Crone, 2015; Crone, et al., 2014). Based on this information, Lamont-Doherty has shown that their model can reliably estimate mitigation radii in deep water. We acknowledge that Lamont-Doherty based their modeling approach on the environmental variability present in the Gulf of Mexico, but the model has limited ability to capture the variability resulting from site-specific factors present in the marine environment offshore New Jersey. While the results confirm bathymetry's role in sound propagation, Crone *et al*. (Crone, et al., 2014; 2013) were able to confirm that the empirical measurements from the Gulf of Mexico calibration survey (the same measurements used to inform Lamont-Doherty's modeling approach for this survey in shallow water) overestimated the size of the exclusion and buffer zones for the shallow-water 2012 survey off Washington and were thus precautionary in that particular case.

For the 2015 proposed survey offshore New Jersey, Lamont-Doherty conducted a retrospective sound power analysis and model validation of one of the lines (a 700-in^3 source towed at 4.5 m depth and shot upslope in water depths ranging from approximately 50 to 20 m) acquired during Lamont-Doherty's seismic survey offshore New Jersey in 2014 to verify the accuracy of its acoustic modeling approach for estimating exclusion and buffer zones (Crone, 2015). Lamont-Doherty used a regression model to fit the collected data 500 m to 3.5 km in line from the source and used a 95th percentile fit to the regression model for all shots along the line. Comparison of the preliminary results showed that the 95th percentile cross-line predicted means of 273 m (896 ft) for the 180-dB re 1 µPa threshold was approximately 28 percent smaller than the model predicted radii of 378 m (1,240 ft). Likewise, the 95th percentile cross-line predicted means of

3,505 m (2.1 mi) for the 160-dB re 1 μPa threshold was approximately 33 percent smaller than the model predicted radii of 5,240 m (3.2 mi).

In summary, Lamont-Doherty used the ratio of the size of safety zones of a large airgun in deep water compared to this airgun array in deep water to determine the size of the safety zone for this airgun in shallow water, given the known zone for the same large airgun in shallow water. NMFS believes that this is a rational method for using the best available information to estimate the proposed exclusion and safety zones (Table 5).

Table 5 – Modeled exclusion zones (EZ) for marine mammals in the survey area.

Source and Volume (in^3)	Tow Depth (m)	Water Depth (m)	Predicted RMS Distances (m)[1]		
			190 dB[2]	180 dB	160 dB
Single Bolt airgun (40 in^3)	6	< 100	21	73	995
4-Airgun subarray (700 in^3)	4.5	<100	101	378	5,240
4-Airgun subarray (700 in^3)	6	<100	118	439	6,100

[1] Predicted distances for 160 dB based on information in Table 1 of the Foundation's application.
[2] The Observatory did not request take for pinniped species in their application and consequently did not include distances for the 190-dB isopleth for pinnipeds in Table 1 of their application. Because NMFS anticipates that pinnipeds have the potential to occur in the survey area, Lamont-Doherty calculated the distances for the 190-dB isopleth and submitted them to NMFS on for inclusion in this table.

2.3 DESCRIPTION OF ALTERNATIVES

2.3.1 ALTERNATIVE 1 – ISSUANCE OF AN AUTHORIZATION WITH MITIGATION MEASURES

The Proposed Action constitutes Alternative 1 and is the Preferred Alternative. Under this alternative, we would issue an Authorization (valid from June through August 2015) to Lamont-Doherty allowing the incidental take, by Level B harassment, of marine mammals subject to the mandatory mitigation and monitoring measures and reporting requirements set forth in the proposed Authorization, subject to changes based on consideration of public comments.

MITIGATION MEASURES

As described in Section 1.2, NMFS must prescribe the means of effecting the least practicable adverse impact on the species or stocks of marine mammals and their habitat. In order to do so, we must consider Lamont-Doherty's proposed mitigation measures, as well as other potential measures. NMFS' evaluation of potential measures includes consideration of the following factors in relation to one another: (1) the manner in which, and the degree to which, we expect the successful implementation of the measure to minimize adverse impacts to marine mammals; (2) the proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and (3) the practicability of the measure for applicant implementation.

Any additional mitigation measure proposed by NMFS beyond what the applicant proposes should be able to or have a reasonable likelihood of accomplishing or contributing to the accomplishment of one or more of the following goals:

- Avoidance or minimization of marine mammal injury, serious injury, or death wherever possible;

- A reduction in the numbers of marine mammals taken (total number or number at biologically important time or location);
- A reduction in the number of times the activity takes individual marine mammals (total number or number at biologically important time or location);
- A reduction in the intensity of the anticipated takes (either total number or number at biologically important time or location);
- Avoidance or minimization of adverse effects to marine mammal habitat, paying special attention to the food base; activities that block or limit passage to or from biologically important areas; permanent destruction of habitat; or temporary destruction/disturbance of habitat during a biologically important time; and
- For monitoring directly related to mitigation, an increase in the probability of detecting marine mammals, thus allowing for more effective implementation of the mitigation.

To reduce the potential for disturbance from acoustic stimuli associated with the activities, Lamont-Doherty has agreed to implement the following monitoring and mitigation measures for marine mammals. These include:

1) Establish a 180 dB re: 1 μPa and 190 dB re: 1 μPa exclusion zone (EZ) for marine mammals before the full array (*i.e.*, 700 in^3) or a single airgun (*i.e.*, 40 in^3) is in operation (Table 5).
2) Utilize NMFS-qualified, vessel-based Protected Species Observers (PSOs) to visually watch for and monitor marine mammals near the seismic source vessel during daytime operations (from nautical twilight-dawn to nautical twilight-dusk) and before and during start-ups of sound sources day or night. Two PSOs would observe the exclusion and disturbance zones. When practicable, as an additional means of visual observation, the *Langseth's* vessel crew may also assist in detecting marine mammals.
3) Visually observe the entire extent of the EZ (180 dB re: 1 μPa for cetaceans and 190 dB re: 1 μPa for pinnipeds) using NMFS-qualified PSOs, for at least 30 minutes (min) prior to starting the airgun array (day or night).
4) Implement a ramp-up procedure when initiating the seismic operations or any time after the entire array has been shut down for more than 8 minutes, which means start the smallest sound source first and add sound sources in a sequence such that the source level of the array shall increase in steps not exceeding approximately 6 dB per 5-minute period. During ramp-up, the PSOs would monitor the EZ, and if they sight marine mammals, they would implement a power-down or shutdown as though the full array were operational. Therefore, initiation of ramp-up procedures from shutdown requires that the PSOs visually observe the full EZ described in Measures 1 and 3.
5) Power-down or shutdown the sound source(s) if a PSO detects a marine mammal that is within, approaches, or enters the applicable EZ. A shutdown means that the crew shuts down all operating sound sources (*i.e.*, turned off). A power-down means reducing the number of operating sound sources to a single operating 40 in^3 airgun, which reduces the EZ to the degree that the animal(s) is no longer within or about to enter it.
6) Set the shot interval for the single operating 40 in^3 airgun to one shot per minute.
7) Following a power-down, the *Langseth* crew would not resume full airgun activity until the marine mammal has cleared the 180- or 190-dB exclusion zone. The observers would consider the animal to have cleared the exclusion zone if:

a. the observer has visually observed the animal leave the exclusion zone; or

b. an observer has not sighted the animal within the exclusion zone for 15 minutes for species with shorter dive durations (*i.e.*, small odontocetes or pinnipeds), or 30 minutes for species with longer dive durations (*i.e.*, mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, and beaked whales).

8) Following a power-down, the *Langseth* crew would resume operating the airguns at full power after 15 minutes of sighting any species with short dive durations (*i.e.*, small odontocetes or pinnipeds). Likewise, the crew would resume airgun operations at full power after 30 minutes of sighting any species with longer dive durations (*i.e.*, mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, and beaked whales).

9) Considering the conservation status of North Atlantic right whales, the *Langseth* crew would be required to shut down the airgun(s) immediately in the unlikely event that observers detect this species, regardless of the distance from the vessel. The *Langseth* would only begin ramp-up if observers have not seen a North Atlantic right whale for 30 minutes.

10) Following a shutdown for more than 8 min and subsequent animal departure, survey operations may resume following ramp-up procedures described in Measure 4.

11) The seismic survey may continue into night and low-light hours if such segment(s) of the survey is initiated when the entire applicable EZs can be effectively monitored visually (*i.e.*, PSO(s) must be able to see the extent of the entire applicable EZ).

12) No initiation of survey operations involving the use of sound sources is permitted from a shutdown position at night or during low-light hours (such as in dense fog or heavy rain) unless at least one airgun (40-in^3 or similar) has been operating during the interruption of seismic survey operations. Given these provisions, it is likely that the vessel's crew would not ramp up the airgun array from a complete shutdown at night or in thick fog, because the outer part of the EZ would not be visible during those conditions.

13) Alter speed or course during seismic operations if a marine mammal, based on its position and relative motion, appears likely to enter the relevant EZ. If speed or course alteration is not safe or practicable, or if after implementing an alteration the marine mammal still appears likely to enter the EZ, further mitigation measures, such as a power-down or shutdown, shall be taken.

14) Power down the airgun array for concentrations of six or more animals are within the 160-dB buffer zone and avoid concentrations of humpback , sei, fin, blue, and/or sperm whales (if possible (*i.e.*, exposing concentrations of animals to 160 dB re 1 μPa). For purposes of the survey, a concentration or group of whales will consist of six or more individuals visually sighted that do not appear to be traveling (*e.g.*, feeding, socializing, etc.); and

15) Restrict the operation of the multi-beam echosounder, sub-bottom profiler, and acoustic Doppler current profiler during transit.

MONITORING MEASURES

Lamont-Doherty proposes to sponsor marine mammal monitoring during the present project, in order to implement the mitigation measures that require real-time monitoring and to satisfy the monitoring requirements of section 101(a)(5)(D).

In addition to the PSOs described above, the Authorization would require Lamont-Doherty to use a passive acoustic monitoring (PAM) system, to the maximum extent practicable, to detect, and allow some localization of marine mammals around the *Langseth* during all airgun operations and during most periods when airguns are not operating. When the PAM operator detects an animal, he/she must notify the PSO immediately of a vocalizing marine mammal so the *Langseth* crew can initiate a power-down or shut-down, if required.

REPORTING MEASURES

Lamont-Doherty would submit a draft report to NMFS and the Foundation within 90 days after the end of the cruise. The report would describe the operations conducted and sightings of marine mammals near the operations. The report would provide full documentation of methods, results, and interpretation pertaining to all monitoring. The report must contain and summarize the following information:

1) Dates, times, locations, heading, speed, weather, sea conditions (including Beaufort sea state and wind force), and associated activities during all seismic operations and marine mammal sightings;
2) Species, number, location, distance from the vessel, and behavior of any marine mammals, as well as associated seismic activity (number of power-downs and shutdowns), observed throughout all monitoring activities;
3) An estimate of the number (by species) of: (A) pinnipeds that have been exposed to the seismic activity (based on visual observation) at received levels greater than or equal to 160 dB re: 1 µPa and/or 190 dB re: 1 µPa with a discussion of any specific behaviors those individuals exhibited; and (B) cetaceans that have been exposed to the seismic activity (based on visual observation) at received levels greater than or equal to 160 dB re: 1 µPa and/or 180 dB re: 1 µPa with a discussion of any specific behaviors those individuals exhibited.
4) A description of the implementation and effectiveness of the: (A) terms and conditions of the Biological Opinion's Incidental Take Statement (ITS); and (B) mitigation measures required by our Authorization. For the Biological Opinion, the report shall confirm implementation of each Term and Condition, as well as any conservation recommendations, and describe their effectiveness, for minimizing the adverse effects of the action on ESA-listed marine mammals.

In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by the Authorization, such as an injury (Level A harassment), serious injury, or mortality (*e.g.*, ship-strike, gear interaction, and/or entanglement), Lamont-Doherty would immediately cease the specified activities and immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, her designees, and the Greater Atlantic Regional Stranding Network Coordinator. Lamont-Doherty may not resume activities until we are able to review the circumstances of the prohibited take. The report must include the following information:

1) Time, date, and location (latitude/longitude) of the incident;

2) The *Langseth's* speed during and leading up to the incident;
3) Description of the incident;
4) Status of all sound source use in the 24 hours preceding the incident;
5) Water depth;
6) Environmental conditions (*e.g*., wind speed and direction, Beaufort sea state, cloud cover, and visibility);
7) A description of marine mammal observations in the 24 hours preceding the incident;
8) Species identification or description of the animal(s) involved;
9) The fate of the animal(s); and
10) Photographs or video footage of the animal (if equipment is available).

In the event that Lamont-Doherty discovers an injured or dead marine mammal, and the PSO determines that the cause of the injury or death is unknown and the death is relatively recent (*i.e*., in less than a moderate state of decomposition as we describe in the next paragraph), Lamont-Doherty would immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, her designees, and the Greater Atlantic Regional Stranding Coordinator. The report must include the same information identified in the paragraph above this section. Activities may continue while we review the circumstances of the incident. We would work with Lamont-Doherty to determine whether modifications in the activities are appropriate.

In the event that Lamont-Doherty discovers an injured or dead marine mammal, and the lead PSO determines that the injury or death is not associated with or related to the authorized activities (*e.g*., previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), Lamont-Doherty would report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, her designees, and the and the Greater Atlantic Regional Stranding Coordinator within 24 hours of the discovery. Lamont-Doherty would provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS. Activities may continue while we review the circumstances of the incident.

TAKE ESTIMATES

Lamont-Doherty modeled the number of different individuals that could be exposed to airgun sounds with received levels greater than or equal to 160 dB re: 1 µPa on one or more occasions by multiplying the total marine area that would be within the 160-dB radius around the operating seismic source on at least one occasion (2,037 km^2 which includes a 25 percent contingency factor to account for repeated tracklines), along with the expected density of animals in the area. Lamont-Doherty acknowledged in their application that this approach does not allow for turnover in the mammal populations in the area during the course of the survey as the actual number of individuals exposed may be underestimated because it does not account for new animals entering or passing through the ensonification area (LGL, 2014; NSF, 2014a, 2014c), however, Lamont-Doherty suggested that the 25 percent contingency factor would cover any potential underestimate of individuals.

Based on public comments received on the *Federal Register* notice of proposed Authorization, NMFS re-evaluated and revised the take estimates. Thus, this Preferred Alternative would satisfy the purpose and need of our proposed action under the MMPA–issuance of an Authorization, along with required mitigation measures and monitoring that meets the standards set forth in section 101(a)(5)(D) of the MMPA and the implementing regulations, based on the best available information.

2.3.2 ALTERNATIVE 2 – NO ACTION ALTERNATIVE

Under the No Action Alternative, NMFS would not issue the Authorization, which would be based on an inability to make one of the findings required by section 101(a)(5)(D) (*i.e.*, negligible impact or small numbers; subsistence impacts are not implicated here). Lamont-Doherty has indicated it would not proceed with their proposed activities absent an Authorization.

2.3.3 ALTERNATIVE 3 – NO ACTION / LAMONT-DOHERTY PROCEEDS WITH SURVEY

Under this Alternative, NMFS would not issue the Authorization, which would be based on an inability to make one of the findings required by section 101(a)(5)(D) (*i.e.*, negligible impact or small numbers; subsistence impacts are not implicated here). Lamont-Doherty could choose to proceed with their proposed activities absent an Authorization. If they chose this option, Lamont-Doherty would not be exempt from the MMPA take prohibitions and would be in violation of the MMPA if take of marine mammals occurs.

For purposes of this EA, NMFS characterizes this Alternative as Lamont-Doherty not receiving an Authorization yet proceeding to conduct the 3-D seismic survey program without the protective measures and reporting requirements required by an Authorization under the MMPA. NMFS takes this approach to meaningfully evaluate the primary environmental issues—the impact on marine mammals from these activities in the absence of protective measures.

2.3.4 ALTERNATIVE 4 – ISSUANCE OF AUTHORIZATION WITH ADDITIONAL MITIGATION

Under Alternative 3, we would issue an Authorization to Lamont-Doherty, allowing the incidental take by Level B harassment only of small numbers of marine mammal species incidental to conducting seismic survey activities in the Atlantic Ocean during the effective period of the Authorization. Alternative 3 would consist of all of the mitigation, monitoring, and reporting measures contained in Alternative 1, including the following additional measures derived from the public comment process on our notice of the proposed Authorization.

(1) **Alternate Survey Timing:** This measure would require Lamont-Doherty to conduct research after the summer season.

(2) **Operational Restrictions**: This measure would require Lamont-Doherty to suspend their activities in low-light/nighttime conditions and minimize the number of repeated tracklines for the survey.

(3) **Augmented Monitoring**: This measure would require the use of alternative technologies and methods (*e.g.*, hydrophone buoys, aerial surveys, shore-based and small-vessel monitoring) to detect marine mammals beyond the proposed visual and acoustic monitoring.

2.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER CONSIDERATION

NMFS considered whether other alternatives could meet the purpose and need and support the Lamont-Doherty's activities. We considered an alternative that would allow for the issuance of an Authorization with no required mitigation or monitoring but eliminated that Alternative from consideration, as it would not be in compliance with the MMPA and therefore would not meet the purpose and need. For that reason, we do not analyze this alternative further in this document.

Chapter 3 – Affected Environment

This chapter describes existing conditions in the proposed survey area. Descriptions of the physical and biological environment of the action area are contained in the documents incorporated by reference (see section 1.3.1) and summarized here.

3.1 Physical Environment

As discussed in Chapter 1, NMFS' proposed action and alternatives relate only to the proposed issuance of our Authorization of incidental take of marine mammals and not to the physical environment. Certain aspects of the physical environment are not relevant to our proposed action (see section 1.3.2 - Scope of Environmental Analysis). Because of the requirements of NAO 216.6, however, we briefly summarize the physical components of the environment here.

The New Jersey shelf lies between the Hudson and the Delaware shelf valleys from 38°40' to 40°30'N and 72°30' to 74°40'W and covers a 25,000-square kilometer (km^2) (9,653-square mile (mi^2)) area. The shelf ranges from 120 to 150 km (75 to 93 mi) in width, sloping to the east and becomes steeper where the shelf break begins at the 120- and 160-m (394- to 525-ft) isobath (Carey et al., 1998). The bottom type of the shelf is categorized as soft, consisting of sandy to muddy-sandy bottom substrate (Navy, 2013).

The water off the U.S. east coast consists of three water masses: coastal or shelf waters, slope waters, and the Gulf Stream. Coastal waters off Canada, which originate mostly in the Labrador Sea, move southward over the continental shelf until they reach Cape Hatteras, where they are entrained between the Gulf Stream and slope waters (NSF, 2014a).

3.1.1 Marine Mammal Habitat

We presented information on marine mammal habitat and the potential impacts to marine mammal habitat in our notice of the proposed Authorization. Also, NSF presented more detailed information on the physical and oceanographic aspects of the New Jersey environment in their draft amended EA (NSF, 2014a) and final EA (NSF, 2014c) . In summary, the marine mammals in the survey area use the nearshore, shelf, shelf break, and continental slope waters, but may have differing habitat preferences based on their life history functions (NJDEP, 2010).

3.2 Biological Environment

3.2.1 Marine Mammals

We provide information on the occurrence of marine mammals with possible or confirmed occurrence in the survey area in section 1.1.2 of this EA (Tables 1a, b, and c). The marine mammals most likely to be present in the action area are in Table 6.

The *Federal Register* notice of the proposed Authorization (80 FR 13961, March 17, 2015) provided information on the stock, regulatory status, abundance, occurrence, seasonality, and hearing ability of the marine mammals in the action area. Lamont-Doherty's application and NSF's EA also provided distribution, life history, and population size information for marine mammals within the action area. We incorporate those descriptions by reference and briefly summarize the information in Table 6.

Table 6 – Marine mammals most likely to be harassed incidental to Lamont-Doherty's proposed survey during the summer (June through August) in 2015.

Species	Stock Name	Regulatory Status[1, 2]	Stock/Species Abundance[3]	Occurrence and Range	Season
North Atlantic right whale (*Eubalaena glacialis*)	Western Atlantic	MMPA - D ESA – EN	456	common coastal/shelf	year-round[4]
Humpback whale (*Megaptera novaeangliae*)	Gulf of Maine	MMPA - D ESA – EN	823	common coastal	spring - fall
Common minke whale (*Balaenoptera acutorostrata*)	Canadian East Coast	MMPA - D ESA – NL	20,741	rare coastal/shelf	spring - summer
Sei whale (*Balaenoptera borealis*)	Nova Scotia	MMPA - D ESA – EN	357	uncommon shelf edge	spring
Fin whale (*Balaenoptera physalus*)	Western North Atlantic	MMPA - D ESA – EN	1,618	common pelagic	year-round
Blue whale (*Balaenoptera musculus*)	Western North Atlantic	MMPA - D ESA – EN	440	uncommon coastal/pelagic	occasional
Sperm whale (*Physeter macrocephalus*)	Nova Scotia	MMPA - D ESA – EN	2,288	common pelagic	year-round
Dwarf sperm whale (*Kogia sima*)	Western North Atlantic	MMPA - NC ESA – NL	3,785	uncommon shelf	year-round
Pygmy sperm whale (*K. breviceps*)	Western North Atlantic	MMPA - NC ESA – NL	3,785	uncommon shelf	year-round
Cuvier's beaked whale (*Ziphius cavirostris*)	Western North Atlantic	MMPA - NC ESA – NL	6,532	uncommon shelf/pelagic	spring - summer
Blainville's beaked whale (*Mesoplodon densirostris*)	Western North Atlantic	MMPA - NC ESA – NL	7,092[5]	uncommon shelf/pelagic	spring - summer
Gervais' beaked whale (*M. europaeus*)	Western North Atlantic	MMPA - NC ESA – NL	7,092[5]	uncommon shelf/pelagic	spring - summer
Sowerby's beaked whale (*M. bidens*)	Western North Atlantic	MMPA - NC ESA – NL	7,092[5]	uncommon shelf/pelagic	spring - summer
True's beaked whale (*M. mirus*)	Western North Atlantic	MMPA - NC ESA – NL	7,092[5]	uncommon shelf/pelagic	spring - summer
Northern bottlenose whale (*Hyperoodon ampullatus*)	Western North Atlantic	MMPA - NC ESA – NL	unknown	rare pelagic	unknown
Rough-toothed dolphin (*Steno bredanensis*)	Western North Atlantic	MMPA - NC ESA – NL	271	rare pelagic	summer
Bottlenose dolphin (*Tursiops truncatus*)	Western North Atlantic Offshore	MMPA - NC ESA – NL	77,532	common pelagic	spring - summer
	Western North Atlantic Northern Migratory Coastal	MMPA - D ESA – NL	11,548[6]	uncommon coastal within the 25-m isobath and estuaries	summer
Pantropical spotted dolphin (*Stenella attenuata*)	Western North Atlantic	MMPA - NC ESA – NL	3,333	rare pelagic	summer - fall
Atlantic spotted dolphin (*S. frontalis*)	Western North Atlantic	MMPA - NC ESA – NL	44,715	common coastal	summer - fall
Spinner dolphin (*S. longirostris*)	Western North Atlantic	MMPA - NC ESA – NL	unknown	rare pelagic	unknown
Striped dolphin (*S. coeruleoalba*)	Western North Atlantic	MMPA - NC ESA – NL	54,807	uncommon shelf	summer
Short-beaked common dolphin (*Delphinus delphis*)	Western North Atlantic	MMPA - NC ESA – NL	173,486	common shelf/pelagic	summer - fall
White-beaked dolphin (*Lagenorhynchus albirostris*)	Western North Atlantic	MMPA - NC ESA – NL	2,003	rare coastal/shelf	summer
Atlantic white-sided-dolphin (*L. acutus*)	Western North Atlantic	MMPA - NC ESA – NL	48,819	uncommon shelf/slope	summer - winter
Clymene dolphin (*Stenella clymene*)	Western North Atlantic	MMPA - NC ESA – NL	6,086[7]	rare slope	summer
Fraser's dolphin (*Lagenodelphis hosei*)	Western North Atlantic	MMPA - NC ESA – NL	726[8]	Pelagic	Rare

Risso's dolphin (*Grampus griseus*)	Western North Atlantic	MMPA - NC ESA – NL	18,250	common shelf/slope	year-round
Melon-headed whale (*Peponocephala electra*)	Western North Atlantic	MMPA - NC ESA – NL	2,283[9]	Pelagic	Rare
False killer whale (*Pseudorca crassidens*)	western North Atlantic	MMPA - NC ESA – NL	442	rare pelagic	spring - summer
Pygmy killer whale (*Feresa attenuate*)	Western North Atlantic	MMPA - NC ESA – NL	1,108[10]	Pelagic	unknown
Killer whale (*Orcinus orca*)	Western North Atlantic	MMPA - NC ESA – NL	28[11]	Coastal	unknown
Long-finned pilot whale (*Globicephala melas*)	Western North Atlantic	MMPA - NC ESA – NL	26,535	uncommon shelf/pelagic	summer
Short-finned pilot whale (*G. macrorhynchus*)	Western North Atlantic	MMPA - NC ESA – NL	21,515	uncommon shelf/pelagic	summer
Harbor porpoise (*Phocoena phocoena*)	Gulf of Maine/ Bay of Fundy	MMPA - NC ESA – NL	79,883	common coastal	year-round
Gray seal (*Halichoerus grypus*)	Western North Atlantic	MMPA - NC ESA – NL	331,000	common coastal	fall - spring
Harbor seal (*Phoca vitulina*)	Western North Atlantic	MMPA - NC ESA – NL	75,834	common coastal	fall - spring
Harp seal (*Pagophilus groenlandicus*)	Western North Atlantic	MMPA - NC ESA – NL	8,600,000	rare pack ice	Jan - May

[1] MMPA: D = Depleted, S = Strategic, NC = Not Classified.

[2] ESA: EN = Endangered, T = Threatened, DL = Delisted, NL = Not listed.

[3] NOAA Technical Memorandum NMFS-NE-228, U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2013 (Waring *et al*., 2014) and the Draft 2014 U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments (*in review*, 2014).

[4] Seasonality based on Whitt *et al*., 2013.

[5] Undifferentiated beaked whales abundance estimate (Waring *et al*., 2014).

[6] During summer months, the primary habitat of the western north Atlantic, Northern Migratory Coastal Stock of bottlenose dolphins is primarily in waters less than 20 m deep within the 25-m isobath, including estuarine and inshore waters (Waring et al., 2014; Kenney, 1990). Toth *et a*l. (2012) suggested a portioning of the Northern Migratory Coastal Stock in waters off of New Jersey. They identified two clusters, one cluster inhabiting waters 0-1.9 km from the shore and a second cluster inhabiting waters 1.9 to 6 km from shore.

[7] There is no abundance information for this species in the Atlantic. The best available estimate of abundance was 6,086 (CV=0.93) (Mullin and Fulling, 2003).

[8] There is no abundance information for this species in the Atlantic. The best available estimate of abundance was 726 (CV=0.70) for the Gulf of Mexico stock (Mullin and Fulling, 2004).

[9] There is no abundance information for this species in the Atlantic. The best available estimate of abundance was 2,283 (CV=0.76) for the Gulf of Mexico stock (Mullin, 2007).

[10] There is no abundance information for this species in the Atlantic. Abundance estimate derived from the Northern Gulf of Mexico stock = 152 (Mullin, 2007) and the Hawaii stock = 956 (Barlow, 2006).

[11] There is no abundance information for this species in the Atlantic. Abundance estimate derived from the Northern Gulf of Mexico stock = 28 (Waring *et al*., 2014).

Pinnipeds: For the proposed Authorization, we considered authorizing take for pinnipeds based upon the best available density information (Navy, 2007) and other anecdotal sources (MMSC, 2014). This section includes a brief summary on life history information for gray, harp, and harbor seals.

Harbor Seals: Harbor seals are part of the "true seal" family, *Phocidae*. True seals lack external ear flaps and have short forelimbs that result in limited locomotion on land. Harbor seals typically inhabit temperate coastal habitats and use rocks, reefs, beaches, and drifting glacial ice as haul outs and pupping sites (Waring, et al., 2014). On the east coast, they range from the Canadian Arctic to southern New England, New York, and occasionally the Carolinas (Waring et al., 2010; Waring, et al., 2014). There are three well known, long-term haul out sites in New Jersey: Sandy Hook, Barnegat Inlet, and Great Bay (NJDEP, 2010).

The best estimate of abundance for harbor seals is 70,142 (CV=0.29) with a minimum population estimate of 55,409 based on corrected available counts along the Maine coast in 2012 (Waring, et al., 2014). Harbor seals eat a variety of prey consisting mainly of fish, shellfish, and crustaceans. Researchers have found that seals complete both shallow and deep dives during hunting depending on the availability of prey (Tollit et al., 1997).

Gray Seals: Gray seals, also from the Phocid family, inhabit coastal waters and typically haul out on rocky coasts and islands, sandbars, ice shelves, and icebergs. The best abundance estimate for the Western North Atlantic stock is 331,000 (Hammill et al., 2012, in prep.). Gray seal abundance is likely increasing in the U.S. Atlantic Exclusive Economic Zone (EEZ), but the rate of increase is unknown (Waring, et al., 2014). Gray seals are opportunistic feeders that consume between 4-6% of their body weight per day. Food sources include fish, crustaceans, squid, octopus, and even seabirds on occasion.

Harp Seals: The harp seal has a widespread distribution in the Arctic and in cold waters of the North Atlantic ((Jefferson et al., 2008)). It is the most abundant seal in the North Atlantic, with most seals aggregating off the east coast of Newfoundland and Labrador to pup and breed; the remainder congregates in the Gulf of St. Lawrence (Lavigne & Kovacs, 1988). These seals are highly migratory (Stenson & Sjare, 1997) and the southern limit of their habitat extends into the U.S. Atlantic Exclusive Economic Zone during winter and spring (Waring, et al., 2014). The best estimate of abundance for harp seals is 7.1 million ((Hammill et al., 2012, in prep). Jefferson *et al*. (2008) indicate that vagrant harp seals reach as far south as New York. Sightings of harp seals off the U.S. east coast, from Maine to New Jersey, are rare but have been increasing in recent years, particularly from January to May (Harris & Gupta, 2006). Harp seals are modest divers by pinniped standards. The average maximum dive is to about 1,200 feet (370 m), lasting approximately 16 minutes. They eat a variety of fish and invertebrates, but mainly focus on smaller fish such as capelin, arctic and polar cod, and invertebrates including krill.

CHAPTER 4 – ENVIRONMENTAL CONSEQUENCES

This chapter of the EA includes a discussion of the impacts of the four alternatives on the human environment. Lamont-Doherty's application, our notice of a proposed Authorization, and other related environmental analyses identified previously, inform our analysis of the direct, indirect, and cumulative effects of our proposed issuance of an Authorization.

Under the MMPA, we have evaluated the potential impacts of Lamont-Doherty's seismic survey activities in order to determine whether to authorize incidental take of marine mammals. Under NEPA, we have determined that an EA is appropriate to evaluate the potential significance of environmental impacts resulting from the issuance of our Authorization.

4.1 EFFECTS OF ALTERNATIVE 1 – ISSUANCE OF AN AUTHORIZATION WITH MITIGATION MEASURES

Alternative 1 is the Preferred Alternative, where we would issue an Authorization to Lamont-Doherty allowing the take by Level B harassment, of marine mammals, incidental to the proposed survey from June through August, 2015, subject to the mandatory mitigation and monitoring measures and reporting requirements set forth in the Authorization, if issued.

4.1.1 IMPACTS TO MARINE MAMMAL HABITAT

NMFS' proposed action would have no additive or incremental effect on the physical environment beyond those resulting from the proposed survey activities. Lamont-Doherty's proposed seismic survey is not located within a marine sanctuary, wildlife refuge, a National Park, or other conservation area. The proposed activity— which uses one seismic source vessel—would minimally add to vessel traffic in the region and would not result in substantial damage to ocean and coastal habitats that might constitute marine mammal habitats. Finally, the proposed Authorization would not impact physical habitat features, such as substrates and/or water quality.

Prey: The overall response of fishes and squids from the seismic survey is to exhibit responses including no reaction or habituation (Peña et al., 2013) to startle responses and/or avoidance (Fewtrell & McCauley, 2012) and vertical and horizontal movements away from the sound source. We expect that the seismic survey would have no more than a temporary and minimal adverse effect on any fish or invertebrate species. Although there is a potential for injury to fish or marine life in close proximity to the vessel, we expect that the impacts of the seismic survey on fish and other marine life specifically related to acoustic activities would be temporary in nature, negligible, and would not result in substantial impact to these species or to their role in the ecosystem.

4.1.2 IMPACTS TO MARINE MAMMALS

We expect that Lamont-Doherty's 3-D seismic survey has the potential to take marine mammals by Level B harassment, as defined by the MMPA. Acoustic stimuli generated by the airgun arrays (and to a lesser extent the multibeam echosounder, sub-bottom profiler, and acoustic Doppler current profiler) may affect marine mammals in one or more of the following ways: behavioral disturbance, tolerance, masking of natural sounds, and temporary or permanent hearing impairment, or non-auditory physical effects (Richardson et al., 1995).

Our *Federal Register* notice of proposed Authorization, Lamont-Doherty's application (LGL, 2014), NSF's draft amended EA (NSF, 2014a) and final EA (NSF, 2014c) provide detailed descriptions of these potential effects of seismic surveys on marine mammals. We incorporate those discussions by reference here and summarize our consideration of additional studies submitted during the public comment period in the following sections.

The effects of noise on marine mammals are highly variable, ranging from minor and negligible to potentially significant, depending on the intensity of the source, the distances between the animal and the source, and the overlap of the source frequency with the animals' audible frequency. Nevertheless, monitoring and mitigation measures required by us for Lamont-Doherty's proposed activities will effectively reduce any significant adverse effects of these sound sources on marine mammals.

Behavioral Disturbance: The studies discussed in the *Federal Register* notice for the proposed Authorization note that there is variability in the behavioral responses of marine mammals to noise exposure. It is important to consider context in predicting and observing the level and type of behavioral response to anthropogenic signals (Ellison et al., 2012).

Marine mammals may react to sound when exposed to anthropogenic noise. These behavioral reactions are often shown as: changing durations of surfacing and dives, number of blows per surfacing, or moving direction and/or speed; reduced/increased vocal activities; changing or cessation of certain behavioral activities (such as socializing or feeding); visible startle response or aggressive behavior (such as tail/fluke slapping or jaw clapping); avoidance of areas where noise sources are located; and/or flight responses (e.g., pinnipeds flushing into water from haul-outs or rookeries). The onset of behavioral disturbance from anthropogenic noise depends on both external factors (characteristics of noise sources and their paths) and the receiving animals (hearing, motivation, experience, demography) and is also difficult to predict (Richardson, et al., 1995; Southall et al., 2007).

Studies have shown that underwater sounds from seismic activities are often readily detectable by marine mammals in the water at distances of many kilometers (Castellote et al., 2012). Many studies have also shown that marine mammals at distances more than a few kilometers away often show no apparent response when exposed to seismic activities (e.g., Akamatsu et al., 1993; Harris et al., 2001; Madsen & Møhl, 2000; Malme et al., 1983, 1984; Richardson et al., 1986; Weir, 2008). Other studies have shown that marine mammals continue important behaviors in the presence of seismic pulses (e.g., Dunn & Hernandez, 2009; Greene Jr. et al., 1999; Holst & Beland, 2010; Holst & Smultea, 2008; Holst et al., 2005; Nieukirk et al., 2004; Richardson, et al., 1986; Smultea et al., 2004).

In a passive acoustic research program that mapped the soundscape in the North Atlantic Ocean, Clark and Gagnon (2006) reported that some fin whales in the northeast Pacific Ocean stopped singing for an extended period starting soon after the onset of a seismic survey in the area. The authors could not determine whether or not the whales left the area ensonified by the survey, but the evidence suggests that most, if not all, of the singers remained in the area. When the survey stopped temporarily, the whales resumed singing within a few hours and the number of singers increased with time. Also, one whale continued to sing while the seismic survey was actively operating (Figure 4, Clark & Gagnon, 2006). The authors concluded that there is not enough scientific knowledge to adequately evaluate whether or not these effects on singing or mating behaviors are significant or would alter survivorship or reproductive success.

It is important to note that Lamont-Doherty's study area is well away from any known breeding grounds for low frequency cetaceans thereby reducing further the likelihood of causing an effect on marine mammal mating behaviors or calving.

MacLeod et al. (2006) discussed the possible displacement of fin and sei whales related to distribution patterns of the species during a large-scale, offshore seismic survey along the west coast of Scotland in 1998. The authors hypothesized about the relationship between the whale's absence and the concurrent seismic activity, but could not rule out other contributing factors (Macleod, et al., 2006; Parsons et al., 2009). We would expect that marine mammals may briefly respond to underwater sound produced by Lamont-Doherty's seismic survey by slightly changing their behavior or relocating a short distance. Based on the best available information, we expect short-term disturbance reactions that are confined to relatively small distances and durations (Thompson et al., 1998; Thompson et al., 2013), with no long-term effects on recruitment or survival of marine mammals.

McDonald et al. (1995) tracked blue whales relative to a seismic survey with a 1,600 in^3 airgun array. One whale started its call sequence within 15 km (9.3 mi) from the source, then followed a pursuit track that decreased its distance to the vessel where it stopped calling at a range of 10 km (6.2 mi) (estimated received level at 143 dB re: 1 μPa (peak-to-peak)). After that point, the ship increased its distance from the whale which continued a new call sequence after approximately one hour and 10 km (6.2 mi) from the ship. The authors reported that the whale had taken a track paralleling the ship during the cessation phase but observed the whale moving diagonally away from the ship after approximately 30 minutes continuing to vocalize. Because the whale may have approached the ship intentionally or perhaps was unaffected by the airguns, the authors concluded that there was insufficient data to infer conclusions from their study related to blue whale responses (McDonald, et al., 1995).

McCauley et al. (2000; 1998) studied the responses of migrating humpback whales off western Australia to a full-scale seismic survey with a 16-airgun array (2,678 cubic inches (in3)) and to a single, 20-in^3airgun. Both studies point to a contextual variability in the behavioral responses of marine mammals to sound exposure. The mean received level for initial avoidance of an approaching airgun was 140 dB re: 1 μPa for humpback whale pods containing females. In contrast, some individual humpback whales, mainly males, approached within distances of 100 to 400 m (328 to 1,312 ft), where sound levels were 179 dB re: 1 μPa (McCauley, et al., 2000). The authors hypothesized that the males gravitated towards the single operating air gun possibly due to its similarity to the sound produced by humpback whales breaching. Despite the evidence that some humpback whales exhibited localized avoidance reactions at received levels below 160 dB re: 1 μPa, the authors found no evidence of any gross changes in migration routes, such as inshore/offshore displacement during seismic operations (McCauley, et al., 2000; McCauley, et al., 1998).

DeRuiter *et al*. (2013) recently observed that beaked whales (considered a particularly sensitive species) exposed to playbacks (*i.e*., simulated) of U.S. Navy tactical mid-frequency active sonar from 89 to 127 dB re: 1 μPa at close distances responded notably by altering their dive patterns. In contrast, individuals showed no behavioral responses when exposed to similar received levels from *actual* U.S. Navy tactical mid-frequency active sonar operated at much further distances (DeRuiter, et al., 2013). As noted earlier, one must consider the importance of context (*e.g*., the distance of a sound source from the animal) in predicting behavioral responses.

Tolerance: With repeated exposure to sound, many marine mammals may habituate to the sound at least partially (Richardson & Wursig, 1997). Bain and Williams (2006) examined the effects of a large airgun array (maximum total discharge volume of 1,100 in^3) on six species in shallow waters off British Columbia and Washington: harbor seal, California sea lion (*Zalophus californianus*), Steller sea lion (*Eumetopias jubatus*), gray whale (*Eschrichtius robustus*), Dall's porpoise (*Phocoenoides dalli*), and the harbor porpoise. Harbor porpoises showed reactions at received levels less than 145 dB re: 1 µPa at a distance of greater than 70 km (43 miles) from the seismic source (Bain & Williams, 2006). However, the tendency for greater responsiveness by harbor porpoise is consistent with their relative responsiveness to boat traffic and some other acoustic sources (Richardson, et al., 1995; Southall, et al., 2007). In contrast, the authors reported that gray whales seemed to tolerate exposures to sound up to approximately 170 dB re: 1 µPa (Bain & Williams, 2006) and Dall's porpoises occupied and tolerated areas receiving exposures of 170–180 dB re: 1 µPa (Bain & Williams, 2006; Parsons, et al., 2009). The authors observed several gray whales that moved away from the airguns toward deeper water where sound levels were higher due to propagation effects resulting in higher noise exposures (Bain & Williams, 2006). However, it is unclear whether their movements reflected a response to the sounds (Bain & Williams, 2006). Thus, the authors surmised that the lack of gray whale responses to higher received sound levels were ambiguous at best because one expects the species to be the most sensitive to the low-frequency sound emanating from the airguns (Bain & Williams, 2006).

Pirotta et al. (2014) observed short-term responses of harbor porpoises to a 2-D seismic survey in an enclosed bay in northeast Scotland which did not result in broad-scale displacement. The harbor porpoises that remained in the enclosed bay area reduced their buzzing activity by 15% during the seismic survey (Pirotta, et al., 2014). Thus, animals exposed to anthropogenic disturbance may make trade-offs between perceived risks and the cost of leaving disturbed areas (Pirotta, et al., 2014). However, unlike the semi-enclosed environment described in the Scottish study area, Lamont-Doherty's seismic study occurs in the open ocean. Because Lamont-Doherty would conduct the survey in an open ocean area, we do not anticipate that the seismic survey would entrap marine mammals between the sound source and the shore as marine mammals can temporarily leave the survey area during the operation of the airgun(s) to avoid acoustic harassment.

Masking: Studies have shown that marine mammals are able to compensate for masking by adjusting their acoustic behavior such as shifting call frequencies and increasing call volume and vocalization rates. For example, blue whales increase call rates when exposed to seismic survey noise in the St. Lawrence Estuary (Di Iorio & Clark, 2010). North Atlantic right whales exposed to high shipping noise increased call frequency (Parks et al., 2007), while some humpback whales respond to low-frequency active sonar playbacks by increasing song length (Miller et al., 2000).

Risch et al. (2012) documented reductions in humpback whale vocalizations in the Stellwagen Bank National Marine Sanctuary concurrent with transmissions of the Ocean Acoustic Waveguide Remote Sensing (OAWRS) low-frequency fish sensor system at distances of 200 km from the source. The recorded OAWRS produced series of frequency modulated pulses and the signal received levels ranged from 88 to 110 dB re: 1 µPa (Risch, et al., 2012). The authors hypothesized that individuals did not leave the area but instead ceased singing and noted that the duration and frequency range of the OAWRS signals (a novel sound to the whales) were similar to those of natural humpback whale song components used during mating (Risch, et al., 2012). Thus, the novelty of the sound to humpback whales in the study area provided a compelling contextual probability for the observed effects (Risch, et al., 2012). However, the authors did not state or imply that these changes had long-term effects on individual animals or populations (Risch, et al., 2012). The changes in vocal behaviors related to mating activities do not apply to the marine mammal species present in the area of Lamont-Doherty's seismic survey. Again, Lamont-Doherty's study area is well away from any known breeding grounds for low frequency cetaceans, thereby reducing further the likelihood of causing an effect on marine mammal mating behaviors.

We expect that masking effects of seismic pulses would be limited in the case of smaller odontocetes given the intermittent nature of seismic pulses (22 or 65 seconds) plus the fact that sounds important to them are predominantly at much higher frequencies than are the dominant components of airgun sounds. Pinnipeds have best hearing sensitivity and/or produce most of their sounds at frequencies higher than the dominant components of airgun sounds, but there is some overlap in the frequencies of the airgun pulses and the calls. However, the intermittent nature of airgun pulses presumably reduces the potential for masking.

Hearing Impairment: Marine mammals exposed to high intensity sound repeatedly or for prolonged periods can experience hearing threshold shift (TS), which is the loss of hearing sensitivity at certain frequency ranges (Finneran et al., 2005; Finneran & Schlundt, 2013; Finneran et al., 2000; Kastak & Schusterman, 1998; Kastak et al., 1999; Schlundt et al., 2013; Schlundt et al., 2000). However, there has been no specific documentation of temporary threshold shift (TTS) or permanent hearing damage, *i.e.*, permanent threshold shift (PTS) in free-ranging marine mammals exposed to sequences of airgun pulses during realistic field conditions (NSF, 2014b).

Lucke et al. (2009) found a threshold shift (TS) of a harbor porpoise after exposing it to airgun noise with a received sound pressure level (SPL) at 200.2 dB (peak –to-peak) re: 1 μPa, which corresponds to a sound exposure level of 164.5 dB re: 1 μPa^2 s after integrating exposure. NMFS currently uses the root-mean-square (rms) of received SPL at 180 dB and 190 dB re: 1 μPa as the threshold above which permanent threshold shift (PTS) could occur for cetaceans and pinnipeds, respectively. Because the airgun noise is a broadband impulse, one cannot directly determine the equivalent of rms SPL from the reported peak-to-peak SPLs. However, applying a conservative conversion factor of 16 dB for broadband signals from seismic surveys (McCauley, et al., 2000) to correct for the difference between peak-to-peak levels reported in Lucke et al. (2009) and rms SPLs, the rms SPL for TTS would be approximately 184 dB re: 1 μPa, and the received levels associated with PTS (Level A harassment) would be higher. This is still above our current 180 dB rms re: 1 μPa threshold for injury. However, we recognize that TTS of harbor porpoises is lower than other cetacean species empirically tested (Finneran & Schlundt, 2010; Finneran et al., 2002; Kastelein & Jennings, 2012).

Recent studies by Kujawa and Liberman (2009) and Lin et al. (2011) found that despite completely reversible threshold shifts that leave cochlear sensory cells intact, large threshold shifts could cause synaptic level changes and delayed cochlear nerve degeneration in mice and guinea pigs, respectively. We note that the high level of TTS that led to the synaptic changes shown in these studies is in the range of the high degree of TTS that Southall et al. (2007) used to calculate PTS levels. It is unknown whether smaller levels of TTS would lead to similar changes. We, however, acknowledge the complexity of noise exposure on the nervous system, and will re-examine this issue as more data become available.

A recent study on bottlenose dolphins (Schlundt, et al., 2013) measured hearing thresholds at multiple frequencies to determine the amount of TTS induced before and after exposure to a sequence of impulses produced by a seismic air gun. The air gun volume and operating pressure varied from 40-150 in^3 and 1000-2000 psi, respectively. After three years and 180 sessions, the authors observed no significant TTS at any test frequency, for any combinations of air gun volume, pressure, or proximity to the dolphin during behavioral tests (Schlundt, et al., 2013). Schlundt et al. (2013) suggest that the potential for airguns to cause hearing loss in dolphins is lower than previously predicted, perhaps as a result of the low-frequency content of air gun impulses compared to the high-frequency hearing ability of dolphins.

The predicted distances at which sound levels could result in Level A harassment are relatively small (585 m; 1,919 ft for cetaceans, and 157 m; 515 ft for pinnipeds). The avoidance behaviors observed in Thompson et al.'s (1998) study supports our expectation that individual marine mammals would avoid exposure at higher levels. Also, it is unlikely that animals would encounter repeated exposures at very close distances to the sound source because Lamont-Doherty would implement the required shutdown and power down mitigation measures to ensure that marine mammals do not approach the applicable exclusion zones for Level A harassment. We also expect that the required vessel-based visual monitoring of the exclusion zones and implementation of mitigation measures would mitigate instances of Level A harassment.

Strandings: In 2013, an International Scientific Review Panel (ISRP) investigated a 2008 mass stranding of approximately 100 melon-headed whales in a Madagascar lagoon system (Southall et al., 2013) associated with the use of a high-frequency mapping system. The report indicated that the use of a 12-kHz multibeam echosounder was the most plausible and likely initial behavioral trigger of the mass stranding event. This was the first time that a relatively high-frequency mapping sonar system had been associated with a stranding event. However, the report also notes that there were several site- and situation-specific secondary factors that may have contributed to the avoidance responses that lead to the eventual entrapment and mortality of the whales within the Loza Lagoon system (*e.g.*, the survey vessel transiting in a north-south direction on the shelf break parallel to the shore may have trapped the animals between the sound source and the shore driving them towards the Loza Lagoon). They concluded that for odontocete cetaceans that hear well in the 10-50 kHz range, where ambient noise is typically quite low, high-power active sonars operating in this range may be more easily audible and have potential effects over larger areas than low frequency systems that have more typically been considered in terms of anthropogenic noise impacts (Southall, et al., 2013). However, the risk may be very low given the extensive use of these systems worldwide on a daily basis and the lack of direct evidence of such responses previously (Southall, et al., 2013).

We have considered the potential for behavioral responses and injury or mortality from Lamont-Doherty's use of the multibeam echosounder. Given that Lamont-Doherty proposes to conduct the survey offshore and transit in a manner that would not entrap marine mammals in shallow water, we do not anticipate that the use of the source during the seismic survey would entrap marine mammals between the vessel's sound sources and the New Jersey coastline. In addition the proposed Authorization outlines reporting measures and response protocols intended to minimize the impacts of, and enhance the analysis of, any potential stranding in the survey area.

NOAA has declared an Unusual Mortality Event (UME) for bottlenose dolphins along the Atlantic coast from early July 2013 through the present. Elevated strandings of bottlenose dolphins have occurred in New York, New Jersey, Delaware, Maryland, Virginia, North

Carolina, South Carolina, Georgia and Florida (through Brevard County). All age classes of bottlenose dolphins are involved and strandings range from a few live animals to mostly dead animals with many very decomposed. Many dolphins have presented with lesions on their skin, mouth, joints, or lungs (NMFS, 2014a). Based upon preliminary diagnostic testing and discussion with disease experts the tentative cause of this UME could be cetacean morbillivirus (NMFS, 2014c). However the investigation is still ongoing and additional contributory factors (*e.g.*, other pathogens, biotoxins, range expansion) to the UME are under investigation, etc. (NMFS, 2014c).

No studies are available that would inform our analysis of whether seismic surveys have any additional impacts on marine mammal species subject to a UME. As discussed above and in the analyses in other documents incorporated by reference, we have evaluated the potential effects of seismic surveys on a number of marine mammal species, including bottlenose dolphins and beaked whales, and have concluded that Lamont-Doherty's proposed seismic survey would, at most, result in a temporary modification in behavior, temporary changes in animal distribution, and/or low-level physiological effects. We base this conclusion on the following factors: (1) the available literature supports our conclusion that the low-frequency content of air gun impulses may have fewer predicted impacts on bottlenose dolphins (Schlundt, et al., 2013); (2) the mitigation and monitoring measures are expected to limit the occurrence and intensity of any exposure; and (3) any effect on the human environment due to the project's impacts on dolphins is not expected to be significant.

In sum, we interpret these effects on all marine mammals as falling within the MMPA definition of Level B (behavioral) harassment. We expect these impacts to be minor because we do not anticipate measurable changes to the population or impacts to rookeries, mating grounds, and other areas of similar significance.

Under the Preferred Alternative, we would authorize incidental take, by Level B harassment only, of 32 species of marine mammals. Based on our best professional judgment and our evaluation of all of the available data, we expect no long-term or substantial adverse effects on marine mammals, their habitats, or their role in the environment.

Lamont-Doherty proposed a number of monitoring and mitigation measures for marine mammals as part of our evaluation for the Preferred Alternative. In consideration of the potential effects of the proposed seismic survey, we determined that the mitigation and monitoring measures described in section 2.3.1 of this EA would be appropriate for the preferred alternative to meet the Purpose and Need.

Injury: Lamont-Doherty did not request authorization to take marine mammals by injury (Level A harassment), serious injury, or mortality. Based on the results of our analyses, Lamont-Doherty's environmental analyses, and previous monitoring reports for the same activities, we do not expect Lamont-Doherty's planned activities to result in injury, serious injury, or mortality within the action area. The required mitigation and monitoring measures would minimize any potential risk for marine mammals.

Vessel Strikes: The potential for striking marine mammals is a concern with vessel traffic. Studies have associated ship speed with the probability of a ship strike resulting in an injury or mortality of an animal. However, it is highly unlikely that Lamont-Doherty would strike a marine mammal given the *Langseth's* slow survey speed (8 to 12 km/hr; 4 to 6 kt). Moreover, mitigation measures would be required of Lamont-Doherty to reduce speed or alter course if a collision with a marine mammal appears likely.

Estimated Take of Marine Mammals by Level B Incidental Harassment: Lamont-Doherty has requested take by Level B harassment as a result of the acoustic stimuli generated by their proposed seismic survey. We expect that the survey would cause a short-term behavioral disturbance for marine mammals in the proposed area.

As mentioned previously, we estimate that the activities could potentially affect, by Level B harassment only, 32 species of marine mammals under our jurisdiction. For each species, these estimates are small numbers relative to the population sizes. Table 7 outlines, the regional density estimates for marine mammals in the action area, the number of Level B harassment takes that we propose to authorize in this Authorization, the percentage of each population or stock proposed for take as a result of Lamont-Doherty's activities, and the population trend for each species.

Table 7 – Proposed Level B harassment take levels, species or stock abundance, and percentage of population proposed for take during the proposed seismic survey in the Atlantic Ocean, June through August, 2015.

Species	Density Estimate[1]	Modeled Number of Instances of Exposures to Sound Levels ≥ 160 dB[2]	Authorized Take[3]	Percent of Species or Stock[4]	Population Trend[5]
Blue whale	0	0	1	0.23	Unknown
Fin whale	0.014	0.65	3	0.23	Unknown
Humpback whale	0	0	3	0.36	Increasing
Minke whale	0	0	2	0.01	Unknown
North Atlantic right whale	0	0	3[6]	0.65	Increasing
Sei whale	0.74	34.48	5[7]	1.40	Unknown
Sperm whale	17.07	795.26	31[7]	1.35	Unknown
Dwarf sperm whale	0.004	0.19	2	0.06	Unknown
Pygmy sperm whale	0.004	0.19	2	0.06	Unknown
Cuvier's beaked whale	0.57	26.56	27	0.41	Unknown
Gervais' beaked whale	0.57	26.56	27	0.37	Unknown
Sowerby's beaked whale	0.57	26.56	27	0.37	Unknown
True's beaked whale	0.57	26.56	27	0.37	Unknown
Blainville's beaked whale	0.57	26.56	27	0.37	Unknown
Northern bottlenose whale	0	0	0	0	Unknown
Rough-toothed dolphin	0	0	0	0	Unknown
Bottlenose dolphin	269	12,532.17	12,532	16.16	Unknown
Pantropical spotted dolphin	0	0	6	0.18	Unknown
Atlantic spotted dolphin	87.3	4,067.13	4,067	18.19	Unknown
Spinner dolphin	0	0	0	0	Unknown
Striped dolphin	0	0	52	0.09	Unknown
Short-beaked common dolphin	0	0	36	0.02	Unknown
White-beaked dolphin	0	0	16	0.80	Unknown
Atlantic white-sided dolphin	0	0	53	0.11	Unknown
Risso's dolphin	32.88	1,531.81	1,532	16.79	Unknown
Fraser's dolphin	0	0	0	0	Unknown
Clymene dolphin	0	0	27	0.44	Unknown

False killer whale	0	0	7	1.58	Unknown
Pygmy killer whale	0	0	2	1.32	Unknown
Killer whale	0	0	7	1.86	Unknown
Long-finned pilot whale	0.444	20.69	21	0.16	Unknown
Short-finned pilot whale	0.444	20.69	21	0.19	Unknown
Harbor porpoise	0	0	4	0.005	Unknown
Gray seal	0	0	2	0.001	Increasing
Harbor seal	0	0	2	0.003	Unknown
Harp seal	0	0	2	0.00003	Increasing

[1] Except where noted, densities are the mean values for the survey area calculated from the SERDP SDSS NODES summer model expressed as number of individuals per 1,000 km^2 (Read *et al*., 2009).

[2] The modeled number of instances of exposures to sound levels ≥ 160 dB re: 1 μPa is the product of the species density (where available), the daily ensonified area of 1,226 km^2, and the number of survey days (30 plus 25 percent contingency for a total of 38 days).

[3] Take estimate includes adjustments for species with no density information or where the SERDP SDSS NODES summer model produced a density estimate of less than 1, NMFS increased the take estimates based on sighting information and mean group size from the Atlantic Marine Assessment Program for Protected Species (AMAPPS) surveys in 2010, 2011, and 2013.

[4,5] Table 2 in this notice lists the stock species abundance estimates used in calculating the percentage of species/stock. Population trend information from Waring *et al*., 2014. Unknown = Insufficient data to determine population trend.

[6] For North Atlantic right whales, NMFS increased the estimated mean group size of one whale (based on CeTAP (1982) and AMAPPS (2010, 2011, and 2013) survey data) to three whales account for cow/calf pairs based on information from Whitt *et al*. (2013).

[7] For sei and sperm whales, the result of the total number of instances of exposures for the duration of the survey would likely overestimate the take estimates because of sei and sperm whale movement patterns and habitat preferences. NMFS adjusted the authorized incidental take based on the mean (average) number of individuals sighted during the 2010, 2011, and 2013 AMAPPS summer surveys (northern and southern legs). These surveys also included fine scale-surveys of NJ waters.

Whitt et al. (2013) conducted acoustic and visual surveys for North Atlantic right whales off the coast of New Jersey from January 2008 to December 2009 and observed one sighting of a cow-calf pair in May 2008, but no other sightings of cow-calf pairs throughout the remainder of the study. NMFS considered this information for the proposed authorization and concluded that it was appropriate to increase Lamont-Doherty's original request for incidental take related to North Atlantic right whales from zero to three (3) to be conservative in estimating potential take for cow/calf pairs.

Our *Federal Register* notice for the proposed Authorization and Lamont-Doherty's application contain complete descriptions of the take estimate calculations. We do not expect the proposed activities to impact rates of recruitment or survival for any affected species or stock. Further, the activities would not adversely affect marine mammal habitat.

Under Alternative 1, the proposed action has no unmitigable adverse impact to subsistence uses, because there are no permitted subsistence uses of marine mammals in the region.

4.2 Effects of Alternative 2– No Action Alternative

Under the No Action Alternative, NMFS would not issue an Authorization to Lamont-Doherty. As a result, Lamont-Doherty would not receive an exemption from the MMPA prohibitions against the take of marine mammals.

NSF has stated that Lamont-Doherty would not conduct the survey in the absence of an Authorization. Thus, Lamont-Doherty would not conduct the seismic survey and marine mammals present in the survey area would not be incidentally harassed. This alternative would eliminate any potential risk to the environment from the proposed research activities. The impacts to the human environment resulting from the No Action alternative—no issuance of the proposed Authorization—would be less than less than the Preferred Alternative because the

4.2.1 Impacts to Marine Mammal Habitat

Under the No Action Alternative, Lamont-Doherty would not conduct the seismic survey and marine mammal habitat would not be affected by the seismic survey. This alternative would eliminate any potential risk to the environment from the proposed research activities.

4.2.2 Impacts to Marine Mammals

Under this No Action Alternative, Lamont-Doherty would not conduct the seismic survey and marine mammals present in the survey area would not be incidentally harassed. This alternative would eliminate any potential risk to the environment from the proposed research activities, and the applicant would not receive an exemption from the MMPA and ESA prohibitions against take.

Under Alternative 2, the proposed action has no unmitigable adverse impact to subsistence uses, as there are no permitted subsistence uses of marine mammals in the region.

4.3 Effects of Alternative 3– No Action / Lamont-Doherty Proceeds with Survey

4.3.1 Impacts to Marine Mammal Habitat

Under this No Action Alternative, Lamont-Doherty's activities would likely result in increased amounts of Level B harassment to marine mammals and possibly takes by injury (Level A harassment), serious injury, or mortality—specifically related to acoustic stimuli—due to the absence of mitigation and monitoring measures required under the proposed Authorization.

4.3.2 Impacts to Marine Mammals

Under this No Action Alternative, Lamont-Doherty's activities would likely result in increased amounts of Level B harassment to marine mammals and possibly takes by injury (Level A harassment), serious injury, or mortality—specifically related to acoustic stimuli—due to the absence of mitigation and monitoring measures required under the proposed Authorization.

While it is difficult to provide an exact number of takes that might occur under the No Action Alternative, we would expect the numbers to be larger than those presented in Table 7 because of the lack of restrictions imposed on Lamont-Doherty's survey operations. Lamont-Doherty could take significantly more marine mammals by harassment due to the lack of required mitigation measures including shutdowns and power downs for marine mammals.

If the activities proceeded without the protective measures and reporting requirements required by a final Authorization under the MMPA, the direct, indirect, or cumulative effects on the human or natural environment of not issuing the Authorization would include the following:

- Marine mammals within the survey area could experience injury (Level A harassment) and potentially serious injury or mortality. The lack of mitigation measures that would otherwise be required in an Authorization could lead to vessels not altering their course or speed around marine mammals, not ramping up or powering or shutting down airguns when marine mammals are within applicable injury harassment zones; and not shutting down for North Atlantic right whales or for groups of six or more large whales;

- Increases in the number of behavioral responses and frequency of changes in animal distribution because of the lack of mitigation measures required in the proposed Authorization. Thus, the incidental take of marine mammals would likely occur at higher levels than we have already identified and evaluated in our *Federal Register* notice on the proposed Authorization; and
- We would not be able to obtain the monitoring and reporting data needed to assess the anticipated impact of the activity upon the species or stock; and increased knowledge of the species as required under the MMPA.

Under Alternative 2, the proposed action has no unmitigable adverse impact to subsistence uses, as there are no permitted subsistence uses of marine mammals in the region.

4.4 Effects of Alternative 4 – Issuance of with Additional Mitigation

4.4.1 Impacts to Marine Mammal Habitat

Effects to the physical environment would be the same under Alternative 3 as those described above for Alternative 1. We would expect no additional effects beyond those already described.

4.4.2 Impacts to Marine Mammals

Under this Alternative, marine mammals would still experience harassment by Lamont-Doherty's proposed seismic survey in the Atlantic Ocean. As described in Alternative 1, anticipated impacts to marine mammals associated with Lamont-Doherty's proposed activities primarily result from noise propagation. Potential impacts to marine mammals might include one or more of the following: tolerance, masking of important natural signals, behavioral disturbance, and temporary or permanent hearing impairment or non-auditory effects. These are the same types of reactions that we would anticipate under the Preferred Alternative (Alternative 1).

The primary difference under Alternative 3 is that we would require additional mitigation and monitoring measures for detecting marine mammals. These additional measures include requiring an alternate time for the survey; implementing operational restrictions for nighttime operations; and the use of alternate technologies to augment monitoring.

Alternate Survey Timing: This measure would require Lamont-Doherty to postpone their research until after the summer season to minimize interactions with recreational fisheries. NSF considered this mitigation measure in their draft amended EA (NSF, 2014a) and final EA (NSF, 2014c) and concluded that the proposed dates for the cruise (June – August) met the Purpose and Need of their action because the personnel and equipment essential to meet the overall project objectives were available. This proposed measure, however, may have the added effect of increasing the number of takes for North Atlantic right whales due to their increased presence off the New Jersey in the fall and winter. Whitt *et al*. (2013) concluded that right whales were not present in large numbers off New Jersey during the summer months (Jun 22 – Sep 27) which corresponds to the effective dates of the seismic survey (June – August). In contrast, peak acoustic detections for the whales occurred in the winter (Dec 18 – Apr 9) and in the spring (Apr 10– Jun 21) for north Atlantic right whales (Whitt, et al., 2013).

Operational Restrictions: This measure would require Lamont-Doherty to suspend their activities in low-light/nighttime conditions and minimize the number of repeated tracklines for the survey. This measure fails to meet one of Lamont-Doherty's research requirements which is to conduct the survey in the shortest time span possible, day and night. The MMPA requires us to take into account the practicability of mitigation measures. Restricting activities to daytime operations only would unnecessarily lengthen the time to complete the survey which would not be practicable from an operational standpoint. Suspending the survey at night would inevitably increase the number of days to complete the survey and would likely result in increased amounts of Level B harassment to marine mammals over a longer duration of time. While the additional measure may provide some added protection for marine mammals present in the research area during nighttime operations, we do not expect that this measure would reduce the overall level of effects. Level B harassment of marine mammals would still occur.

Augmented Monitoring: This measure would require the use of alternative methods to detect marine mammals beyond the proposed visual observation and passive acoustic monitoring. NSF considered this mitigation measure in their draft amended EA (NSF, 2014a) and final EA (NSF, 2014c) and concluded that at the present time, these technologies are still not feasible, commercially viable, or appropriate to meet their Purpose and Need.

While technologies for these monitoring methods are still in development, NMFS expects the new technologies to provide additional marine mammal detection capability beyond that of the visual observations from shipboard observers. In addition, improving monitoring capabilities may allow for necessary mitigation measures (*i.e.*, power-downs and shutdowns) to be implemented more quickly and more frequently, thereby, potentially reducing further the number of marine mammal takes. However, until these technologies are developed and fully tested, we are unable to provide a reasonable estimate of this reduction in take levels.

Under Alternative 3, the proposed action has no unmitigable adverse impact to subsistence uses, as there are no permitted subsistence uses of marine mammals in the region.

4.5 Compliance with Necessary Laws – Necessary Federal Permits

NMFS determined that the issuance of an Authorization is consistent with the applicable requirements of the MMPA, ESA, MSFMCA, and CZMA, and our regulations. Please refer to section 1.4 of this EA for more information.

4.6 Unavoidable Adverse Impacts

Lamont-Doherty's application, our *Federal Register* notice of a proposed Authorization, and other environmental analyses identified previously summarize unavoidable adverse impacts to marine mammals or the populations to which they belong or on their habitats, as well as subsistence uses of marine mammals, occurring in the seismic survey area. We incorporate those documents by reference.

We acknowledge that the incidental take Authorization would potentially result in unavoidable adverse impacts. However, we do not expect Lamont-Doherty's activities to have adverse consequences on the viability of marine mammals in the Atlantic Ocean. We do not expect the marine mammal populations in that area to experience reductions in reproduction, numbers, or distribution that might appreciably reduce their likelihood of surviving and recovering in the wild.

We expect that the numbers of individuals of all species taken by harassment would be small (relative to species or stock abundance), that the seismic survey and the take resulting from the seismic survey activities would have a negligible impact on the affected species or stocks of marine mammals, and that there would not be any relevant subsistence impacts.

4.7 Cumulative Effects

NEPA defines cumulative effects as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR §1508.7). Cumulative impacts can result from individually minor but collectively significant actions that take place over a period of time.

The proposed seismic survey would add another, albeit temporary, activity to the marine environment in the Atlantic Ocean and the proposed survey would be limited to a relatively small area for a comparatively short period of time. NSF's draft amended EA (NSF, 2014a) and final EA (NSF, 2014c) summarize the potential cumulative effects to marine mammals or the populations to which they belong to and their habitats within the survey area. This section incorporates the NSF's draft amended EA (NSF, 2014a) and final EA (NSF, 2014c)by reference and provides a brief summary of the human-related activities affecting the marine mammal species in the action area.

4.7.1 Previous Seismic Research Surveys in the Same Area

NSF's draft amended EA (NSF, 2014a) and final EA (NSF, 2014c) acknowledges that scientists have conducted numerous seismic surveys in the general vicinity of the proposed survey from 1979 to 2002. The previous surveys used different airgun array configurations (*e.g.*, a 6-airgun, 1,350-in^3 array in 1990; a single, 45-in^3 GI Gun in 1996 and 1998; and two 45-in^3 GI Guns in 2002).

4.7.2 Future Seismic Research in the Atlantic Ocean

The U.S. Geological Survey (USGS) would conduct two seismic surveys over the span of two years to support the delineation of the U.S. Extended Continental Shelf (ECS) in the Atlantic Ocean August through September, 2014, and April to August, 2015. The USGS would use the *Langseth* to conduct survey for approximately 18 to 21 days covering approximately 3,000 km of seismic tracklines that do not overlap with Lamont-Doherty's proposed survey offshore New Jersey.

USGS' 2015 survey is short-term in nature. As the Authorization holder, USGS would be required to use mitigation and monitoring measures to minimize impacts to marine mammals and other living marine resources in the activity area. We are unaware of any synergistic impacts to marine resources associated with reasonably foreseeable future actions that may be planned or occur within the same region of influence as the proposed survey.

4.7.3 Unusual Mortality Event (UME) for Bottlenose Dolphins

NOAA has declared an UME for bottlenose dolphins along the Atlantic coast from early July 2013 through the present. Elevated strandings of bottlenose dolphins have occurred in North Carolina. All age classes of bottlenose dolphins are involved and strandings range from a few live animals to mostly dead animals with many very decomposed (NMFS, 2014a). Based upon preliminary diagnostic testing and discussion with disease experts, the tentative cause of this UME could be cetacean morbillivirus (NMFS, 2014c). However the investigation is still ongoing and additional contributory factors (pathogens, biotoxins, range expansion) to the UME are under investigation. (NMFS, 2014c).

4.7.4 Military Activities

Although the proposed survey will occur within the U.S. Navy's Atlantic City Range Complex, this range is one of several range complexes collectively referred to as the "Northeast Range Complexes". The type of activities conducted by the U.S. Navy in these range complexes includes the use of active sonars, gunnery events with both inert and explosive rounds, bombing events with both inert and explosive bombs, and other testing and training activities (NSF, 2014a). . If Lamont-Doherty's proposed activities were to occur simultaneously, the cumulative environmental effects resulting from the seismic survey would be negligible and not additive or cumulative because the proposed survey would be transitory, moving about 200 km a day. The implementation of mitigation measures and the limited spatial overlap with other activities would minimize any potential for cumulative effects.

4.7.5 Future Oil and Gas Exploration

The proposed survey site is outside of the Bureau of Ocean and Energy's (BOEM) Outer Continental Shelf (OCS) Mid-Atlantic and South Atlantic Planning Areas for proposed geological and geophysical (G&G) activities (BOEM, 2014). We do not anticipate that the BOEM activities would occur simultaneously to Lamont-Doherty's proposed seismic survey and we are unaware of any synergistic impacts to marine resources associated with reasonably foreseeable future actions that may be planned or occur within the same region of influence as the proposed survey.

4.7.6 Climate Change

4.7.6.1 Introduction

Climate change is a global issue and greenhouse gas emissions are a concern from a cumulative perspective because individual sources of greenhouse gas emissions are not large enough to have an appreciable impact on climate change. Greenhouse gases are compounds that contribute to the greenhouse effect, a natural phenomenon in which these gases trap heat within the surface-troposphere (lowest portion of the earth's atmosphere) system, causing heating (radiative forcing) at the surface of the earth. Scientific evidence indicates a trend of increasing global temperature over the past century due to increasing greenhouse gas emissions from human activities (Karl et al., 2009). Additionally, the Intergovernmental Panel on Climate Change reports that physical and biological systems on all continents, and in most oceans, are already being affected by climate changes and that there is strong evidence for global warming associated weather changes and that humans have "very likely" contributed to this problem through burning fossil fuels and adding other "greenhouse gases" to the atmosphere (IPCC, 2007a, 2007b). Finally, some of the major potential concerns for the marine environment as a result of global warming include sea temperature rise, melting of polar ice, rising sea levels, changes to major ocean current systems and ocean acidification.

4.7.6.2 Climate Change and the Northeast United States

Over the last several decades, the Northeast United States has experienced noticeable changes in its climate. Since 1970, the average annual temperature rose by 2°F and the average winter temperature increased by 4°F. Heavy precipitation events increased in magnitude and frequency, and for the region as a whole, the majority of winter precipitation now falls as rain, not snow. Climate scientists project that these trends will continue and over the next several decades, temperatures in the Northeast are projected to rise an additional 2.5 to 4°F (1.4 to 2.2°C) in winter and 1.5 to 3.5°F (0.8 to 1.9°C) in summer. It is further projected that the Northeast will face continued warming and more extensive climate-related changes, some of which could dramatically alter the region's economy, landscape, character and quality of life (Karl, et al., 2009)

With the large degree of uncertainty on the impact of climate change to marine mammals in the Atlantic, we recognize that warming of this region could affect the prey base and habitat quality for marine mammals. Nonetheless, we expect that the conduct of the seismic survey and the issuance of an Authorization to Lamont-Doherty would not result in any noticeable contributions to climate change.

CHAPTER 5 – LIST OF PREPARERS AND AGENCIES CONSULTED

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

FINDING OF NO SIGNIFICANT IMPACT FOR THE PROPOSED ISSUANCE OF AN INCIDENTAL HARASSMENT AUTHORIZATION TO LAMONT-DOHERTY EARTH OBSERVATORY TO TAKE MARINE MAMMALS INCIDENTAL TO CONDUCTING A MARINE GEOPHYSICAL SURVEY IN THE NORTHWEST ATLANTIC OCEAN, JUNE – AUGUST, 2015

NATIONAL MARINE FISHERIES SERVICE

BACKGROUND

We (National Marine Fisheries Service, Office of Protected Resources, Permits and Conservation Division) propose to issue an Incidental Harassment Authorization (Authorization) to Lamont-Doherty Earth Observatory of Columbia University (Lamont-Doherty) under the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. 1631 *et seq.*) for the incidental taking of small numbers of marine mammals, incidental to the conduct of a marine geophysical (seismic) survey in federal waters in the northwest Atlantic Ocean, June through August, 2015.

Under the MMPA, NMFS, shall grant authorization for the incidental taking of small numbers of marine mammals if we find that the taking will have a negligible impact on the species or stock(s), and would not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant). The Authorization must prescribe, where applicable, the permissible methods of taking; other means of effecting the least practicable impact on the species or stock and its habitat; and requirements pertaining to the mitigation, monitoring and reporting of such taking.

Our proposed action is a direct outcome of Lamont-Doherty requesting an authorization to take marine mammals, by harassment, incidental to conducting a marine seismic survey within the Atlantic Ocean. Lamont-Doherty's seismic survey activities, which have the potential to behaviorally disturb marine mammals, warrant an incidental take authorization from us under section 101(a)(5)(D) of the MMPA.

The issuance of an Authorization to Lamont-Doherty would allow for the taking of marine mammals, consistent with provisions under MMPA, and is considered a major federal action under the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq.*). Thus, we prepared an Environmental Assessment (EA) in accordance with NEPA, the Council on Environmental Quality (CEQ) regulations in 40 CFR §§ 1500-1508, and NOAA Administrative Order (NAO) 216-6 "*Environmental Review Procedures for Implementing the National Environmental Policy Act*".

The EA addresses the potential environmental impacts of the proposed action and alternatives for the issuance of an Authorization and incorporates, by reference, all relevant analyses of Lamont-Doherty's proposed action within the following documents:

- NMFS' notice of the proposed Authorization in the *Federal Register* (80 FR 13961, March 17, 2015);

- *Request for an Incidental Harassment Authorization to Allow the Incidental Take of Marine Mammals during a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Atlantic Ocean off New Jersey, Summer, 2015* (LGL, 2014);
- *Final Environmental Assessment of a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Atlantic Ocean off New Jersey, June–July 2014* (NSF, 2014c);
- *Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Atlantic Ocean off New Jersey, Summer 2015* (NSF, 2014a);
- *Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey* (NSF, 2011); and
- *Record of Decision for Marine Seismic Research Funded by the National Science Foundation. June, 2012* (NSF, 2012)

We considered four alternatives in the analysis and Alternative 1 is the preferred alternative And based on our review of Lamont-Doherty's proposed seismic survey and the measures contained within Alternative 1, we have determined that no significant direct, indirect, or cumulatively significant impacts to the human environment would occur from implementing the Preferred Alternative.

ANALYSIS

NAO 216-6 (May 20, 1999) contains criteria for determining the significance of the impacts of a proposed action. In addition, the CEQ regulations at 40 CFR §1508.27 state that the significance of an action should be analyzed both in terms of "context" and "intensity." Each criterion listed below this section is relevant to making a finding of no significant impact. We have considered each criterion individually, as well as in combination with the others. We analyzed the significance of this action based on the NAO 216-6 criteria and CEQ's context and intensity criteria. These include:

1) **Can the proposed action reasonably be expected to cause substantial damage to the ocean and coastal habitats and/or essential fish habitat as defined under the Magnuson-Stevens Act and identified in Fishery Management Plans (FMP)?**

   Response: Our proposed action of issuing an Authorization for the take of marine mammals incidental to the conduct of a seismic survey is not expected to cause damage to the ocean and coastal habitats and/or essential fish habitat. The mitigation and monitoring measures required by the Authorization would not affect ocean and coastal habitats or essential fish habitat.

   There are marine species with EFH overlapping the proposed survey area. Effects on EFH by Lamont-Doherty's survey and issuance of the Authorization assessed here would be temporary and minor. The main effect would be short-term disturbance that might lead to temporary and localized relocation of the EFH species or their food. The actual physical and chemical properties of the EFH would not be impacted by our proposed action. Therefore, NMFS, Office of Protected Resources, Permits and Conservation Division has determined that the issuance of an Authorization for the taking of marine mammals incidental to Lamont-Doherty's seismic survey would not have an adverse impact on EFH, and an EFH consultation is not required.

2) Can the proposed action be expected to have a substantial impact on biodiversity and/or ecosystem function within the affected area (e.g., benthic productivity, predator-prey relationships, etc.)?

Response: We do not expect our action to have a substantial impact on biodiversity or ecosystem function within the affected environment. Our proposed action of authorizing Level B harassment for Lamont-Doherty's seismic survey would be limited to temporary behavioral responses (such as brief masking of natural sounds) and temporary changes in animal distribution. These effects would be short-term and localized.

3) Can the proposed action reasonably be expected to have a substantial adverse impact on public health or safety?

Response: The proposed survey activities would occur in the Atlantic Ocean, approximately 25 to 85 km (15.5 to 52.8 mi) off the coast of New Jersey between approximately 39.3–39.7° N and approximately 73.2–73.8° W and away from any populated area. We do not expect our action to have a substantial adverse impact on public health or safety as the taking, by harassment, of marine mammals would pose no risk to humans.

4) Can the proposed action reasonably be expected to adversely affect endangered or threatened species, their critical habitat, marine mammals, or other non-target species?

Response: We have determined that our issuance of an Authorization would likely result in limited adverse effects to 32 species of marine mammals. The EA evaluates the affected environment and potential effects of our proposed action, indicating that Lamont-Doherty's seismic survey has the potential to affect marine mammals in a way that requires authorization under the MMPA. The activities and required mitigation measures would not affect physical habitat features, such as substrates and water quality.

We have determined that the proposed activities may result in some Level B harassment (in the form of short-term and localized changes in behavior and displacement) of small numbers, relative to the population sizes, of 32 species of marine mammals. The impacts of the seismic survey on marine mammals relate to acoustic activities, and we expect these to be temporary in nature and not result in substantial impact to marine mammals or to their role in the ecosystem.

The seismic surveys may have the potential to adversely affect the following species listed as threatened or endangered marine mammals under the Endangered Species Act of 1973 (ESA; 16 U.S.C. 1531 *et seq.*): blue, fin, humpback, North Atlantic right, sei, and sperm whales. A May 2015 Biological Opinion issued under the ESA concluded that Lamont-Doherty's project was not likely to jeopardize the continued existence of any listed species and would not affect critical habitat.

To reduce the potential for disturbance from the activities, Lamont-Doherty would implement several monitoring and mitigation measures for marine mammals, which are outlined in the EA. Taking these measures into consideration, we expect that the responses of marine mammals from the Preferred Alternative would be limited to temporary displacement from the area and/or short-term behavioral changes, falling within the MMPA definition of "Level B harassment." We do not anticipate that take by injury (Level A harassment), serious injury, or mortality would occur, nor have we authorized take by injury, serious injury, or mortality. We expect that impacts would be at the lowest level practicable due to the incorporation of the proposed mitigation measures.

5) **Are significant social or economic impacts interrelated with natural or physical environmental effects?**

Response: We expect that the primary impacts to the natural and physical environment would be temporary in nature with no interrelated significant social or economic impacts. Issuance of an Authorization would not result in inequitable distributions of environmental burdens or access to environmental goods.

We have determined that issuance of the Authorization would not adversely affect low-income or a minority population—as our action only affects marine mammals. Further, there would be no impact of the activity on the availability of the species or stocks of marine mammals for subsistence uses, as there are no such uses of marine mammals in the proposed action area. Therefore, we expect that no significant social or economic effects would result from our issuance of an Authorization or Lamont-Doherty's proposed seismic survey.

6) **Are the effects on the quality of the human environment likely to be highly controversial?**

Response: Although there is some lack of agreement within the scientific and stakeholder communities about the potential effects of noise on marine mammals, there is not a substantial dispute about the size, nature, or effect of our proposed action. For several years, we have assessed and authorized incidental take for multiple geophysical surveys conducted within the same year and have developed relatively standard mitigation and monitoring measures, all of which have been vetted during past public comment periods. The scope of this action is no different than past geophysical surveys, is not unusually large or substantial, and would include the same or similar mitigation and monitoring measures required in past surveys. Previous projects of this type required marine mammal monitoring and monitoring reports, which have been reviewed by us to ensure that activities have a negligible impact on marine mammals.

NMFS received comments from private citizens, the state of New Jersey, 2 organizations, and the Marine Mammal Commission. Members of the public commented on their general opposition towards any type of seismic study within the Atlantic Ocean and Lamont-Doherty's action. We fully considered all of the public comments in preparing the proposed Authorization and the EA. Although some members of the public have raised concern over the effects of the survey, we have determined, based on the best available scientific literature, the limited duration of the project, and the low-level effects to marine mammals, that our proposed Authorization would have a negligible impact on the affected species or stocks of marine mammals.

7) **Can the proposed action reasonably be expected to result in substantial impacts to unique areas, such as historic or cultural resources, park land, prime farmlands, wetlands, wild and scenic rivers, essential fish habitat, or ecologically critical areas?**

Response: The issuance of an Authorization for the take of marine mammals incidental to the conduct of a seismic survey would not impact the survey area. There are no unique areas, such as historic or cultural resources, park land, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas that could potentially be affected by our proposed action. The impacts to EFH and habitat from Lamont-Doherty's action would likely have minor adverse effects but would be localized and short-term in nature. (See responses to questions 1 and 2.)

8) **Are the effects on the human environment likely to be highly uncertain or involve unique or unknown risks?**

Response: The potential risks associated with research seismic surveys are neither unique nor unknown nor is there significant uncertainty about impacts. We have issued Authorizations for similar activities or activities with similar types of marine mammal harassment in the Atlantic, Pacific, and Southern Oceans and conducted NEPA analysis on those projects. In no case have impacts to marine mammals from these past activities, as determined from monitoring reports, exceeded our analysis under the MMPA and NEPA. Therefore, we expect any potential effects from the issuance of our Authorization to be similar to prior activities which are not likely to be highly uncertain or involve unique or unknown risks.

9) **Is the proposed action related to other actions with individually insignificant, but cumulatively significant impacts?**

Response: The EA and the documents it references analyzed the issuance of an Authorization for the take of marine mammals incidental to the conduct of a seismic survey the impacts of the seismic survey in light of other human activities within the study area. We expect the following combination to result in no more than minor and short-term impacts to marine mammals in the survey area in terms of overall disturbance effects: (a) our issuance of an Authorization with prescribed mitigation and monitoring measures for the seismic survey; (b) past, present, and reasonably foreseeable future seismic surveys in the Atlantic Ocean offshore New Jersey; (c) military activities; (d) unusual mortality event for bottlenose dolphins; (e) future oil and gas exploration; and (f) climate change.

The proposed action of Lamont-Doherty conducting the survey in the Atlantic Ocean and our proposed action of issuing an Authorization to Lamont-Doherty for the incidental take (Level B behavioral harassment) of a small number of marine mammals are interrelated. The survey conducted under the requirements of an Authorization authorizing Level B harassment of marine mammals is not expected to result in cumulatively significant impacts when considered in relation to other separate actions with individually insignificant effects.

We have issued incidental take authorizations for other research surveys that may have resulted in the harassment of marine mammals, but these research seismic surveys are dispersed both geographically (throughout the world) and temporally, are short-term in nature, and use mitigation and monitoring measures to minimize impacts to marine mammals and to minimize other potential adverse environmental impacts in the activity area.

We are aware of one other research seismic survey in the Atlantic Ocean scheduled for offshore New Jersey. On August 21, 2014, we issued an Authorization for a U.S. Geological Survey (USGS) survey for the take of marine mammals, by Level B harassment, incidental to conducting a seismic survey in the Atlantic Ocean off the eastern seaboard, August to September, 2014 and April, 2015. The USGS prepared a separate EA for their action and issued a FONSI. NMFS adopted the EA on August 21, 2014 and determined that the issuance of the Authorization was not likely to result in significant impacts on the human environment and prepared a FONSI.

Both USGS surveys are dispersed both geographically and temporally, and are short-term in nature. The Authorizations require mitigation and monitoring measures to minimize impacts to marine mammals and other living marine resources in the activity area. We are unaware of any synergistic impacts to marine resources associated with reasonably foreseeable future actions that may be planned or occur within the same region of influence.

The Cumulative Effects section of the EA and the material incorporated by reference go into more detail regarding other past, present, and reasonably foreseeable future actions, but concludes that the impacts of Lamont-Doherty's proposed survey in the Atlantic Ocean are expected to be no more than minor and short-term with no potential to contribute to cumulatively significant impacts.

10) Is the proposed action likely to adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources?

Response: We have determined that the proposed action is not an undertaking with the potential to affect historic resources. The issuance of an Authorization for the take of marine mammals incidental to the conduct of a seismic survey would affect marine mammals and would not adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or cause loss or destruction of significant scientific, cultural or historical resources.

11) Can the proposed action reasonably be expected to result in the introduction or spread of a non-indigenous species?

Response: Our proposed action does not have the potential to introduce or spread non-indigenous species because it does not encourage or require the *Langseth* to conduct long-range vessel transit that would lead to the introduction or spread of non-indigenous species. The *Langseth* complies with all international and U.S. national ballast water requirements to prevent the spread of a non-indigenous species.

12) Is the proposed action likely to establish a precedent for future actions with significant effects or does it represent a decision in principle about a future consideration?

Response: Our action of issuing an Authorization for the take of marine mammals incidental to the conduct of a seismic survey would not set a precedent for future actions with significant effects or represent a decision in principle. Each MMPA authorization applied for under section 101(a)(5) must contain information identified in our implementing regulations. We consider each activity specified in an application separately and, if we issue an Authorization, we must determine that the impacts from the specified activity would result in a negligible impact to the affected species or stocks. Our issuance of an Authorization may inform the environmental review for future projects, but would not establish a precedent or represent a decision in principle about a future consideration.

13) Can the proposed action reasonably be expected to threaten a violation of any Federal, State, or local law or requirements imposed for the protection of the environment?

Response: The issuance of an Authorization would not result in any violation of federal, state, or local laws for environmental protection. The applicant is required to obtain any additional federal, state, and local permits necessary to carry out the proposed activities.

14) Can the proposed action reasonably be expected to result in cumulative adverse effects that could have a substantial effect on the target species or non-target species?

Response: The proposed action would not result in any significant cumulative adverse effects on target or non-target species incidentally taken by harassment due to seismic survey activities.

We have determined that marine mammals may exhibit behavioral changes such as avoidance of or changes in movement within the action area. However, we do not expect the authorized harassment to result in significant cumulative adverse effects on the affected species or stocks.

We have issued incidental take authorizations for other seismic research surveys (to Lamont-Doherty and other entities) that may have resulted in the harassment of marine mammals, but they are dispersed both geographically (throughout the world) and temporally, are short-term in nature, and all use mitigation and monitoring measures to minimize impacts to marine mammals. Because of the relatively short time that the project area would be ensonified (not more than 30 days), the action would not result in synergistic, or cumulative adverse effects that could have a substantial effect on any species.

DETERMINATION

In view of the information presented in this document and the analysis contained in the supporting EA titled *"Issuance of an Incidental Harassment Authorization to Lamont-Doherty Earth Observatory to Take Marine Mammals by Harassment Incidental to a Marine Geophysical Survey in the Northwest Atlantic Ocean, June – August, 2015"*, and documents that it references, we have determined that issuance of an Incidental Harassment Authorization to Lamont-Doherty in accordance with Alternative 1 (Preferred Alternative) would not significantly impact the quality of the human environment, as described in this FONSI and in the EA.

In addition, we have addressed all beneficial and adverse impacts of the action to reach the conclusion of no significant impacts. Accordingly, the preparation of an Environmental Impact Statement for this action is not necessary.

Perry Gayaldo

for Donna S. Wieting
Director, Office of Protected Resources,
National Marine Fisheries Service

MAY - 5 2015

Date

APPENDIX F

PUBLIC COMMENTS ON DRAFT AMENDED EA

[redacted]

From: Francis Bovasso LII <[redacted]>
Sent: Monday, January 05, 2015 9:43 AM
To: NSF COMMENT NJ
Subject: seismic blasting

To Whom it may concern,

The last thing we need is seismic blasting off our coast. I have run a struggling Charter Boat Business out of Manasquan for over 10 years. Between Sandy destroying the reefs (by covering up with sand)(and ending our season early), ridiculous Government Regulations (on seasons and bag limits), and the horrendous economy, us Charter Boat operators are becoming extinct.

1 This blasting has shown to disrupt fish migration, kill fish and decimate the shellfish, over the long and short term. What are you thinking? It is better to kill a resource because this cheap technology is what's best for the oil industry research. It is no different than draining a lake to see whats on the bottom.

I am one, but between my Family, Friends, Associates, and Customers, ...if this happens we will cross party lines and vote out whoever is part of this administration, and seek legal actions. You screw with MY JOB I'm going to see you lose yours.

Captain Frank Bovasso
Predator Sport Fishing
[redacted]

[redacted]

From:	Jack Fullmer <[redacted]>
Sent:	Wednesday, January 14, 2015 2:07 PM
To:	NSF COMMENT NJ; Dive-NJCDC- Glenn Arthur; Kim Hansen; Mike Lavitt; Jack Fullmer
Subject:	Comments -Geophysical survey
Attachments:	Geophysical Survey.doc

Attached please find comments from the NJ Council of Diving Clubs on the proposed Seismic Survey off Barnegat Inlet this summer.
Jack Fullmer

NEW JERSEY COUNCIL OF DIVING CLUBS

P. O. Box 841
Eatontown, NJ 07724-0841
http://www.scubanj.org

Comments
Marine Geophysical Survey by the
R/V Marcus G. Langseth
Summer, 2015

1/11/15

National Science Foundation
Division of Ocean Sciences
4201 Wilson Blvd, Suite 725
Arlington, VA 22230

The New Jersey Council of Diving Clubs (NJCDC) is an organization of 14 sport diving clubs in New Jersey with a few clubs in nearby states. Recreational Sport Diving is a multi-million dollar industry in New Jersey with 30 specialized dive shops, about 25 commercial dive boats, even more private dive boats, and several manufacturing companies devoted to producing dive gear and supporting the sport. Most diving off NJ is done on shipwrecks and artificial reefs. The NJCDC respectfully submits the following comments on the proposal to conduct a seismic survey southeast of Barnegat Inlet this summer.

Our first concern is for the safety of Sport Divers who do not presently know how close they can be
to the seismic survey vessel. Your EIS stated you would coordinate with the sport diving community prior
2 to the survey! Last year the NJCDC made repeated efforts to contact the project and ask that question, and
it took a number of weeks before someone from Columbia University finally got back to us and attempted
to answer that question.

His answer was that sport divers need to stay 3.2 miles from the Marcus G. Langseth for a dB level of 160 with a 4 airgun subarray, and I'm sure he felt that would be safe. However, the US Office of Naval Research suggests an underwater dB level of 145 for safety for sport divers and we do not have a distance for that dB level. When we contacted DAN (Diver Alert Network) which handles most safety concerns for the sport diving community, we were told to follow OSHA guidelines which top off at 115 dB, which I believe is for air. Consequently, we are a little bit confused and uncertain on this issue and need a definitive answer ASAP and before the project begins.

The second issue is the way the coordinates for the survey area are being represented on a chart.
Most dive boats use GPS coordinates which represent positions as degrees, minutes, and up to a thousandth
3 of a minute. It might be better for the dive boats and fishing boats if the chart that represents the survey
rectangle or the security rectangle were represented in GPS coordinates rather than the way you are
presently presenting the coordinates in your notice or EIS. At least I had some problems plotting it.

The third issue is that the EIS only mentions the Lillian shipwreck within the survey area.
Although I personally am not familiar with other shipwrecks in that area, there may be other wrecks in that
area and/or within 3.2 miles of the survey area or within a 145 dB level of the survey area that are visited
by divers. Most of the inshore area of the survey rectangle are depths that are within dive limits. The
4 NOAA Automated Wreck and Obstruction List is not a complete list of wrecks and obstructions off the NJ
coast. There are estimated to be almost 7000 wrecks off the NJ coast, so do not assume there are no other
wrecks close by that could be visited by other dive boats.

5 Finally, the NJCDC does not want marine life injured by this project. National Marine Fisheries should consider remotely monitoring the fish and marine life in the survey rectangle during the survey, perhaps on the Lillian wreck as all wrecks are a focal point for marine life. And, within a safe distance, we hope to be down there with our underwater cameras to record any impact on marine life..

Sincerely

Jack Fullmer
Legislative Committee.
NJCDC

Please reply directly to :

Jack Fullmer
[redacted]

Since I am presently out of state for some time, you might also want to cc:

Glen A. Arthur
Chairman, NJCDC
[redacted]

6 PS: We do look forward to coordinating with the same individual that tried to help from Columbia University again this year, and we need to know exactly when the survey will be run!

[redacted]

From:	Cassandra Ornell (Clean Ocean Action) <Science@cleanoceanaction.org>
Sent:	Friday, January 16, 2015 2:23 PM
To:	NSF COMMENT NJ
Cc:	Cindy Zipf (Clean Ocean Action)
Subject:	Request for 30-day extension on public comment period
Attachments:	COA seismic extension request letter - 01-16-15.pdf

To Whom It May Concern:

Please find attached a letter from Clean Ocean Action requesting a 30-day extension on the public comment period for the for Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015.

Please contact Cindy Zipf (copied here) with any questions or to discuss this request further.

Best,

Cassandra Ornell
Staff Scientist
Clean Ocean Action (COA)
18 Hartshorne Drive, Suite 2
Highlands, NJ 07732

(p) 732-872-0111 (f) 732-872-8041

January 16, 2015

Via electronic mail sent to nsfcommentnj@nsf.gov
Mr. Richard W. Murray
Division Director, Division of Ocean Sciences
Directorate for Geosciences
National Science Foundation
4201 Wilson Boulevard
Arlington, Virginia 22230

RE: Request for a 30-day extension on the comment period for Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015

Dear Mr. Murray:

On behalf of the over 115 environmental, fishing, boating, business, women's, religious, and other groups represented in the Clean Ocean Action coalition, we are requesting a 30-day extension to the public comment period for the Draft Amended Environmental Assessment (EA) of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015.

Any proposal to perform seismic surveys off the coasts of New Jersey and New York is a matter of significant public import. Seismic surveys may threaten significant harm to marine mammals, sea turtles, fish, and invertebrates, and may threaten human uses of the ocean for activities such as fishing and recreation. Accordingly, the public should be afforded the adequate time and opportunity to take a hard look at the proposed seismic survey.

This project is of great interest and concern to many groups and individuals in the environmental, fishing,
7 diving, and tourism sectors, as well as to the New Jersey State Legislature and several federal and state elected officials.

The Draft Amended EA contains references to 126 additional sources of published data and scientific literature, which were not contained in the December 2013 Draft EA. Given the extent of new information cited in the Draft Amended EA, this information must be assessed and cross-referenced with the original publications. Finally, time is needed for us to share our conclusions with the network of organizations and interested parties.

For these reasons, it is imperative that the public be provided with an additional 30 days to review the Draft Amended EA and submit comments. We would welcome an opportunity to discuss this matter with you or your staff at your convenience. For further discussion, please contact Cindy Zipf at Clean Ocean Action at 732.872.0111 or zipf@cleanoceanaction.org.

Thank you for your consideration of our request and we look forward to hearing from you.

Sincerely,

Cindy Zipf
Executive Director
Clean Ocean Action

[redacted]

From: EDWARD YATES <[redacted]>
Sent: Sunday, January 18, 2015 1:18 PM
To: NSF COMMENT NJ
Subject: Eddie Yates
Attachments: UBONJ.docx

DATE: January 18th, 2015

Via electronic mail sent to nsfcommentnj@nsf.gov

Mr. Richard W. Murray

Division Director, Division of Ocean Sciences

Directorate for Geosciences

National Science Foundation

4201 Wilson Boulevard

Arlington, Virginia 22230

RE: Request for a 30-day extension on the comment period for Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Atlantic Ocean off New Jersey, Summer 2015

Dear Mr. Murray:

On behalf of United Boatman of New Jersey we are requesting a 30-day extension to the public comment period for the Draft Amended Environmental Assessment (EA) of a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Atlantic Ocean off New Jersey, Summer 2015.

8 The reasons that the United Boatman of New Jersey are requesting a 30-day extension are due to the migrating species of fish including bluefish, sea bass, fluke, and school sized blue fin tuna which migrate from south to north and east to west during that time frame. We cannot afford any disruption in normal patterns as we are restricted to such a limited season for these species already. Any disruption in normal pattern could and more likely will cause disruption in their normal traveling patterns and result in days lost at sea.

9 Any proposal to perform seismic surveys off the coasts of New Jersey and New York is a matter of significant public import. Seismic surveys may threaten significant harm to marine mammals, sea turtles, fish, and invertebrates, and may threaten human uses of the ocean for activities such as fishing and recreation. Accordingly, the public should be afforded the adequate time and opportunity to take a hard look at the proposed seismic survey.

This project is of great interest and concern to many groups and individuals in the environmental, fishing, diving, and tourism sectors, as well as to the New Jersey State Legislature and several federal and state elected officials.

The Draft Amended EA contains references to 126 additional sources of published data and scientific literature that were not contained in the December 2013 Draft EA. Given the extent of new information cited in the Draft Amended EA, this information must be assessed and cross-referenced with the original publications. Finally, time is needed for us to share our conclusions with the network of organizations and interested parties.

For these reasons, it is imperative that the public be provided with an additional 30 days to review the Draft Amended EA and submit comments. We would welcome an opportunity to discuss this matter with you or your staff at your convenience. For further discussion, please contact Eddie Yates and [redacted] or email me at [redacted].

Thank you for your consideration of our request and we look forward to hearing from you.

Sincerely,

Captain Eddie Yates, President of the United Boatman of New Jersey

[redacted]

From: Mary Wilding <[redacted]>
Sent: Sunday, January 18, 2015 3:18 PM
To: NSF COMMENT NJ
Subject: Request for 30 day extension on comment period re Marine Geophysical Survey by R/V Marcus G. Langseth
Attachments: Ltr re extension for seismic blasting proposal.doc

Please see attached letter. Thank you. Mary C. Wilding

January 19, 2015

Mr. Richard W. Murray
Division Director, Division of Ocean Sciences
Directorate for Geosciences
National Science Foundation
4201 Wilson Boulevard
Arlington, Virginia 22230

RE: Request for a 30-day extension on the comment period for Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015

Dear Mr. Murray:

As a concerned citizen who lives on the New Jersey shore, I am requesting a 30-day extension to the public comment period for the Draft Amended Environmental Assessment (EA) of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015.

Any proposal to perform seismic surveys off the coasts of New Jersey and New York is a matter of significant public import. Seismic surveys may do significant harm to marine mammals, sea turtles, fish, and invertebrates, and may threaten human uses of the ocean for activities such as fishing and recreation. Accordingly, individuls and organizations should be afforded the adequate time and opportunity to take a hard look at the proposed seismic survey and investigate research findings from similar activities.

This project is of great interest and concern to many groups with which I am affiliated and individuals in the environmental, fishing, diving, and tourism sectors, as well as to the New Jersey State Legislature and several federal and state elected officials.

10 The Draft Amended EA contains references to 126 additional sources of published data and scientific literature that were not contained in the December 2013 Draft EA. Given the extent of new information cited in the Draft Amended EA, this information must be assessed and cross-referenced with the original publications. Finally, time is needed for us to share conclusions with the network of organizations and interested parties.

For these reasons, it is imperative that the public be provided with an additional 30 days to review the Draft Amended EA and submit comments. I would welcome an opportunity to discuss this matter with you or your staff at your convenience. For further discussion, please contact me.

I thank you for your consideration of our request and look forward to hearing from you.

Sincerely,

Mary C. Wilding
[redacted]

[redacted]

From: Marlena Christensen <[redacted]>
Sent: Tuesday, January 20, 2015 1:13 PM
To: NSF COMMENT NJ
Subject: Attn: Richard W Murray, Division of Ocean Sciences

Dear Mr. Murray,

As a concerned citizen who lives on the New Jersey shore, I am requesting a 30-day extension to the public comment period for the Draft Amended Environmental Assessment (EA) of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015.

Any proposal to perform seismic surveys off the coasts of New Jersey and New York is a matter of significant public import. Seismic surveys may do significant harm to marine mammals, sea turtles, fish, and invertebrates, and may threaten human uses of the ocean for activities such as fishing and recreation. Accordingly, individuls and organizations should be afforded the adequate time and opportunity to take a hard look at the proposed seismic survey and investigate research findings from similar activities.

This project is of great interest and concern to many groups with which I am affiliated and individuals in the
11 environmental, fishing, diving, and tourism sectors, as well as to the New Jersey State Legislature and several
federal and state elected officials.

The Draft Amended EA contains references to 126 additional sources of published data and scientific literature that were not contained in the December 2013 Draft EA. Given the extent of new information cited in the Draft Amended EA, this information must be assessed and cross-referenced with the original publications. Finally, time is needed for us to share conclusions with the network of organizations and interested parties.

For these reasons, it is imperative that the public be provided with an additional 30 days to review the Draft Amended EA and submit comments. I would welcome an opportunity to discuss this matter with you or your staff at your convenience. For further discussion, please contact me.

I thank you for your consideration of our request and look forward to hearing from you.

Sincerely,

Marlena Christensen
[redacted]

[redacted]

From: Glenn Arthur <[redacted]>
Sent: Wednesday, January 21, 2015 2:39 PM
To: NSF COMMENT NJ
Subject: Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Atlantic Ocean off New Jersey, Summer 2015

As a concerned citizen I have researched your Draft Environmental Assesment. At no point in the document is the safety of recreational SCUBA divers mentioned. In your previous attempt in 2014 your Final Environmental Assesment stated:

13 "Significant impacts on, or conflicts with, divers or diving activities would be avoided through communication with the diving community before and during the survey and publication of a Notice to Mariners about operations in the area."

Page 52

http://www.nsf.gov/geo/oce/envcomp/nj-seismic-research/nj-final-ea-1-july-2014.pdf

To my knowledge no such "communication" occurred. Most online lists of "for hire" dive boats and dive shops are incomplete or dated. There exists no list of private boat owners who dive from their vessels for you to use as a means of contact. Most boat Captains have "secret" numbers for sites that are not listed on NOAA charts or online. There was (last year) and is (this year) no mention of, in any of your
12 documents, a safe distance away from your survey area for recreational SCUBA divers to safely conduct their operations without risk of injury. You have included the same statement I quoted above in your draft for this year. Plans and schedules are now being formed for the 2015 diving season. Who do you plan on notifying before and during this year's attempt?

With no inclusion of your Environmental Assessments in the Federal Register it
14 was only through the efforts of certain NGOs that any to this had been made public. Is there any requirement for you to hold public hearings and if so how do I request it? Please consider this an official request for public hearings. With the holidays at the beginning of this public comment period, I appreciate your extension. It is however still
15 insufficient as there are several other events happening off the coast of New Jersey that has taken up mine and others' time. Please consider this an official request for a thirty day extension of the public comment period.

Thank you for at least this small opportunity to comment on this event.

• *Cultural Resources*—With the following possible exceptions, there are no known cultural resources in the proposed Project area. One shipwreck, a known dive site, is in or near the survey area (see Fig. 2 in § III): the Lillian (Galiano 2009; Fisherman's Headquarters 2014; NOAA 2014a). Shipwrecks are discussed further in § IV. Airgun sounds would have no effects on solid structures; no significant impacts on shipwrecks would be anticipated (§ IV). No impacts to cultural resources would be anticipated.

Page 11

Recreational SCUBA Diving

Wreck diving is a popular form of recreation in the waters off New Jersey. A search for shipwrecks in New Jersey waters was made using NOAA's automated wreck and obstruction information system (NOAA 2014a). Results of the search are plotted in Figure 2 together with the survey lines. There are over 900 shipwrecks/obstructions in New Jersey waters, most (58%) of which are listed by NOAA (2014b) as unidentified. Only one shipwreck, a known dive site, is in or near the survey area (Fig. 2); the Lillian (Galiano 2009; Fisherman's Headquarters 2014; NOAA 2014a).

Page 32

(5) Direct Effects on Recreational SCUBA Divers and Dive Sites and Their Significance

No significant impacts on dive sites, including shipwrecks, would be anticipated. Airgun sounds would have no effects on solid structures. The only potential effects could be temporary displacement of fish and invertebrates from the structures.

Significant impacts on, or conflicts with, divers or diving activities would be avoided through communication with the diving community before and during the survey and publication of a Notice to Mariners about operations in the area. In particular, dive operators with dives scheduled on the shipwreck Lillian during the survey would be contacted directly. That dive site represents only a very small percentage of the recreational dive sites in New Jersey waters. No dive vessels were observed in the survey area during the ~14 days that the Langseth was there in July 2014.

Page 54

http://www.nsf.gov/geo/oce/envcomp/amended_mountain_nj_margin_ex_draft_18dec14-b.pdf

Glenn A. Arthur

[redacted]

[redacted]

From: Kirk Larson <[redacted]>
Sent: Wednesday, January 21, 2015 3:29 PM
To: NSF COMMENT NJ
Subject: seismic testing

Mr. Richard W. Murray
Division Director, Division of Ocean Sciences
Directorate for Geosciences
National Science Foundation
4201 Wilson Boulevard
Arlington, Virginia 22230

RE: Request for a 30-day extension on the comment period for Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015

Dear Mr. Murray:

16 On behalf of **the Mayor of Barnegat Light** we are requesting a 30-day extension to the public comment period for the Draft Amended Environmental Assessment (EA) of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015.

17 **Our town is concerned with the effects of the seismic testing that could affect the economics of our town.**

Any proposal to perform seismic surveys off the coasts of New Jersey and New York is a matter of significant public import. Seismic surveys may threaten significant harm to marine mammals, sea turtles, fish, and invertebrates, and may threaten human uses of the ocean for activities such as fishing and recreation. Accordingly, the public should be afforded the adequate time and opportunity to take a hard look at the proposed seismic survey.

This project is of great interest and concern to many groups and individuals in the environmental, fishing, diving, and tourism sectors, as well as to the New Jersey State Legislature and several federal and state elected officials.

The Draft Amended EA contains references to 126 additional sources of published data and scientific literature that were not contained in the December 2013 Draft EA. Given the extent of new information cited in the Draft Amended EA, this information must be assessed and cross-referenced with the original publications. Finally, time is needed for us to share our conclusions with the network of organizations and interested parties.

For these reasons, it is imperative that the public be provided with an additional 30 days to review the Draft

Amended EA and submit comments. We would welcome an opportunity to

discuss this matter with you or your staff at your convenience. For further discussion, please contact **Kirk O.**

Larson Sr, [redacted]

Thank you for your consideration of our request and we look forward to hearing from you.

Sincerely,

Mayor Kirk O. Larson Sr.

[redacted]

From: Clifford, Jonathan <Jonathan.Clifford@mail.house.gov>
Sent: Wednesday, January 21, 2015 6:09 PM
To: NSF COMMENT NJ
Subject: Attention Mr. Richard W. Murray
Attachments: Seismic Testing Extension Letter 1212015.pdf

Please see the attached letter from members of the New Jersey Congressional delegation requesting an extension to the comment period for proposed seismic testing off the coast of New Jersey. If you have any comments, concerns, or replies, please let me know.

Regards,
Jonathan

Jonathan S. Clifford
Legislative Assistant

Congressman Frank A. LoBiondo
U.S. House of Representatives
2427 Rayburn House Office Building
Washington, DC 20515-3002

Work: 202-225-6572
Fax: 202-225-3318
Email: jonathan.clifford@mail.house.gov

Congress of the United States
Washington, DC 20515

January 20, 2015

Mr. Richard W. Murray
Division Director, Division of Ocean Sciences
Directorate for Geosciences
National Science Foundation
4201 Wilson Boulevard
Arlington, Virginia 22230

Dear Mr. Murray:

We, the undersigned, are aware of the proposed seismic testing, which is slated to occur off the coast of New Jersey in the summer of 2015. This project is of great interest and concern to many groups and individuals in the environmental, fishing, diving, and tourism sectors. In order for interested parties to submit thoughtful and well-researched comments, we are requesting a 30-day extension to the public comment period for the Draft Amended Environmental Assessment (EA) of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off the coast of New Jersey.

18 Any proposal to perform seismic surveys off the coasts of New Jersey and New York is a matter of significant impact to citizens, businesses, and the ecosystem. Seismic surveys may threaten significant harm to marine mammals, sea turtles, fish, and invertebrates, and may threaten human uses of the ocean for activities such as fishing and recreation. Accordingly, the public should be afforded the adequate time and opportunity to take a hard look at the proposed seismic survey.

The Draft Amended EA contains references to 126 additional sources of published data and scientific literatures which were not contained in the December 2013 Draft EA. Given the extent of new information cited in the Draft Amended EA, time is required to assess this information and cross-reference it with the original publications.

For these reasons, it is imperative that the public be provided with an additional 30 days to review the Draft Amended EA and submit comments.

Thank you for your consideration of our request and we look forward to hearing from you.

Sincerely,

Robert Menendez
United States Senator

Cory Booker
United States Senator

Christopher H. Smith
Member of Congress

Frank Pallone Jr.
Member of Congress

Frank A. LoBiondo
Member of Congress

Tom MacArthur
Member of Congress

[redacted]

From: [redacted]
Sent: Thursday, January 22, 2015 7:59 PM
To: NSF COMMENT NJ
Subject: 30 Day Extension
Attachments: extension request letter Original.docx

Mr. Murray,

Paul Haertel, President of the Jersey Coast Anglers Association, has asked me to forward our association's comments to you concerning an extension of 30 days to more adequately review more information that has become available concerning seismic blasting.

A signed copy of our association's comments will also be mailed to you in the very near future.

Thank You.

John Toth
JCAA Board Member

Attachment

[redacted]

From: [redacted]
Sent: Thursday, January 22, 2015 8:21 PM
To: NSF COMMENT NJ
Subject: 30 Day Extension
Attachments: JCAA Seismic Blasting Letter (1).doc

Mr. Murray,

The attachment I sent to you was in error. It was a draft that both I and Paul Haerttel were working on.

This attachment shows the JCAA letterhead and information about our location.

Sorry for this oversight.

A signed copy of it will also be sent to you.

John Toth

Attachment

Jersey Coast Anglers Association
Working for Marine Recreational Anglers
1201 Route 37 East Suite 9 Toms River NJ 08753
TEL.: 732-506-6565 - FAX: 732-506-6975

January 22, 2015

Mr. Richard W. Murray
Division Director, Division of Ocean Sciences
Directorate for Geosciences
National Science Foundation
4201 Wilson Boulevard
Arlington, Virginia 22230

RE: Request for a 30-day extension on the comment period for Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015

Dear Mr. Murray:

On behalf of Jersey Coast Anglers Association, we are requesting a 30-day extension to the public comment period for the Draft Amended Environmental Assessment (EA) of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015.

Seismic surveys may threaten significant harm to all marine mammals, especially sea turtles, fish, and invertebrates, and may threaten human uses of the ocean for activities such as fishing and recreation. Accordingly, the public should be afforded the adequate time and opportunity to thoroughly review the proposed seismic survey.

19 This project is of serious interest and concern to many fishing organizations and individuals in the environmental, diving, and tourism sectors, and also with New Jersey's legislators and a number of federal officials.

The Draft Amended EA contains references to 126 additional sources of published data and scientific literature that were not contained in the December 2013 Draft EA. Given the extent of new information cited in the Draft Amended EA, this information must be assessed and cross-referenced with the original publications. Finally, time is needed for us to share our conclusions with the above network of organizations and interested parties.

For these reasons, it is imperative that the public be provided with an additional 30 days to review the Draft Amended EA and submit comments. We would welcome an opportunity to discuss this matter with you or your staff at your convenience. For further discussion, please contact JCAA member John Toth [redacted].

Thank you for your consideration of our request and we look forward to hearing from you.

Sincerely,

Paul Haertel
President
Jersey Coast Anglers Association

[redacted]

From: ROBERT SWITZER <[redacted]>
Sent: Friday, January 23, 2015 10:36 AM
To: NSF COMMENT NJ
Subject: Fw: Reply to thread 'It s Back! Seismic Testing!'

20 I am 100% opposed to the planned seismic testing off our coast.

The procedure disrupts wildlife and is unnecessary.

Regards,
Robert Switzer
[redacted]

Sent from my BlackBerry 10 smartphone on the Verizon Wireless 4G LTE network.

From: BASS BARN <thebassbarn.com@vsobr.com>
Sent: Friday, January 23, 2015 9:48 AM
To: [redacted]
Subject: Reply to thread 'It's Back! Seismic Testing!'

Dear rob,

njdiver has just replied to a thread you have subscribed to entitled - It's Back! Seismic Testing! - in the Offshore Fishing Forum forum of BASS BARN.

This thread is located at:
http://www.thebassbarn.com/forum/6-offshore-fishing-forum/553729-s-back-seismic-testing-new-post.html

Here is the message that has just been posted:
****

Good news on the proposed Seismic Survey off Barnegat Inlet later this summer. "NSF has decided to extend the public comment period by an additional 15 days above and beyond the 37 days it was planned to be open for comment. The public comment period will now close on February 9, 2015, 11:59pm Eastern Standard Time."Last year's attempt was stymied by equipment failure and to our knowledge no announcement or warning was issued to our community. Please let them know what you think of this situation by sending an email comment to:

nsfcommentnj@nsf.gov (http://www.thebassbarn.com/neo/b/compose?to=nsfcommentnj@nsf.gov)

We are searching for studies done on the effects of their equipment on recreational divers and will post and inform our community when the final Environmental Assessment has been published. The proposed Environmental Assessment can be found here:

http://www.nsf.gov/geo/oce/envcomp/amended_mountain_nj_margin_ex_draft_18dec14-b.pdf
****

There may also be other replies, but you will not receive any more notifications until you visit the forum again.

All the best,
BASS BARN

~~~~~~

Unsubscription information:

To unsubscribe from this thread, please visit this page:
http://www.thebassbarn.com/forum/subscription.php?do=removesubscription&type=thread&subscriptionid=1614074&auth=125d401afc5dfe966f0d7a18637058a2

To unsubscribe from ALL threads, please visit this page:
http://www.thebassbarn.com/forum/subscription.php?do=viewsubscription&folderid=all

BASS BARN, a part of VerticalScope Inc.
111 Peter Street, Suite 700
Toronto, Ontario, Canada
M5V 2H1

Contact Us - http://www.thebassbarn.com/forum/sendmessage.php
~~~~~~

[redacted]

From: [redacted]
Sent: Friday, January 23, 2015 3:06 PM
To: NSF COMMENT NJ
Subject: 30 day Extension
Attachments: extension request letter (3) (1).docx

Mr. Murray,

Mr Anthony Mauro, Chairman, New Jersey Outdoor Alliance, requested that I forward the comments of this organization to you.

John Toth

Atachment

January 22,2015

Via electronic mail sent to nsfcommentnj@nsf.gov
Mr. Richard W. Murray
Division Director, Division of Ocean Sciences
Directorate for Geosciences
National Science Foundation
4201 Wilson Boulevard
Arlington, Virginia 22230

RE: Request for a 30-day extension on the comment period for Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015

Dear Mr. Murray:

On behalf of the New Jersey Outdoor Alliance, we are requesting a 30-day extension to the public comment period for the Draft Amended Environmental Assessment (EA) of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015.

Seismic surveys off the coasts of New Jersey and New York is a significant public issue. Seismic surveys may threaten significant harm to marine mammals, sea turtles, fish, and invertebrates, and may threaten human uses of the ocean for activities, especially fishing. Therefore, the public should be afforded ample time and opportunity to thoroughly review the proposed seismic survey.

This project is of great interest and concern to many groups and individuals in the environmental,
21 fishing, diving, and tourism interests, as well as our New Jersey State Legislators.

The Draft Amended EA contains references to 126 additional sources of published data and scientific literature that were not contained in the December 2013 Draft EA. Given the extent of this new information cited in the Draft Amended EA, this information must be assessed and cross-referenced with the original publications. Additionally, time is needed for us to share our conclusions with our member organizations and the network of other organizations and interested parties.

For these reasons, it is important that the public be provided with an additional 30 days to review the Draft Amended EA and submit comments. We would welcome an opportunity to discuss this matter with you or your staff at your convenience. For further discussion, please contact Captain Pete Grimbilas at [redacted]

A signed copy of this letter will also be mailed to you in the near future

Thank you for your consideration of our request and we anticipate hearing from you.

Sincerely,

Anthony Mauro,
Chairman
New Jersey Outdoor Alliance

[redacted]

From: [redacted]
Sent: Sunday, January 25, 2015 4:11 PM
To: NSF COMMENT NJ
Subject: seismic survey off barnegat inlet

74 until further research and testing is done on the effects of this blasting to map out the ocean floor and what is under it we have no idea how it will effect the fish and marine mammals in that area and that reason alone is enough to halt this study! let's see what could happen by researching the effects first instead of making it happen by continuing the seismic survey!

thank you
john aurnhammer
[redacted]

[redacted]

From: Lincoln Hollister <linc@princeton.edu>
Sent: Wednesday, January 28, 2015 9:31 AM
To: NSF COMMENT NJ
Subject: comment on Draft Amended EA, Marine Geophysical Survey off NJ, Summer 2015

This is my comment on the Draft Amended EA for the Marine Geophysical Survey off NJ, Summer 2015:

[redacted]

Lincoln S. Hollister

Professor Emeritus and Senior Geologist

Department of Geosciences, Princeton University

Princeton, NJ 08544

609-258-4106

[redacted]

From: Lincoln Hollister <linc@princeton.edu>
Sent: Wednesday, February 04, 2015 9:31 AM
To: NSF COMMENT NJ
Subject: revised comment on Draft Amended EA

I had made an error in my last paragraph, and have rewritten it to better state a point. I hope you will substitute the below for the letter I sent On Jan 28. Only the last paragraph has changed.

Revised comment on the Draft Amended EA for the Marine Geophysical Survey off NJ, Summer 2015:

Local environmental groups coordinated by Clean Ocean Action (COA) have, for about a year, continuously attacked the proposed Rutgers-led marine seismic study of the effects of sea level rise on the NJ Shore. The intent of these groups is to stop the Rutgers project, no matter the environmental costs from the research not being done.
At issue is the standard tool of marine seismic research, airguns, which the environmental groups claim will
22 bring death and destruction to marine life. To achieve their goal of stopping the Rutgers project, the environmental groups prey on the fears of NJ Shore residents by greatly exaggerating the levels of sound produced by airgun arrays, and they erroneously claim that similar marine seismic studies done over the past 40 plus years have damaged marine life.

If there is an impact on marine life by airguns – for example, if fish swim away from the approaching airguns, the environmental groups would lead us to think the fish will never return, but the data show that the fish return within days following a seismic study. The claim that the airguns cause death and destruction of marine life has no basis in fact and is scientifically without merit.

The benefits to New Jersey and humanity from the results of the Rutgers project far exceed what little disturbance, if any, might be done to marine life by the seismic survey. Our knowledge of how Earth works,
23 including the effects of sea level rise on the NJ Shore, will be much increased, and the basic research of the flagship public university of New Jersey will be able to move forward. Seventy percent of Earth is under water; seismic airguns are the best tool scientists have to study that part of the planet.

The opposition of environmental groups to science-focused marine seismic surveys negatively impacts the ability of academics to do research. Stopping such a survey is particularly damaging because of the loss of data
24 and basic understanding of processes such as sea level rise on which public policy is built. University-based science is severely set back, research programs are dismantled, and education of the next generation is impaired. Students' and young scientists' careers are interrupted and future students are deterred from entering marine seismic science.

Lincoln S. Hollister

Professor Emeritus and Senior Geologist

Department of Geosciences, Princeton University

Princeton, NJ 08544

609-258-4106

[redacted]

From: Catie Tobin (Clean Ocean Action) <Education@cleanoceanaction.org>
Sent: Monday, February 09, 2015 4:48 PM
To: NSF COMMENT NJ
Cc: Cindy Zipf (Clean Ocean Action); Lauren Townsend
Subject: Seismic Comments on Draft Amended EA
Attachments: COA et al seismic comments on Draft Amended EA.pdf

Please see attached.

Catie Tobin
Marine Science Education Coordinator
Clean Ocean Action (COA)
18 Hartshorne Drive, Suite 2
Highlands, NJ 07732
(p) 732.872.0111 (f) 732.872.8041
www.cleanoceanaction.org

Give to support a clean ocean!

[redacted]

From: Catie Tobin (Clean Ocean Action) <Education@cleanoceanaction.org>
Sent: Monday, February 09, 2015 4:56 PM
To: NSF COMMENT NJ
Cc: Cindy Zipf (Clean Ocean Action); Lauren Townsend
Subject: Updated Seismic Comments on Draft Amended EA
Attachments: COA et al seismic comments on Draft Amended EA.pdf

Please see the updated document attached.

Catie Tobin
Marine Science Education Coordinator
Clean Ocean Action (COA)
18 Hartshorne Drive, Suite 2
Highlands, NJ 07732
(p) 732.872.0111 (f) 732.872.8041
www.cleanoceanaction.org

Give to support a clean ocean!

Clean Ocean Action · Jersey Coast Anglers Association · Fishermen's Dock Cooperative · New Jersey Outdoor Alliance · Greater Point Pleasant Charter Boat Association · Reef Rescue · Barnegat Light, NJ · Anglers Conservation Network · United Boatmen of New Jersey · Viking Village · Beach Buggy Association of New Jersey · Save Barnegat Bay · Hands Across the Sand · The Ocean Foundation

February 9, 2015

Via electronic mail sent to nsfcommentnj@nsf.gov
Mr. Richard W. Murray
Division Director, Division of Ocean Sciences
Directorate for Geosciences
National Science Foundation
4201 Wilson Boulevard
Arlington, Virginia 2230

RE: Comments on the National Science Foundation Draft Amended Environmental Assessment of a Marine Geophysical Survey in the Northwest Atlantic Ocean Offshore New Jersey, June to August 2015.

Dear Mr. Murray:

On behalf of the undersigned organizations, Clean Ocean Action (COA) submits the following comments in response to the National Science Foundation (NSF) request for comments on the Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G.* Langseth in the Atlantic Ocean off New Jersey, Summer 2015.[1]

Rutgers University, in collaboration with the National Science Foundation, Lamont-Doherty Earth Observatory (L-DEO), and the University of Texas, proposes to conduct a seismic vessel survey off the coast of New Jersey for approximately 30 days between June and August 2015 to study changes in sea level from 60 million years ago to present. The proposed project involves the use of two four-airgun subarrays towed at a depth of either 4.5 m or 6 m and operating alternately, in conjunction with a multibeam echosounder and sub-bottom profiler. The nominal source levels of the airgun subarrays would be approximately 246 decibels (dB) re: 1 μPa (peak-to-peak), and airguns would fire every 5-6 seconds, 24 hours a day, for an approximately 30 day period set to run between June and August, 2015. The area to be surveyed is a roughly rectangular region that encompasses approximately 230 square miles and is positioned between 15.5 and 52.8 miles of the coast of New Jersey.

The Draft Amended EA has been prepared pursuant to the National Environmental Policy Act (NEPA) and tiers to the 2011 Programmatic Environmental Impact Statement (EIS)/Overseas

[1] Available at http://www.nsf.gov/geo/oce/envcomp/amended_mountain_nj_margin_ex_draft_18dec14-b.pdf (hereafter "Draft Amended EA").

Environmental Impact Statement (OEIS) for Marine Seismic Research funded by the National Science Foundation or Conducted by the U.S. Geological Survey and 2012 NSF Record of Decision. The Draft Amended EA will be used in support of an application for an Incidental Harassment Authorization (IHA) from the National Marine Fisheries Service (NMFS) under section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA). Prior to approving the project and issuing an IHA for the survey, the federal agencies involved must comply with Section 7 Consultation under the Endangered Species Act (ESA)[2] and an Essential Fish Habitat assessment under the Magnuson-Stevens Fishery Conservation and Management Act.[3]

The seismic survey will have significant environmental impacts, and this triggers the need for a full Environmental Impact Statement (EIS). To the extent that the agencies rely on an EA, there are significant flaws, deficiencies and ecological concerns with the Draft Amended EA. These comments focus on three broad topic areas: regulatory compliance, marine mammal take estimations, monitoring and mitigation measures, and evaluation of project alternatives.

<u>Regulatory Compliance</u>

Significant Environmental Impacts Trigger the Need for an EIS
NEPA's fundamental purposes are to guarantee that: (1) agencies take a hard look at the environmental consequences of their actions before these actions occur; and (2) agencies make the relevant information available to the public so that it may also play a role in both the decision-making process and the implementation of that decision. See, e.g. 40 C.F.R. § 1500.1. To assure transparency and thoroughness, agencies also must "to the fullest extent possible...[e]ncourage and facilitate public involvement" in decision-making. 40 C.F.R. §1500.2(d).

In the case of the seismic project, the applicability of at least three of the significance factors as described in NEPA (impacts to a species listed under the ESA, controversial effects, significant cumulative impacts) indicate that NMFS and the NSF must prepare an EIS. The presence of one
25 or more significant effects can trigger the need for a full EIS. *See, e.g. Nat'l Parks & Conserv. Ass'n. v. Babbitt*, 241 F.3d 722, 731 (9th Cir. 2001) (either of two significance factors considered by the court "may be sufficient to require preparation of an EIS in appropriate circumstances"); *Anderson v. Evans*, 350 F.3d 815, 835 (9th Cir. 2003) (presence of one or more factors can necessitate preparation of a full EIS). Furthermore, the agency must fully analyze the impacts of, alternatives to, and mitigation measures for the action. 40 C.F.R. §§ 1502.14, 1502.16, 1508.7, 1508.8.

The groups strongly urge the preparation of a full EIS for this project, which would include complete scientific substantiation for the project, a thorough analysis of all direct, indirect, and cumulative environmental impacts, and consideration of a full range of alternatives to the

[2] Section 7 of the ESA (16 U.S.C. 1531 <u>et seq.</u>) outlines the procedures for Federal Interagency cooperation to conserve federally-listed species and designated critical habitats.
[3] Public Law (P.L.) 94-265, as amended by the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (P.L. 109-479). EFH Guidelines at 50 CFR 600.05-600.930 outline the process to satisfy EFH consultation under Section 305(b)(2)-(4)) of the MSA.

project. Moreover, to meet its NEPA obligations, the NEPA document must be made available for public review and comment. *See, e.g. Anderson v. Evans*, 314 F.3d 1006, 1016 (9th Cir. 2002) ("the public must be given an opportunity to comment on draft EAs and EISs"). Following is a description of some, but not all, of the potentially significant environmental impacts as well as the deficiencies of the EA.

Coastal Zone Management Act (CZMA)
The CZMA requires that applicants for federal permits to conduct an activity affecting a natural
resource of the coastal zone of a state "shall provide in the application to the licensing or
26 permitting agency a certification that the proposed activity complies with the enforceable
policies of the state's approved program and that such activity will be conducted in a manner
consistent with the program."[4] The marine mammals and fish that will be affected by the
seismic survey are "natural resources" protected by New Jersey's coastal management
program. Accordingly, the state should be given the opportunity to review the project for
consistency with its coastal management program.

Endangered Species Act
Section 7(a)(2) of the ESA requires federal agencies to "insure that any action authorized,
funded, or carried out by such agency . . . is not likely to jeopardize the continued existence of
any endangered species or threatened species or result in the adverse modification of habitat
of such species . . . determined . . . to be critical . . . ."[5] To accomplish this goal, agencies must
consult with the delegated agency of the Secretary of Commerce or Interior whenever their
27 actions "may affect" a listed species.[6] NMFS has the discretion to impose terms, conditions, and
mitigation on any authorization.
The seismic survey puts several ESA-listed species at risk. Listed species affected include blue, fin, humpback, North Atlantic right, sei, and sperm whales. The proposed seismic survey can have harmful impacts on listed marine mammals, which must be fully and accurately vetted through the consultation process. Accordingly, the agencies must complete consultation and obtain any take authorizations before authorizing the proposed seismic survey here. Moreover, NSF and Rutgers should adopt robust mitigation measures such as those described in the alternatives section above to avoid adverse impacts to listed species.

28 NMFS' reliance on the 160-dB Level B and 180/190 Level A thresholds do not reflect the best
available science. As described above, the best available science supports lower thresholds for
many marine species. The ESA requires the use of the best available science.[7]

29 Additionally, NMFS should also evaluate the impact on potential right whale critical habitat.
Recent studies have further shown that mid-Atlantic coastal areas are a key migratory route

[4] 16 U.S.C. § 1456(c)(3)(A).
[5] 16 U.S.C. § 1536(a)(2); 50 C.F.R. § 402.14(a).
[6] *Id.*
[7] 16 U.S.C. § 1536(a)(2); *Intertribal Sinkyone Wilderness v. NMFS*, 970 F. Supp. 2d 988 (N.D. Cal. 2013) (rejecting the agency's reliance on out-dated thresholds for impacts of Navy sonar activities).

between calving and feeding grounds.[8] NMFS has indicated that it intends to amend the
29 current critical habitat to potentially include the coastal area adjacent to the survey area, but has substantially delayed issuing its proposal. *See* 75 Fed. Reg. 61,690 (Oct. 6, 2010) (indicating the agency had already begun developing the amendment and would publish a proposed rule "in the second half of 2011"). Accordingly, NMFS should consider how the seismic survey may impact habitat that is under consideration for designation for North Atlantic right whales.

In sum, the federal agencies must fully comply with the ESA and develop a robust biological
30 opinion based on the best available science. We further urge NSF and Rutgers to establish more stringent mitigation measures to protect ESA-listed species than are currently proposed by the IHA.

Marine Mammal Take Estimations

The Draft Amended EA relies on the same broad methodology to develop marine mammal exclusion and buffer zones (corresponding with Level A and Level B harassment, respectively)
31 and estimate total marine mammal takes as was used in the March 2014 Draft EA, despite several concerns raised by the Marine Mammal Commission and others during the comment period on the draft IHA. COA shares many of the MMC concerns and recommends that the Draft Amended EA be revised to account for expert recommendations.

The thresholds used to determine take are not based on the best available science. The EA uses the single sound pressure level of 160 dB re 1 μPa (RMS) as a threshold for estimating behavioral, sublethal take in all marine mammal species affected by the proposed survey.[9] As acknowledged in the EA, this approach does not reflect the best available science, and the choice of threshold is not sufficiently conservative in several important respects. In fact, experts
32 characterize the 160-dB threshold as "overly simplified, scientifically outdated, and artificially rigid."[10] NMFS is obviously aware of the existence better science, which is demonstrated and analyzed by the agency's own draft acoustic guidance which is currently pending finalization.[11] The best available science indicates that NMFS must use a more conservative threshold.

Using a single sound pressure level of 160-dB for harassment represents a major step backward from recent authorizations. For Navy sonar activity, NMFS has incorporated into its analysis

[8] *See* Pace, R.M. III and R. Merrick. 2008. Northwest Atlantic Ocean Habitats Important to the Conservation of North Atlantic Right Whales (Eubalaena glacialis). NEFSC Ref. Doc. 08-07; Garrison, L.P. 2007. Defining the North Atlantic Right Whale Calving Habitat in the Southeastern United States: An Application of a Habitat Model. NOAA Technical Memorandum NOAA NMFS-SEFSC-553. A more recent study, also recommended that "currently defined critical habitat should be expanded to include areas farther offshore and generally further north off the coast of Georgia." Keller, C.A., Application of a Habitat Model to Define Calving Habitat of the North Atlantic Right Whale in the Southeastern United States. Endang. Species. Res. Vol. 18: 73-87 (2012): doi: 10.3354/esr00413.

[9] 77 Fed. Reg. at 58260.

[10] Clark, C., Mann, D., Miller, P., Nowacek, D., and Southall, B., Comments on Arctic Ocean Draft Environmental Impact Statement at 2 (Feb. 28, 2012); *see* 40 C.F.R. § 1502.22.

[11] 78 Fed. Reg. 78822 (Dec. 2013).

linear risk functions that endeavor to account for risk and individual variability and to reflect the potential for take at relatively low levels.[12]

Furthermore, current scientific literature establishes that behavioral disruption can occur at substantially lower received levels for some species, including many species that will be impacted by the proposed survey here. For example, a single seismic survey has been shown to cause endangered fin and humpback whales to stop vocalizing – a behavior essential to breeding and foraging – and cause other baleen whales to abandon habitat over an area at least 100,000 square nautical miles.[13] Bowhead whales migrating through the Beaufort Sea have shown almost complete avoidance of seismic airgun received levels at 120 dB to 130 dB and below.[14]

Some odontocetes are highly sensitive to a range of low-frequency and low-frequency-dominant anthropogenic sounds, including seismic airgun noise. Cuvier's beaked whales
33 exhibited alarming behavioral impacts when exposed to sonar at low received levels 89-120db.[15] The proposal anticipates Level B take of 168 Cuvier's beaked whales, which far underestimates actual take. Harbor porpoises, which are mostly inshore, but occasionally occur in the project area, have been observed to engage in avoidance responses 50 miles from a seismic airgun array, a result that is consistent with both captive and wild animal studies showing porpoises abandoning habitat in response to pulsed sounds at very low received levels, well below 120 dB.[16]

Although the agencies should be aware of these studies showing seismic surveys can have significant behavioral impacts to marine mammals well below 160 dB, the EA irrationally sets the behavioral harassment threshold at 160 dB. If the agency were to modify its threshold estimates, as it must based on the best available science, the estimated number of marine mammal takes incidental to the proposed seismic survey would be significantly higher than the EA's current estimates.

[12] *See, e.g.*, 74 Fed. Reg. 4844, 4844-4885 (Jan. 27, 2009).

[13] Clark, C.W., and Gagnon, G.C., Considering the temporal and spatial scales of noise exposures from seismic surveys on baleen whales (2006) (IWC Sci. Comm. Doc. IWC/SC/58/E9); *see also* MacLeod, K., Simmonds, M.P., and Murray, E., Abundance of fin (*Balaenoptera physalus*) and sei whales (*B. Borealis*) amid oil exploration and development off northwest Scotland, *Journal of Cetacean Research and Management* 8: 247-254 (2006).

[14] Miller, G.W., Elliot, R.E., Koski, W.R., Moulton, V.D., and Richardson W.J., Whales, *In* Richardson, W.J. (ed.), Marine Mammal and Acoustical Monitoring of Western Geophysical's Open-Water Seismic Program in the Alaskan Beaufort Sea, 1998 (1999); Richardson, W.J., Miller, G.W., and Greene Jr., C.R., Displacement of migrating bowhead whales by sounds from seismic surveys in shallow waters of the Beaufort Sea, *Journal of the Acoustical Society of America* 106:2281 (1999).

[15] Stacy L. DeRuiter et at., First Direct Measurements of Behavioural Responses by Cuvier's Beaked Whales to Mid-Frequency Active Sonar *Biology Letters*, 9: 20130223 1 (2013).

[16] *See, e.g.*, Bain, D.E., and Williams, R., Long-range effects of airgun noise on marine mammals: responses as a function of received sound level and distance (2006) (IWC Sci. Comm. Doc. IWC/SC/58/E35).

Given the agency's decidedly non-conservative approach to estimating impacts thresholds for injury to marine mammals from the proposed survey, it is likely that many more marine mammals will be harmed than estimated.

Furthermore, the Draft Amended EA is inconsistent in several regards with the Final Incidental
34 Harassment Authorization (IHA) issued by the National Marine Fisheries Service (NMFS) for the project in 2014, and COA recommends that the applicant rectify these inconsistencies to account for measures previously required by the agency.

Model used in establishing exclusion and buffer zones

The applicant has estimated marine mammal exclusion and buffer zones via a simplistic model that assumes uniform propagation in the water column and no seafloor interactions. This is problematic given that the model employed appears to only have been field-tested in the Gulf of Mexico, which in addition to having very different environmental and oceanographic
35 conditions from those off the coast of New Jersey, is also a much deeper marine environment. Use of scaling factors with the Gulf of Mexico measurements oversimplifies the complex and potentially synergistic interactions that the sound source would have with the seafloor geology. As such, COA recommends that the applicant re-estimate exclusion and buffer zones after inputting project-specific operational details (including tow depth, airgun source intensity, and number of firing airguns) and environmental parameters (including water depth, seafloor geology, and how sound refracts in the water column) into its sound propagation model.

Underestimation of marine mammal takes in a small area

The concentrated multiplied impact of the applicant's proposal has not been adequately assessed, especially given the relatively small ocean area affected. The proposal would run seismic pulses back and forth over 4,900 km of tracklines for 24 hours a day over a 30-day period. Under this scenario, many areas will be ensonified multiple times over the duration of the study, some on multiple occasions within the same day, particularly if some data collected
36 do not meet quality objectives. Simply multiplying the total ensonified area by the estimated marine mammal densities will underestimate the total number of takes, as it does not take into account the fact that areas will be ensonified on multiple occasions over the 30-day project period. At minimum, the EA must assess the total multiplied ensonified area for a given day (with a 25% contingency, discussed further below) by the applicable marine mammal densities and the total number of survey days. Furthermore, these concentrated multiplied affects must be evaluated for all marine life species, not just mammals and turtles.

Cumulative impacts of marine mammal exposure to seismic surveys and sonar off the Atlantic Coast

37 An agency must take a hard look at the cumulative impacts of the proposed action and determine and provide a meaningful analysis of the environmental impacts of these activities. "NEPA always requires that an environmental analysis for a single project consider the cumulative impacts of that project together with 'past, present and reasonably foreseeable

future actions.'"[17] CEQ's regulations for implementing NEPA emphasize that "[c]umulative impacts can result from individually minor but collectively significant actions taking place over a period of time."[18]

37 The Draft Amended EA fails to describe the cumulative effects from other seismic surveys, including oil and gas seismic surveys, and sonar on the same stocks of marine mammals. Marine mammals that are affected by the proposed project include many of the same stocks or populations of animals that will be exposed to seismic surveys for oil and gas, research surveys farther offshore, and military activities using sonar. The programmatic environmental analysis for Atlantic oil and gas surveys estimates more than 138,000 instances of take. The Navy Atlantic testing and training estimates 21.8 million instances of harm to marine mammals in the coming years. This added to the USGS seismic surveys offshore in 2014 and 2015 and the survey similar to the one proposed here warrants a thorough analysis of the impacts of acoustic disturbance on these animals.

Inconsistences between Draft Amended EA and 2014 Final IHA

The Draft Amended EA indicates that the study proposed for the summer of 2015 is nearly identical to the project proposed by the applicants for the summer of 2014; the NMFS issued a Final IHA for this project in July of 2014. Despite the project similarities, there are several inconsistencies between the Final IHA and the Draft Amended EA. Notably, the 2014 Final IHA included several additional precautions to protect marine life from the detrimental impacts of seismic airguns that have been omitted from the Draft Amended EA. As such, COA does not consider the Draft Amended EA to be complete or representative of the best available mitigation measures, including the No Action Alternative, or Alternative time-of –year for study to be conducted.

The 2014 Final IHA states, "NMFS finds it more appropriate to incorporate a mechanism to explicitly account for the potential of positive immigration of marine mammals into the survey area...therefore we are using a generalized turnover estimate of 1.25...[which] will help better
38 estimate the number of animals exposed."[19] Despite the inclusion of this contingency factor in the Final IHA, the Draft Amended EA states, "NSF has traditionally not included this factor into take calculations and therefore has not included it here."[20] No explanation is provided in the report for why the 1.25 turnover estimate is omitted, particularly in light of it having been included in the 2014 Final IHA for the same project. As the federal agency responsible for permitting marine mammal takes has stated that a 25% contingency is an "appropriate" mechanism to conservatively account for the inherent uncertainty of marine mammal

[17] *Native Ecosystems Council v. Dombeck*, 304 F.3d 886, 895 (9th Cir. 2002) (quoting 40 C.F.R. § 1508.7).
[18] 40 C.F.R. § 1508.7.
[19] National Oceanic and Atmospheric Administration. 2014. Takes of Marine Mammals Incidental to Specified Activities; Marine Geophysical Survey in the Northwest Atlantic Ocean Offshore New Jersey, July to August 2014. July 8.
[20] LGL Ltd., environmental research associates. 2014. "Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015" (hereafter, "Draft Amended EA"), p. 47.

movements in and around the survey area, it is essential that it be included in the calculations presented in the EA.

The Final IHA authorized takes (by Level B harassment) for a total of four (4) gray seals, 112
harbor seals, and four (4) harp seals. Despite the inclusion of pinniped species in the Final IHA,
the Draft Amended EA states that "no pinnipeds are included" because they are "not expected
39 to occur there during the survey."[21] Even though the Draft Amended EA contains different
conclusions than those reached by NMFS in issuing its Final IHA in 2014, no new or updated
data are presented in the Draft Amended EA to support such claims, and the only information
provided on pinnipeds has been incorporated by reference from the 2014 EA for the project.
As such, COA recommends that updated species information and take estimates be provided
for the three pinniped species included in the 2014 Final IHA.

The 2014 Final IHA required a more conservative exclusion zone for marine mammals, which
the Biological Opinion indicated would also apply to sea turtles; namely, the standard 180-dB
exclusion threshold was increased by 3 dB (thereby triggering operational mitigation at the 177-
40 dB isopleth). The Draft Amended EA states, "NSF does not view this overly precautionary
approach appropriate, and it is not included here."[22] It is inappropriate for NSF to disregard
NMFS's decision to take a more conservative approach in protecting federally protected marine
mammals and threatened and endangered sea turtle species from the harmful effects of
seismic airguns. As such, the EA should be amended to include updated estimates of marine
mammal and sea turtle impacts under the 177-dB exclusion zone approach.

<u>Monitoring and Mitigation Measures</u>

Marine Mammal Monitoring and Mitigation Measures

The Draft Amended EA indicates that monitoring and mitigation prior to and during survey activities would follow measures outlined in the June 2011 Final Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey. Specifically, if a marine mammal is observed within the mitigation zone, a power down would occur and activity would remain suspended until the animal is visually observed to have left the mitigation zone, has not been observed within the mitigation zone for at least 15 minutes (for small odontocetes and pinnipeds) or 30 minutes (for mysticetes and large odontocetes), or the vessel has moved outside the mitigation zone within which the animal was most recently observed.

41

The 15 and 30 minute wait times are too limited and inappropriate because many marine mammals, especially large odontocetes, can and do remain underwater for much longer periods of time. For example, grand mean dive times for Blainville's and Cuvier's beaked

[21] Draft Amended EA, p. 12.

[22] Draft Amended EA, p. 6-7.

whales are approximately 60 minutes, [23] but individuals have been observed to remain submerged for over 80 minutes.[24] Sperm whales have a grand mean dive time of approximately 45 minutes,[25] but have been known to remain underwater for up to 55 minutes.[26] This information, adds to the need to conduct a full Environmental Impact Statement, and include assessments of longer, more conservative time thresholds (i.e., at least 60 minutes) for large odontocetes observed in the mitigation zone.

Evaluation of Fisheries and Shellfish Impacts

The agencies have a statutory obligation to consult on the impact of federal activities on essential fish habitat under the Magnuson-Stevens Fishery Conservation and Management Act ("Magnuson Act").[27]

The Magnuson Act requires consultation with NMFS when actions to be permitted, funded, or undertaken by a federal agency may adversely affect essential fish habitat. The statute defines adverse effect as "any impact that reduces quality and/or quantity of EFH [and] may include
42 direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey, reduction in species' fecundity), site-specific or habitat wide impacts, including individual, cumulative, or synergistic consequences of actions."[28] The essential fish habitat consultation should include an evaluation of the effects of the action on essential fish habitat and proposed mitigation.[29] Upon receipt of an essential fish habitat assessment, NMFS is required to provide essential fish habitat conservation recommendations for federal actions that would adversely affect essential fish habitat. As required by Section 305(b)(4) of the Magnuson Act, the Federal agency must respond with a description of measures proposed for avoiding, mitigating, or offsetting the impact of the activities on essential fish habitat and explain its reasons for not following any essential fish habitat conservation recommendations.

The Draft Amended EA provides only broad information on commercial and recreational fishing activities that have historically occurred in the waters off New Jersey. No site-specific
43 information on habitat types and fisheries of particular interest is provided, aside from a list of species with Essential Fish Habitat (EFH) in the survey area. Specific information on how these

[23] Marine Mammal Commission. 2014. Letter to the National Marine Fisheries Service in reference to the Incidental Harassment Authorization issued in connection with the application submitted by Lamont-Doherty Earth Observatory (LDEO), in collaboration with the National Science Foundation (NSF), to take small numbers of marine mammals by harassment incidental to a marine geophysical survey to be conducted off North Carolina. August 18. Available at: http://www.nsf.gov/geo/oce/envcomp/hatteras-fall2014/appendix_f_publiccomments.pdf.

[24] Baird, R.W., D.L. Webster, G.S. Schorr, D.J. McSweeney, and J. Barlow. 2008. Diel variation in beaked whale diving behavior. Marine Mammal Science 24:630-642

[25] Watwood S.L., P.J.O. Miller, M. Johnson, P.T. Madsen, and P.L. Tyack. 2006. Deep-diving foraging behavior of sperm whales (Physeter macrocephalus). Journal of Animal Ecology 75:814–825.

[26] Drouot V., A. Gannier, and J.C. Goold. 2004. Diving and feeding behaviour of sperm whale (Physeter macrocephalus) in the northwestern Mediterranean Sea. Aquatic Mammals 30:419–426.

[27] 16 U.S.C. §§ 1801-1884.

[28] 50 C.F.R. § 600.910(a); *see also* National Marine Fisheries Service, Essential Fish Habitat: A marine fish habitat conservation mandate for federal agencies, Gulf of Mexico Region (2010) http://sero.nmfs.noaa.gov/hcd/pdfs/efhdocs/gom_guide_2010.pdf.

[29] 50 C.F.R. § 600.920(e).

vital habitat areas may be affected by seismic activity and measures that could be taken to mitigate such impacts is not provided in the Draft Amended EA.

44 The Draft Amended EA reports that although many commercial fisheries operate within 5.6 km from shore, the highest-value fish (e.g., flounder and tuna) are caught farther offshore.[30] Specific information is not provided on how far offshore and whether fishing areas for these commercially valuable species overlap with the survey area. Additionally, the Draft Amended EA contains several references to recently published literature that indicates potentially severe impacts to fish and shellfish from noise from sources such as seismic airguns; some of these studies also include recommendations for mitigating the negative impacts. As an example, the Hovem et al. (2012) study referenced in the report indicated that "seismic surveys should occur at a distance of 5-10 km from fishing areas, in order to minimize potential effects on fishing."[31] The Draft Amended EA offers no response to this and other recommendations made by subject matter experts and instead concludes that "newly available information does not affect the outcome of the effects assessment as presented in the PEIS."[32] This combination of unspecific fisheries information and a lack of assimilation of new and important research are insufficient to meet the obligations to consult on EFH impacts and comply with NEPA's hard look requirement.

45 **Evaluation of Incidental Harm to Recreational Underwater and SUBA Divers**

The EA provides mention to wreck diving, noting that it is "a popular form of recreation in the waters off New Jersey"[33] however it provides little information to the impacts that this proposed study would have on the recreational underwater diving community. Based on NOAA's automated wreck and obstruction information system, the applicant concludes that "only one shipwreck, a known dive site, is in or near the survey area,"[34] but does not account for smaller dive sites that may not be included in NOAA's system.

46 The Draft Environmental Assessment lacks any information regarding harm to divers that may be present during the study. A full EIS must assess these threats, and identify strict monitoring and mitigation to reduce harm to divers.

47 **Evaluation of Alternative Actions**

The "heart" of the NEPA process is an agency's duty to consider "alternatives to the proposed action" and to "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources."[35] CEQ regulations require NMFS to "rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed

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[30] Draft Amended EA, p. 52.
[31] Draft Amended EA, p. 52.
[32] Id.
[33] Draft Amended EA, p. 32.
[34] Draft Amended EA, p. 32.
[35] 42 U.S.C. §§ 4332(2)(C)(iii), 4332(2)(E).

study, briefly discuss the reasons for their having been eliminated."[36] "A 'viable but unexamined alternative renders [the] environmental impact statement inadequate.'"[37]

The Draft Amended EA does not provide sufficient evaluation of the No Action alternative, under which the study would not proceed and researchers would instead rely on core samples and 2-dimensional seismic data previously obtained within the project area to evaluate historical changes in sea level. Given that this project would occur in public waters upon which a variety of marine life and human uses rely, a comparison of the potential environmental and socioeconomic harm from the seismic activities against the potential contribution of the study results to scientific understanding is critical.

Furthermore, the Draft Amended EA contains only brief discussion of conducting the study at another time. Availability of the seismic vessel is cited as the primary reason for proposing the survey in the summer months, in addition to weather considerations. Given that weather issues (including Hurricane Arthur and "equipment damage from rough seas") are identified in the Draft Amended EA as a primary contributor to the failure of the researchers to complete the survey within the time allotted last summer,[38] it is questionable why the summer months
48 have again been identified as the only viable timeframe for the project. The Draft Amended EA also states that the study is timed to avoid right whale migration months of November through April. COA notes that recent research has confirmed the year-round presence of North Atlantic right whales off the New Jersey coast, and furthermore, that the numbers of up-call detections per day were highest in the March through June time period.[39] Based on this information, we recommend the Draft Amended EA incorporate information from experts in marine mammal biology and fisheries in its evaluation of alternate times of year from the study.

Conclusion

The Proposed Project threatens serious harm, both environmentally and economically, to numerous species of marine mammals, fishermen, and commercial and recreational divers and is therefore contrary to the goals, mandates, and prohibitions of the MMPA.

The Environmental Assessment is seriously flawed and deficient including incomplete information, inadequate assessment of impacts, and insufficient evaluation of alternatives and mitigation measures. Importantly, the Proposed Project must not be allowed to be conducted during summer, which is the peak of marine mammal (and other marine species) activity off the New Jersey coast, as well as the height of tourism and fishing seasons.

For the reasons detailed above, the undersigned organizations request a finding of significant impact, and trigger a full Environmental Impact Statement of the Marine Geophysical Survey by

[36] 40 C.F.R. § 1502.14(a).

[37] *Muckleshoot Indian Tribe v. U.S. Forest Serv.*, 177 F.3d 800, 814 (9th Cir. 1999) (quoting *Citizens for a Better Henderson v. Hodel*, 768 F.2d 1051, 1057 (9th Cir. 1985)).

[38] Draft Amended EA, p. 4.

[39] Whitt, A.D., Dudzinski, K., and Laliberte, J.R. 2013. North Atlantic right whale distribution and seasonal occurrence in nearshore waters off New Jersey, USA, and implications for management. *Endangered Species Research* 20: 59-69.

the *R/V/ Marcus* G. Langseth in the Atlantic Ocean off New Jersey, Summer 2015. There should
49 also be a public hearing on the proposal.

Sincerely,

Cindy Zipf, Executive Director
Clean Ocean Action

John Toth
Jersey Coast Anglers Association

Jim Lovegren
Fishermen's Dock Cooperative

Peter Grimbilas

- New Jersey Outdoor Alliance
- Greater Point Pleasant Charter Boat Association
- Reef Rescue

Mayor Kirk O. Larson
Barnegat Light, NJ
Commercial Fisherman

Captain Paul Eidman
Anglers Conservation Network

Captain Edward K. Yates, President
United Boatmen of New Jersey

Ernie Panaceck, General Manager
Viking Village, Barnegat Light

Tim Burden, President
Beach Buggy Association of New Jersey

Britta Wenzel, Executive Director
Save Barnegat Bay

Dede Shelton, Executive Director
Hands Across the Sand

Richard Charter, Senior Fellow
Coastal Coordination Program
The Ocean Foundation

[redacted]

From: Megan Brunatti <Megan.Brunatti@dep.nj.gov>
Sent: Monday, February 09, 2015 6:24 PM
To: NSF COMMENT NJ
Subject: NJDEP Comment Letter - Draft Amended EA of a Marine Geophysical Survey in the Atlantic Ocean off New Jersey Summer 2015
Attachments: NJDEP Comment Letter - NSF Draft Amended EA.pdf

Attached please find NJDEP's comment letter regarding the Draft Amended EA of a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Atlantic Ocean off New Jersey Summer 2015. Thank you for providing the NJDEP with the opportunity to review and provide comments on this proposed project.

Please confirm receipt of the attached.

Thank you,

Megan Brunatti
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DEPARTMENT OF ENVIRONMENTAL PROTECTION
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CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

February 9, 2015

Holly Smith
National Science Foundation
4201 Wilson Blvd., Room 725
Arlington, VA 22230

RE: Marine Geophysical Survey by the R/V Marcus Langseth in the Atlantic Ocean off New Jersey Summer 2015 Comments on the Draft Amended Environmental Assessment

Dear Ms. Smith:

The New Jersey Department of Environmental Protection's (Department) Office of Permit Coordination and Environmental Review (PCER) distributed the Draft Amended Environmental Assessment (Amended EA) for the proposed Marine Geophysical Survey by the R/V Marcus Langseth in the Atlantic Ocean off New Jersey in the summer of 2015 for review and comment. We offer the following comments from several Department programs for your consideration.

Marine Fisheries Administration

The proposed area for seismic testing off the coast of New Jersey extends from Barnegat Ridge to the 35 fathom line and runs in a northwest to southeast direction intersecting fathom curves at a general perpendicular nature along its extent. The entire reach of the survey area is utilized by commercial and recreational fishermen from New Jersey and the proposed survey timeframe coincides with the peak of many commercial and recreational fisheries. There is also at least one known ship wreck within the study area that is popular among scuba divers and spearfishing enthusiasts.

50

Existing seismic studies and research have documented a variety of fisheries impacts. Studies have shown the noise produced from this activity can cause physical impacts such as short and long term damage to the ears of fish, and in some cases physical impacts lead to mortality. Research has also documented behavioral impacts that show a clear change in "normal" activity and an increase in "alarm" response behavior that results in changing of schooling behavior, change in swimming speeds, change in water column location and avoidance of sound. Studies have also demonstrated declining catch rates for a number of commercial fisheries during seismic testing activities. It is reasonably foreseeable that the proposed survey may impact fisheries distribution, movement, spawning patterns and accessibility to prey. However, the science is highly variable and the proposed study is different in scope, duration and frequency and is therefore difficult to quantify any specific impact.

The proposed time frame referenced in the proposal is a period of high to peak population abundance of several commercially and recreationally important fish species and commercial and recreational activity off the coast of New Jersey. Based on National Marine Fisheries Service data, New Jersey's fisheries, both commercial and recreational, are some of the most productive, highest grossing and employ more people than other states in the Mid-Atlantic and along the Atlantic Coast. These activities will take place offshore from some of New Jersey's important fishing ports, including Barnegat Light, Atlantic City, and Point Pleasant. Data analysis of
50 commercial and recreational landings from 1996 to 2013 indicate that this entire area is not only used by multiple commercial fisheries including gillnetters, otter trawl vessels, scallop boats, and long liners, but also an area heavily utilized by recreational fishermen. Both sectors in combination pursue over 35 species of fish in this area including but not limited to: albacore, bluefish, big eye tuna, Bluefin tuna, bonita, black sea bass, butter fish, cobia, cod, smooth dogfish, spiny dogfish, summer flounder, Atlantic menhaden, monkfish, red hake, skate, tilefish, swordfish, yellow fin tuna, and skipjack tuna.

Considering just two of the several species harvested during 2013; summer flounder and black sea bass, May through August represents 20 percent of the commercial black sea bass harvest, . and 22 percent of the commercial summer flounder harvest. This represents \$250,000 worth of black sea bass and \$1,360,000 of potential loss of summer flounder. This period generates 21% of commercial harvest revenue for New Jersey fishermen and represents 60 to 100% of the entire recreational season for the species listed above. Recreationally, 67% of the annual black sea bass are harvested during this period while 89% for summer flounder is represented during this time frame. Local businesses including restaurants, hotels, bait and tackle shops, and other coastal related trades are dependent on this time period generating income.

The time of year, proposed location of this activity (15 – 60 miles offshore), and length of time for the testing (30 consecutive days) are all significant negative factors that may likely adversely affect normal fisheries movement, migration and availability. These impacts could lead to direct and indirect consequences to New Jersey's important commercial and recreational fishing industries. This time period is the peak timeframe for scuba related activities and this sector
51 could be significantly impacted by the sound generated from this activity. Proper consideration
52 and notification needs to be provided to this important recreational sector during any activity.
53 Further, the potential economic impacts of the marine geophysical survey should be noted.

54 A portion of the proposed survey area is a recognized productive and historical fishing area known as "The Fingers" under NJDEP's Prime Fisheries Area Mapping. Areas beyond State waters are also heavily utilized by New Jersey's commercial and recreational fishing industry.
55 Marine fish and fisheries are protected under the New Jersey Coastal Management Program (NJCMP), and public access to and use of natural resources are major components of the Coastal Zone Management Act and the NJCMP. Based on previous studies examining seismic surveys.

and fisheries disturbances, it is reasonably foreseeable that the proposed surveys will have an impact from fisheries distribution, movement, migration and spawning perspectives that will lead to direct and indirect negative consequences to NJ's fishing industries. Svein Løkkeborg, et al. highlighted that "reduced catches on fishing grounds exposed to seismic survey activities have been demonstrated."[1] The conclusions reached by the Løkkeborg study are further supported by other recent studies concluding that catch rates reduced in the presence of seismic studies.[2]

Offshore waters also serve as essential habitat for invertebrate species during various stages of their lifecycles. Studies have provided "evidence that noise exposure during larval development
56 produces body malformations in marine invertebrates. Scallop larvae exposed to playbacks of seismic pulses showed significant developmental delays and 46% developed body abnormalities. Similar effects were observed in all independent samples exposed to noise while no malformations were found in the control groups."[3] A reduction in harvestable stock would result in further impacts to our commercial fisheries.

In reference to section IV. Environmental Consequences – Alternative Action: Another Time, the Marine Fisheries Administration proposes a September – October timeframe. This would not be during the winter months (weather) and outside the migration of the North Atlantic right whale which occurs mostly between November and April. Some marine mammal species are expected
57 to occur in the area year-round, so altering the timing of the proposed project would likely result in no net difference for those species. In response to "*The proposed dates for the cruise (~34 days in June–August) are the dates when the personnel and equipment essential to meet the overall project objectives are available; if the date of the cruise were changed, for example to late spring or early fall, it is likely that the Langseth would not be available*", this appears to propose that the Langseth is booked into the foreseeable future. The geologic formations which this project proposes to map are static and not likely to change if this project is rescheduled to September – October in a year in which the personnel and equipment essential to meet the overall project objectives are available.

The Amended EA describes the proposed survey area to represent less than one half percent (0.28%) of the area of waters from the NJ shore to the EEZ (600 km2/210,768 km2). While this description may be true, it is also misleading. A better comparison would be the percent of
58 survey area to the Exclusive Economic Zone (EEZ), where "*During 2002–2006 (the last year reported), commercial catch in the EEZ along the U.S east coast has only been landed by U.S. and Canadian vessels, with the vast majority of the catch (>99%) taken by U.S. vessels (Sea Around Us Project 2011).*" or the distinct areas which the commercial fisheries target.

[1] Løkkeborg, S.; Ona, E.; Vold, A.; & Salthaug, A., 2012. Effects of Sounds from Seismic Air Guns on Fish Behavior and Catch Rates. Advances in Experimental Medicine and Biology, 730, 415-419.

[2] Fewtrell, J.L. & McCauley R.D., 2012, Impact of Air Gun Noise on Behavior of Marine Fish and Squid. Marine Pollution Bulletin, 64, 984-993.

[3] de Soto, N.; Delorme, N.; Atkins, J.; Howard, S.; Williams, J. & Johnson, M. 2013. Anthropogenic noise causes body malformations and delays development in marine larvae. Scientific Reports. 3. Article No. 2831.

Endangered and Nongame Species Program (ENSP)

New Jersey's Atlantic Ocean waters act as a migration corridor for several endangered marine mammals and sea turtles which transit between habitats farther north and south. Marine mammals, especially cetaceans, may be adversely affected by noise created during seismic testing activities. Cetaceans' primary means of communication, navigation, locating food, locating mates, and avoiding predators and other threats is through their sense of hearing, which is much more highly developed than that of humans and can detect sounds within a much wider range of frequency. Noise pollution, in the form of repeated or prolonged sounds may adversely impact marine mammals by disrupting otherwise normal behaviors associated with migration, feeding, alluding predators, rest, breeding, etc. Any alterations to these behaviors may jeopardize the survival of an individual simply by increasing efforts directed at avoidance of the
59 noise and the perceived threat. In addition, animals distressed by noise generated by survey activities may become more susceptible to disease or predation by species which are not directly affected themselves. Furthermore, the proposed activities will add to an existing and increasing cacophony of anthropogenic noise pollution which may already be negatively impacting species. Acoustic detections of whale calls by Geo-Marine, Inc. confirmed the presence of right whales within 37 km of the shoreline, approximately between Seaside Park and Stone Harbor, during all seasons, concluding that some individual right whales occur in the nearshore waters off New Jersey either transiently or regularly.

Other listed marine mammals were also found year round, including humpback and fin whales (GMI, Inc. 2010). Similarly, the ENSP has records of harbor porpoise occurring in the project vicinity and within the proposed project period. Despite the time of year and fairly short duration of seismic surveys, individual whales and other marine mammals remaining in the area may still be impacted by project activities.

Sea turtles likely use sound for navigation, predator avoiding, locating prey, and other activities (Piniak et al. 2012). Although information regarding the impacts of anthropogenic noise on sea turtles is somewhat lacking, there is evidence to suggest that observed effects due to airguns may include behavioral changes, as well as temporary or even permanent hearing loss (Moein et al. 1995). The marine waters off New Jersey provide critical migration and feeding areas for sea turtle species such as Kemp's Ridley, Green, Atlantic Loggerhead and Leatherback turtles, the
60 Draft Amended Environmental Assessment fails to include the numerous sea turtle sightings reported from the Oyster Creek Nuclear Generating Station, located in Forked River, NJ. These sea turtles, mostly reported between June and September, travelled through Barnegat Inlet and are presumably using Barnegat Bay as a feeding area. It is possible, therefore, that sea turtles may be migrating through the study location during the critical June-July period, making them susceptible not only to impacts (e.g. behavior changes, hearing loss) from seismic activity, but to entanglement in the seismic array gear, and injuring/mortality due to ship strikes. Although the EA states that "recent monitoring studies show that some sea turtles do show localized movement away from approaching airguns", the extent to which sea turtles will exhibit avoidance behavior, along with the impacts to airgun exposure, remain unclear. Many of the sea
61 turtles migrating near NJ during the proposed project period are juveniles. Effects from air gun noise to smaller turtles will undoubtedly be greater than those observed in monitoring studies, while their ability to swim away/avoid the array due to their size will be reduced.

62 It is encouraging that the researchers plan to reduce the sonic signature to a more reasonable
level than was previously proposed by using the smaller source array. To further protect marine
species, we recommend that an aerial survey be performed over the project area just prior to the
vessel leaving its home port. The purpose of the flyover would be to determine if there is a
63 feeding, static, or migrating population of marine mammals (especially right whales, and also
harbor porpoise, which have a lower recommended PTS threshold level, according to new
NMFS guidelines, now undergoing public comment) or sea turtles in the vicinity. If marine
mammals or sea turtles are not observed during the flyover, then the survey could be performed
as scheduled. If marine mammals or sea turtles are found within or near the project area during
the flyover, then delaying the survey for 3-4 days would be prudent.

In addition to the flyover, we recommend the incorporation of a QA/QC plan that would
designate one person as responsible for ensuring the cessation of sound producing activities if
64 marine mammals or sea turtles are observed during transect runs. The vessel should stop all
noise for at least 30 minutes after the animal is no longer observable in the area. The designee
would document any observations of marine mammals or sea turtles, and send all relevant
occurrence information to the ENSP for inclusion into the Biotics database.

Division of Land Use Regulation

The Division of Land Use Regulation (DLUR) is currently reviewing a Federal Consistency for
the proposed National Science Foundation (NSF) marine geophysical survey. NSF submitted the
65 request for the Federal Consistency determination on December 22, 2014. The Department
expects to provide a final determination by February 19, 2015. If necessary, the Department can
request a 15 day extension, and the final determination would therefore be provided by March 5,
2015.

Office of Permit Coordination and Environmental Review (PCER)

DEP's PCER is responsible for coordinating all Federal National Environmental Policy Act
(NEPA) projects to ensure that the Department is proactively involved in the early review and
66 comment of projects in New Jersey. The central element in the environmental review process is
an evaluation of alternatives, including the "no action" alternative. NEPA requires consideration
and evaluation of reasonable alternatives that meet the project's purpose and need while
minimizing or avoiding environmental impacts. NEPA also requires the evaluation of a No
Action Alternative and a practical range of other "reasonable" action alternatives.

It is the Department's position that the Amended EA's Alternative Action is inadequate in
minimizing or avoiding certain environmental impacts. The Department notes that the Amended
67 EA did not incorporate any changes to the scope or timing of the study between last year and this
year. The project was not amended to change the study period, or incorporate other harm
68 minimization strategies like additional monitoring. The Department finally notes that the current
project still does not incorporate suggestions offered by the National Marine Fisheries Service in
69 a letter to National Science Foundation, dated June 18, 2014. This letter specifies that: "some
level of adverse effect to [Essential Fish Habitat (EFH)] may occur"; and "additional research

and monitoring is needed to gain a better understanding of the potential effects these activities may have on EFH...and should be a component of future NSF funded seismic survey activities." The Amended EA failed to consider these elements as part of any alternative.

It is also the Department's position that the Amended EA's No Action Alternative does not
70 adequately explain the need for conducting this seismic study. The Amended EA fails to
substantiate how the data collected from this study is necessary for a much greater effort to
analyze and report information. The Amended EA further fails to explain the need to conduct
the marine geophysical survey during the summer months. As stated in the Amended EA, "not
conducting the cruise (no action) would result in less data and support for the academic
institutions involved." The Department does not dispute this fact, but the Amended EA fails to
explain the need for this data to be collected this year. The geologic formations which this
71 project proposes to map are relatively static and not likely to change if this project is rescheduled
in the fall of a different year.

Based upon DEP's concerns in response to the marine geophysical survey proposed last year, the timing of the proposed 2015 study should have been moved to the fall/winter months. The Department recommends that the study be moved to an alternate time of year, such as September to October to reduce the impact to fisheries and marine mammals. If this is not possible in 2015 due to the schedule of the R/V Marcus Langseth, the Department recommends that the study be rescheduled to September-October of another year.

Since the Department and NSF have agreed that there is not enough data available to definitively
project the impact of the proposed survey on fisheries and marine mammals off the coast of New
72 Jersey, the Department recommends that NSF incorporate a study of these impacts into the
proposed marine geophysical survey. A bio-assessment study should be conducted in
conjunction with the marine geophysical survey and by an independent researcher. A study of
this type would provide data that would be essential to future marine geophysical surveys in the
Atlantic Ocean, particularly off the coast of New Jersey.

Thank you providing the New Jersey Department of Environmental Protection an opportunity to comment on the Draft Amended Environmental Assessment. If you have any questions regarding these comments, please contact Megan Brunatti at (609)292-3600 or Megan.Brunatti@dep.nj.gov.

Sincerely,

John Gray, Deputy Chief of Staff
New Jersey Department of Environmental Protection

C: Ginger Kopkash, Assistant Commissioner, LUM
Kelly Davis, NJDEP – DFW
Brandon Muffley, Marine Fisheries Administration
Megan Brunatti, PCER

January 20, 2015

Mr. Richard W. Murray
Division Director, Division of Ocean Sciences
Directorate for Geosciences
National Science Foundation
4201 Wilson Boulevard
Arlington, Virginia 22230

RE: Request for a 30-day extension on the comment period for Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015

Dear Mr. Murray:

As a concerned citizen who lives on the New Jersey shore, I am requesting a 30-day extension to the public comment period for the Draft Amended Environmental Assessment (EA) of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015.

Any proposal to perform seismic surveys off the coasts of New Jersey and New York is a matter of significant public import. Seismic surveys may do significant harm to marine mammals, sea turtles,
73 fish, and invertebrates, and may threaten human uses of the ocean for activities such as fishing and recreation. Accordingly, individuals and organizations should be afforded the adequate time and opportunity to take a hard look at the proposed seismic survey and investigate research findings from similar activities.

This project is of great interest and concern to many groups with which I am affiliated and individuals in the environmental, fishing, diving, and tourism sectors, as well as to the New Jersey State Legislature and several federal and state elected officials.

I thank you for your consideration.

Sincerely,

Patricia A. Morgan
[redacted]

APPENDIX G
COMMENT-RESPONSE MATRIX

Comment #	Commenter	Comment	Response	Final Amended EA Page # or Section
General Opposition to Proposed Activity				
1	Frank Bovasso	Opposed seismic survey based on concerns about impacts to fishing industry and connection with oil and gas.	The National Science Foundation (NSF) acknowledges the concern expressed over the proposed activity. As noted in the Draft Amended Environmental Assessment (EA), p. 56, the proposed activity is not related to oil industry research. The proposed activity is not expected to have significant impacts on the fishing industry (see Draft Amended EA, p. 52-53 and 56). No changes were made in the Final Amended EA in response to this comment.	No change
20	Robert Switzer	Opposed seismic survey; suggests it would disrupt wildlife and is unnecessary.	NSF acknowledges the concern expressed over the proposed activity. The proposed activity is not expected to have significant impacts on wildlife (Draft Amended EA, Chapter IV). As was described in the Draft Amended EA, p. 1-2, the proposed seismic survey would collect data in support of a research proposal that was reviewed under the NSF merit review process and identified as an NSF program priority to meet NSF's need to foster an understanding of Earth processes. No changes were made in the Final Amended EA in response to this comment.	No change
74	John Aurnhammer	Requested further research and testing on the effects of seismic surveys on fish and marine mammals before the survey moves forward. Suggests that we have no idea how the activity would affect fish and marine mammals.	NSF acknowledges the concern expressed over the proposed activity. NSF disagrees, however, that there is "no idea" how the proposed activity would affect fish and marine mammals in the survey area. Based on the analysis presented in the Draft Amended EA and the Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by NSF or Conducted by the U.S. Geological Survey (PEIS) and the 2014 Final EA (to which the Draft Amended EA tier), the proposed activity is not expected to have significant impacts on fish (see Draft Amended EA, p. 50-53) and marine mammals (see Draft Amended EA, p. 49-50). As noted in the Draft Amended EA, Chapter IV, no significant impacts to marine mammals or fish were observed during the 2014 survey activity, or in previous NSF-funded seismic surveys. Furthermore, the federal agencies with regulatory authority over the protection of fisheries and marine mammals did not determine that significant impacts would occur. To learn more about impacts of seismic surveys on fish, NSF provided federal funds to support an international conference on the effects of sound on the marine environment. No changes were made in the Final Amended EA in response to this comment.	No change
Request 30 Day Extension				
7	Clean Ocean Action (COA) et al.[1];	Requested 30 day extension based	A 30-day extension of the public comment period on the Draft Amended EA was	No change

[1] Clean Ocean Action, Jersey Coast Anglers Association, Fishermen's Dock Cooperative, New Jersey Outdoor Alliance, Greater Point Pleasant Charter Boat Association, Reef Rescue, Barnegat Light, NJ, Anglers Conservation Network, United Boatmen of New Jersey, Viking Village, Beach Buggy Association of New Jersey, Save Barnegat Bay, Hands

Comment #	Commenter	Comment	Response	Final Amended EA Page # or Section
9 10 11 15 16 18 19 21 73	United Boatman of New Jersey; Mary C. Wilding; Marlena Christensen; Glenn Arthur; Mayor of Barnegat Light, Kirk O. Larson, Sr.; Members of the New Jersey Congressional Delegation: Menendez; Booker; Smith; Pallone; Lobiondo; MacArthur; Jersey Coast Anglers Association; New Jersey Outdoor Alliance; Patricia Morgan	on the assumption that the Draft Amended EA contains reference to 126 additional sources of published data and scientific literature that were not contained in the December 2013 Draft EA.	requested based on an assertion that the document included the addition of 126 new published data and scientific literature. NSF compared the sources cited in the 2014 Final EA for the project issued on July 1, 2014, with the 2015 Draft Amended EA. The 2014 Final EA, which was issued nearly 6 months before the 2015 Draft Amended EA, contained all but 6 of the sources identified in "Section VI. Literature Cited". Three of those sources were actually referenced in the 2014 Final EA document on page 32 but were inadvertently omitted from the "Section VI. Literature Cited". Of the remaining three additional sources, one is the 2014 Final EA for the "Seismic Reflection Scientific Research Surveys During 2014 and 2015 in Support of Mapping the US Atlantic Seaboard Extended Continental Margin and Investigating Tsunami Hazards" issued on August 21, 2014. Despite the addition of only a few sources of published data and scientific literature referenced in the 2015 Draft Amended EA, NSF decided to extend the public comment period by an additional 15 days above and beyond the 37 days it was planned to be open for comment. The public comment period was opened on December 19, 2014 and closed on February 9, 2015, 11:59pm Eastern Standard Time. No changes were made in the Final Amended EA in response to this comment.	
8	United Boatman of New Jersey	Requested 30-day extension of the public comment period because of the migratory species of fish including bluefish, sea bass, fluke, and school sized blue fin tuna that migrate from south to north and east to west during that timeframe. They cannot afford any disruption in normal patterns, as they are restricted to a limited season for these species already. They noted that any disruption in normal	NSF extended the public comment period by an additional 15 days above and beyond the 37 days it was planned to be open for comment. As noted in the Draft Amended EA, p. 53, any impacts to fish species would occur very close to the survey vessel and would be temporary. The PEIS also concluded that seismic surveys could cause temporary, localized reduced fish catch to some species, but that effects on commercial and recreation fisheries were not significant. In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, Protected Species Observers (PSOs) and other crew members have seen no seismic sound-related fish or invertebrate injuries or mortality. As noted in the Draft Amended EA, p.53, past seismic surveys in the proposed survey area (2002, 1998, 1995, and 1990) did not result in noticeable effects on commercial or recreational fish catches, based on a review of multi-year National Marine Fisheries Service (NMFS) fish catch data in	No change

Across the Sand, and The Ocean Foundation. After the close of the public comment period, COA submitted a revised comment, adding the Center for Biological Diversity as a signatory.

Com-ment #	Commenter	Comment	Response	Final Amen-ded EA Page # or Section
		pattern could result in days lost at sea.	the months when seismic surveys were undertaken. No fish kills or injuries were observed during the 2014 survey (RPS 2014a)[2]. To sample fishing vessel traffic during the proposed survey period off New Jersey, we requested historical National Automated Identification System[3] (NAIS) data from the U.S. Coast Guard (USCG) Navigation Center for June and July 2013 and 2014. The number of fishing vessels equipped with AIS was 21–27 per month, with only 4–6 of those spending more than a few hours in the proposed survey area. Some, but not all, small recreational fishing vessels would be included, as the use of AIS systems is voluntary for small vessels. No fisheries activities except vessels in transit were observed in the survey area during the 13 days that the *Langseth* was there in July 2014. Given the proposed activities, no significant impacts on marine invertebrates, marine fish, their Essential Fish Habitat (EFH), and their fisheries would be expected. Fishing activities would not be precluded from operating in the proposed survey area. Space-use conflicts would be avoided and, therefore, impacts would be negligible, through communication with the fishing community and publication of a Notice to Mariners about operations in the area. No changes were made in the Final Amended EA in response to this comment.	
Request Public Hearing				
14 49	Glenn Arthur COA et al.	Expressed interest in a public hearing and sought clarification as to whether one was required.	Thank you for your interest in the proposed Marine Geophysical Survey off New Jersey. There is no federal requirement for holding a public hearing for an EA under the National Environmental Protection Act (NEPA); however, there is a requirement of public participation. As standard practice, NSF fulfills its public participation requirement on EAs by making draft EAs available to the public on the NSF website for a 30 day-open comment period. Following this practice, the Draft Amended EA was made available for public comment on 19 December 2014. Because the comment period overlapped with several holidays, an extra 7 days was added to the original open comment period, providing 37 days for public comment. After consideration of requests to extend the public comment period, NSF decided to further extend the public comment period by an additional 15 days above and beyond the 37 days it was planned to be open for comment, finally closing on 9 February 2015.	No change

[2] RPS. 2014. Draft protected species mitigation and monitoring report: 3-D seismic survey in the northwest Atlantic Ocean off New Jersey, 1 July 2014–23 July 2014, R/V *Marcus G. Langseth*. Rep. from RPS, Houston, TX, for Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY.

[3] Using the National Automated Identification System (NAIS), detailed information on marine vessel traffic is collected, consolidated, and disseminated to the USCG and other government agencies; the information includes vessel type, name, and other information that allows the data to be sorted by activities, e.g., fishing, diving, sailing, recreational, and cargo. Because AIS-equipped vessels transmit at regular intervals, it is possible to discriminate between vessels that are in the area for a period of time and those that are passing through.

Comment #	Commenter	Comment	Response	Final Amended EA Page # or Section
			No changes were made in the Final Amended EA in response to this comment.	
Scuba Diving Safety				
2 12 46	New Jersey (NJ) Council of Diving Clubs; Glenn Arthur; COA et al.	Expressed concern about safe diving distance from seismic survey. COA et al. noted that a full EIS must address these concerns and identify strict monitoring and mitigation.	In their comments, the New Jersey Council of Diving Clubs (NJCDC) suggested that a 145-decibel (dB) low-frequency sound limit could provide a suitable margin of safety for sport divers. Based on in situ measurements collected during 2014 using seismic streamer data and analyzed by Crone (pers. comm. 2015), a 145-dB level would be ~14 km (~7.5 nm) from the vessel. This 145-dB value is extrapolated from measured values; measured values at 160-dB and 180-dB distances were significantly lower, by 30–50%, than modeled values. Except for the *Lillian*, there is only one potential dive site in a 14-km buffer around the survey area, an unidentified wreck very near the outer edge of the buffer in >60 m water depth. The 14-km buffer is conservative, as it is around the entire survey area, not the vessel itself. The vessel, which would be constantly moving, would be a minimum of 14 km from a point on the edge of the buffer, but could be as far away as ~65 km from that point when it is at the far end of the survey area. As a mitigation measure to avoid space-use conflict, Columbia University's Lamont-Doherty Earth Observatory (L-DEO) has initiated outreach efforts to the diving community for proposed 2015 activities and would continue to do so should the activity go forward. Coordination activities would include direct contact with known dive shops, charter vessels, and communications through Notice to Mariners and direct radio contact with any dive boats observed at any distance from the *Langseth* during operations. NSF appreciates the efforts the diving community has made to coordinate and avoid space-use conflicts in both 2014 and 2015. As there is no indication of significant impacts associated with the proposed activity, preparation of an Environmental Impact Statement (EIS) is not required. The Final Amended EA has been updated to reflect recommended diving distances from the actively operating seismic vessel.	Chapter IV (5)
3	NJ Council of Diving Clubs	Expressed concern about the way the coordinates for the survey were represented in the Draft EA.	Thank you for your suggestion. The Final Amended EA has been revised to give the Global Positioning System (GPS) coordinates in degrees and decimal minutes as requested.	Page 4
4	NJ Council of Diving Clubs;	Noted that only one shipwreck (the *Lillian*) is identified within the survey area and suggested there may be other shipwrecks in the area, including more within the suggested	Thank you for bringing to our attention that there may be additional dive sites not captured during our review of potential sites, including shipwrecks, within the survey area. The National Oceanic and Atmospheric Administration (NOAA) Automated Wreck and Obstruction System offered the most comprehensive source of potential dive sites within the survey area. Although there could be additional dive and wreck	No change

Comment #	Commenter	Comment	Response	Final Amended EA Page # or Section
		diving buffer area.	sites within the survey area, during the public comment period, no other specific sites were identified within the survey area. Regardless, LDEO would use outreach efforts in advance of the survey to contact prospective divers. Local dive operators known to operate in the survey area would be notified about survey activities. Location of the *Langseth* and proposed activities within the survey area would be communicated to the public via Notice to Mariners. Therefore mariners in or near the survey area would be made aware of *Langseth* activities even if specific dive sites were not captured in Figure 2, of the Final Amended EA.	
45	COA et al.	COA et al. also noted that the Draft EA provided little information to the impacts that this proposed study would have on the recreational underwater diving community.	As there are many more dive sites outside of the survey area, and only one site identified within the survey area, very little impact would be expected on the recreational diving community from the proposed activity (Draft Amended EA, p. 54). To sample diving activity during the proposed survey period off New Jersey, historical NAIS data for both diving boats and pleasure craft in June and July 2013 and 2014 were requested and evaluated. There was only one AIS-identified dive boat in the survey area, apparently moving through the area in June 2013 and June 2014. In 2015, only one operator appears to have scheduled summer dives on the *Lillian*, on 11 July and 23 August (Deep Expeditions 2015[4]). As of 1 May 2015, no other operators were found that had scheduled dives on the *Lillian* during the summer of 2015. As noted in the Draft Amended EA, p. 54, no dive vessels were observed within the survey area during the 2014 survey. No changes were made in the Final Amended EA in response to this comment.	
6	NJ Council of Diving Clubs	Expressed interest in coordinating scuba diving and survey activity with the same individual as last year and knowing survey timing.	LDEO (and the same individual) would continue to coordinate with local scuba diving operations for the proposed 2015 survey as was done in 2014. The 2015 survey activity was proposed for a 30-day period within the June/July/August 2015 timeframe. If the survey moves forward, the specific dates of the survey would be conveyed through the outreach efforts described in the Final Amended EA and in the above noted responses. No changes were made in the Final Amended EA in response to this comment.	No change
13	Glenn Arthur	Expressed concern that in 2014 there was no communication with the diving community before and during the survey and questioned who would be notified before and during the 2015 survey.	In 2014, LDEO contacted local dive shops known to operate at the dive site *Lillian*. In addition, LDEO coordinated with the USCG to issue Notice to Mariners to alert vessel operators within the area. For the 2015 survey, LDEO would again coordinate with local scuba diving operators as was done in 2014 and with USCG to issue Notice to Mariners. No changes were made in the Final Amended EA in response to this comment.	No change

[4] Deep Expeditions. 2015. Independence II 2015 schedule. Accessed in April 2015 at http://www.deepexpeditions.com/DESchedule2015.pdf.

Comment #	Commenter	Comment	Response	Final Amended EA Page # or Section
51	NJDEP	Noted that the proposed survey time period is the peak timeframe for scuba related activities and that this sector could be significantly impacted by the sound generated from this activity.	NSF agrees with New Jersey Department of Environmental Protection (NJDEP) that the proposed survey time period likely does overlap with the peak timeframe for scuba diving off the coast of New Jersey. NSF, however, disagrees with NJDEP's assessment that this sector could be significantly impacted by the sound generated from this activity. The majority of scuba diving sites are located closer to shore, whereas the survey location is more distant from shore. Out of 900 shipwrecks or obstructions identified by the NOAA Automated Wreck and Obstruction System, only one infrequently used dive site (the *Lillian*) was located within the survey area. Although it is possible that undocumented dive sites are located within or near the survey area, none have been specifically identified during the public comment period. The proposed seismic activity would only occur for ~30 days within the June/July/ August timeframe, leaving 60 days within peak summer season for divers to dive when no seismic activities would be occurring at the *Lillian* dive site, or any undocumented sites within or near the survey area. To sample diving activity during the proposed survey period off New Jersey, historical NAIS data for both diving boats and pleasure craft in June and July 2013 and 2014 were evaluated. There was only one AIS-identified dive boat in the survey area, apparently moving through the area in June 2013 and June 2014. In 2015, only one operator appears to have scheduled summer dives on the *Lillian*, on 11 July and 23 August (Deep Expeditions 2015[4]). As of 1 May 2015, no other operators were found that have scheduled dives on the *Lillian* during summer 2015. Regardless of whether all dive sites have been documented in Figure 2 of the Final EA, LDEO would coordinate with local scuba diving operators and with USCG to issue Notice to Mariners to coordinate and avoid space use conflicts with divers in and near the proposed survey area. No changes were made in the Final Amended EA in response to this comment.	No change
52	NJDEP	Commented that the proper consideration and notification needs to be provided to this important recreational sector during any activity.	As noted above and in the Draft Amended EA, LDEO would coordinate with local scuba diving operators as was done in 2014 and with USCG to issue Notice to Mariners. No changes were made in the Final Amended EA in response to this comment.	No change
Survey Monitoring and Mitigation				
5	NJ Council of Diving Clubs	Suggested that National Marine Fisheries remotely monitoring fish and marine life within the survey area during the survey. Noted they	NSF is unable to comment on behalf of NMFS. NSF, however, has considered using underwater cameras to monitor fish; however, because underwater visibility within the survey area is extremely low, underwater cameras would likely not be an effective mechanism to record any potential impacts, especially at increasing	No change

Comment #	Commenter	Comment	Response	Final Amended EA Page # or Section
		hope to use underwater cameras to record any impact during the survey.	distances from the camera. As noted in the Draft Amended EA, Chapter IV, no significant impacts from the proposed activity would be anticipated on fish and marine life in the survey area. No changes were made in the Final Amended EA in response to this comment.	
30	COA et al.	Stated that the federal agencies must fully comply with the ESA and develop a robust biological opinion based on the best available science. They further urged, "NSF and Rutgers to establish more stringent mitigation measures to protect ESA-listed species than are currently proposed by the IHA."	NSF did consult under Endangered Species Act (ESA) Section 7. NMFS issued a Biological Opinion (BO)/Incidental Take Statement (ITS) with robust monitoring and mitigation measures that NSF would implement. Although COA et al. suggest that NSF establish more stringent mitigation measures to protect ESA-listed species, no particular measures were identified or recommended. As this public comment was submitted before the issuance of the NMFS notice of intent to issue an Incidental Harassment Authorization (IHA) and the IHA for the proposed 2015 activity, NSF assumes "more stringent mitigation measures to protect ESA-listed species than are currently proposed by the IHA" was in reference to mitigation measures identified in the 2014 IHA. Regardless, NSF believes the monitoring and mitigation measures identified in the Draft Amended EA, which were based on the PEIS standard measures, are conservative and robust. As noted above, NSF would, of course, comply with the requirements set forth in the IHA. No changes were made in the Final Amended EA in response to this comment.	No change
41	COA et al.	Claimed that the 15- and 30-minute wait times for mitigation are too limited. Suggested that this information adds to the need to conduct a full EIS and that longer, more conservative time thresholds (i.e., at least 60 minutes) for large odontocetes observed in the mitigation zone are needed.	NSF has proposed the use of 15- and 30-min mitigation wait times as those were identified in the PEIS as appropriate standard mitigation measures and have been standard measures in past IHAs. Based on the amount of time it would take the seismic vessel to exit the Exclusion Zone (EZ) for the *Langseth's* full 36-airgun array, a 15-min clearance time has been designated for small odontocetes/pinnipeds/turtles, whereas a more precautionary 30-min period was chosen for large cetaceans. (For the smaller source to be used for the proposed survey, the time to exit the 180-dB zone would be ~3 min, but the 15-min and 30-min clearance times would be retained.) As noted by NMFS (2013)[5], even though some whales are known to dive for longer periods (e.g., sperm and beaked whales), it is unlikely that an animal would dive and follow the vessel at the average acquisition speed, and a significant portion of dive movement is vertical rather than horizontal. Thus, the vessel would be well beyond the EZ and the diving animal within the designated clearance periods. NSF disagrees with COA's statement that consideration of whale dive times adds to the need for a full EIS for the proposed activity; whale dive times were considered in	No change

[5] NMFS (National Marine Fisheries Service). 2013. Notice; issuance of an Incidental Take Authorization (ITA). Takes of marine mammals incidental to specified activities; marine geophysical survey in the northeast Atlantic Ocean, June to July 2014. **Fed. Regist.** 78(109; 6 June 2013):34069-34083.

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			the PEIS and have been considered within the framework of the Final Amended EA. NSF would comply with the requirement established in the IHA for the proposed activity. No changes were made in the Final Amended EA in response to this comment.	
63	NJDEP	Recommended to further protect marine species that an aerial survey be performed over the project area just prior to the vessel leaving its home port. The purpose of the flyover would be to determine if there is a feeding, static, or migrating population of marine mammals (especially right whales and harbor porpoise which have a lower recommended PTS [permanent threshold shift] threshold level, according to new NMFS guidelines, now undergoing public comment) or sea turtles in the vicinity. If marine mammals or sea turtles are not observed during the flyover then the survey could be performed as scheduled. If marine mammals or sea turtles were found within or near the project area during the flyover, then delaying the survey for 3-4 days would be prudent.	The aerial survey recommended by NJDEP would not be a scientifically rigorous or effective mitigation measure. Regardless, NSF did bring this recommendation to the attention of NMFS during the IHA consultation process. NMFS, the federal agency with jurisdiction to regulate activities having the potential to affect marine mammals in the proposed survey area, however, did not recommend conducting aerial surveys as a mitigation measure that would further protect marine mammals in the IHA issued for the proposed survey. If this measure were to be included in the study, it would unnecessarily add noise to the survey area and would require further assessment under NEPA, ESA, and the Marine Mammal Protection Act (MMPA). Importantly, because of the high-risk nature of marine mammal aerial surveys, especially those that occur farther offshore, NSF would only consider conducting one if it were recommended or required, and scientifically justified, by NMFS. On May 17, 2008, a Cessna 337A, N5382S, crashed while attempting to divert to Eagles Nest Airport (31E), West Creek, New Jersey, for an emergency landing and the certified commercial pilot and one passenger were fatally injured, and the other two passengers were seriously injured.[6] The plane was conducting a marine mammal survey flight for a study funded by NJDEP. The proposed survey would take place substantially beyond the nearshore area that NJDEP had contracted for the fatal aerial survey, further increasing risk in the event of an in-flight emergency. Aside from the high risk associated with this recommendation, NJDEP has not demonstrated that this measure has biologically relevant scientific merit and would improve marine species protection. In contrast, the monitoring and mitigation plan proposed by NSF includes standard and systematic monitoring and mitigation measures for seismic surveys. The *Langseth* would carry five PSOs on board to observe for marine species around the vessel and survey area. Observations would begin during daylight hours immediately upon leaving port. During deployment of seismic gear, PSOs would have the opportunity to monitor around the vessel and observe for feeding, static, or migrating populations of sea turtles or marine mammals. Seismic operations would not begin if marine mammals, sea turtles, or sea birds were observed within a designated zone around the seismic source. The	No change

[6] NJDEP EBS Final Report: Volume III, July 2010; http://www.kathrynsreport.com/2013/01/trenton-new-jersey-woman-injured-in.html**)**

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			standard monitoring and mitigation measures described in the PEIS and Draft Amended EA would be followed along with the additional measures set forth in the associated IHA and BO/ITS. No changes were made in the Final Amended EA in response to this comment.	
64	NJDEP	Recommended that the incorporation of a QA/QC[7] plan that would designate one person as responsible for ensuring the cessation of sound producing activities if marine mammals or sea turtles are observed during transect runs. The vessel should stop all noise for at least 30 minutes after the animal is no longer observable in the area. The designee would document any observations of marine mammals or sea turtles, and send all relevant occurrence information to the ENSP for inclusion into the Biotics database.	As described in the Draft Amended EA (p. 5-8) and associated IHA application (p. 34-40), 5 NMFS-approved PSOs would be independently contracted to participate on the survey. Although inclusion of PSOs during a seismic survey is a standard measure required by the PEIS and has been the case for previous surveys, it is also a requirement of the IHA and BO/ITS issued by NMFS. PSOs would monitor and report on the presence and behavior of marine species, and direct the implementation of the mitigation measures for the research activity as described in the NSF Draft Amended EA, Letter of Concurrence (LOC) issued by the United States Fish and Wildlife Service (USFWS), and IHA and BO/ITS, including the cessation of seismic sources because of the presence of marine species within a designated area around the vessel. PSOs would document any observations during the survey as described by the Draft Amended EA, IHA, and BO/ITS. As the survey would be conducted in federal waters outside of NJ state waters and NMFS has federal jurisdiction over the protection of marine mammals, NSF would be legally required to follow the monitoring and mitigation requirements dictated in the IHA and BO/ITS issued by NMFS; this includes adhering to designated cessation periods of the seismic source because of the presence of marine mammals. In addition to the five independently contracted PSOs, NSF offered NJDEP the opportunity to identify a staff member to participate as an observer during the survey, should it go forward. Whereas ultimate authority to enforce the requirements of the IHA, including cessation of seismic activity, would remain with the PSOs, the NJDEP observer would have the opportunity to monitor, make recommendations, record and document observations, and provide observations to NJDEP's Endangered and Nongame Species Program for inclusion in the Biotics database. After NMFS approval, the formal report of PSO observations could be provided to NJDEP's Endangered and Nongame Species Program for inclusion in the Biotics database. To address concerns about space-use conflicts, throughout the duration of the survey, the R/V *Langseth* and any support vessel could keep a log of all vessels observed within the survey area; the complete log could be included in the formal report of PSO observations submitted to NJDEP's Endangered and Nongame	No change

[7] QA/QC was not defined by NJDEP, however, NSF has assumed it to mean "Quality Assurance/Quality Control."

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			Species Program. NAIS data could also be evaluated and reported to NJDEP to confirm vessel activity in the survey area. These offers and suggestions were repeatedly made to New Jersey over the past several months; unfortunately, however, NJDEP has not responded to any of these offers and suggestions. No changes were made in the Final Amended EA in response to this comment.	
72	NJDEP	Asserted that NJDEP and NSF are in agreement that there is not enough data available to definitely project the impact of the proposed survey on fisheries and marine mammals off the coast of NJ. Recommended that NSF incorporate a study of these impacts into the proposed marine geophysical survey. Suggested that a bio-assessment study should be conducted in conjunction with the marine geophysical survey and by an independent researcher.	Based on the analysis presented in the Draft Amended EA, the PEIS, and 2014 Final EA, along with consultation conclusions under the MMPA, ESA, and EFH, and results/observations from funding seismic research surveys for several decades, NSF draws the conclusion that the proposed activity would not significantly impact marine species or their habitat off the coast of NJ. As stated in the Draft Amended EA (page vi), "With the planned monitoring and mitigation measures, unavoidable impacts to each species of marine mammal and sea turtle that could be encountered would be expected to be limited to short-term, localized changes in behavior and distribution near the seismic vessel. At most, effects on marine mammals may be interpreted as falling within the U.S. Marine Mammal Protection Act (MMPA) definition of "Level B Harassment" for those species managed by NMFS. No long-term or significant effects would be expected on individual marine mammals, sea turtles, seabirds, fish, the populations to which they belong, or their habitats." Further, NJDEP recommended that NSF incorporate a study of the potential impacts of the proposed survey on fisheries and marine mammals into the proposed marine geophysical survey. The proposed activity already includes a monitoring plan that, should the survey go forward, would assess the project's impacts on marine species, including marine mammals, sea turtles, sea birds, and fish. As described in the Draft Amended EA (pages 5-8 and 45), the associated IHA application, the issued IHA, and the BO/ITS, 5 NMFS-approved PSOs would be independently contracted to be present during the survey to conduct monitoring activities and implement mitigation measures. Rotating shifts of PSOs would allow 2 observers to monitor for marine species during daylight hours, and 1 observer to monitor the Passive Acoustic Monitoring system during day and nighttime seismic operations. Although inclusion of PSOs during a seismic survey is a standard measure required by the PEIS, it is also a requirement of the IHA and BO/ITS issued by NMFS, and was identified and required in the IHA issued for the survey in 2014. PSOs would monitor and report on the presence and behavior of marine species, and implement any of the mitigation measures for the research activity as described in the NSF Draft Amended EA, LOC issued by USFWS, and the IHA and BO/ITS, including the cessation of seismic sources. PSOs would document any observations, including species behavior and abundance,	No change

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			during the survey as described by the Draft Amended EA and as required by the IHA and BO/ITS. Within 90 days of the conclusion of the survey, an observation report would be provided to NMFS, which, after NMFS review, is a public document. Pre-survey monitoring would commence upon departure from port and during initial gear deployment; monitoring would continue throughout the duration of the survey. Post-survey monitoring would occur upon conclusion of the seismic operations, during gear retrieval, transit through survey area, and transit to port. Should a support vessel be used during the survey, the vessel could serve as an additional platform for marine species observations. NJDEP suggested that a bio-assessment study should be conducted in conjunction with the marine geophysical survey and by an independent researcher. NJDEP, however, did not define or provide any details about what a bio-assessment study should, from their perspective, include or evaluate. The research proposal for the proposed activity was submitted to the NSF Marine Geology and Geophysics program (MG&G), which supports a broad range of research on all aspects of geology and geophysics of the ocean basins and margins, as well as the Great Lakes. Proposals submitted to this program must relate to established program priorities (for more detail see: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=11726). Whereas collaborative interdisciplinary research efforts are encouraged and funded by NSF, they are not a pre-requisite for all funding opportunities, including MG&G. A bio-assessment study was not included in the research proposal associated with this proposed activity. During the NSF merit review process, inclusion of a bio-assessment study was not recommended by the panel or MG&G as necessary for award. The research proposal was, however, determined to be highly meritorious during the merit review process, met all NSF program requirements, and was recommended by NSF Program Officers as worthy of funding. No changes were made in the Final Amended EA in response to this comment.	
Potential Socioeconomic Impacts				
17 53	Mayor of Barnegat Light, Kirk O. Larson, Sr.; NJDEP	Expressed concern about the potential economic impacts of the survey, including on the town of Barnegat Light. Stated that the potential economic impacts of the survey should be noted.	As noted in the Draft Amended EA, p. 10-11, implementation of the proposed activity would not affect, beneficially or adversely, socioeconomic resources. Because of the distance from shore, human activities in the area around the survey vessel would be limited to SCUBA diving, commercial and recreational fishing activities, and other vessel traffic transiting near the survey area. Because of the nature of the proposed activity and geographic location, no impacts would be expected on marine-related local businesses such as coastal restaurants, hotels, and bait and tackle shops.	Chapter III, "Fisheries"

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			Potential impacts on fishing, SCUBA diving, and vessel traffic were described in the Draft Amended EA, Chapter III and IV. There could be space-use conflicts with SCUBA divers in the survey area; however, most SCUBA diving activity takes place outside of the survey area, closer to shore. As very few dive sites would be impacted in the survey area and given the short duration of the proposed activity (~30 days), economic impacts on the diving industry would be limited, if any. L-DEO would coordinate with local dive operators to avoid space-use conflicts (e.g., for dives on the *Lillian*). Similarly, space-use conflicts could arise with fishing vessels within the survey area; however, LDEO would coordinate with vessels to avoid issues. To sample fishing vessel traffic during the proposed survey period off New Jersey, we requested historical NAIS data from the USCG Navigation Center for June and July 2013 and 2014. The number of fishing vessels equipped with AIS was 21–27 per month, with only 4–6 of those spending more than a few hours in the proposed survey area. Some, but not all, small recreational fishing vessels would be included, as the use of AIS systems is voluntary for small vessels. There was only one AIS-identified dive boat in the survey area, apparently moving through the area in June 2013 and June 2014. In 2015, it appears that one dive operator has scheduled summer dives on the *Lillian*, on 11 July and 23 August. During the ~13 days of 2014 survey activity, no fisheries activities or dive vessels were seen in the survey area (Draft Amended EA, p. 52 and 54). Additionally, there was limited merchant vessel activity in the survey area; most merchant traffic was lining up for “safety fairway” to the west of the survey area (Draft Amended EA, p. 55). No significant impacts from the proposed activity would be expected on diving activities and commercial and recreational fishing. The Final Amended EA was updated to reflect 2013 and 2014 NAIS data.	
Potential Impacts on Marine Life and/or habitat				
22	Lincoln Hollister	Suggested that the potential impacts from airguns on marine life have been exaggerated by opponents of seismic surveys and notes there is no scientific evidence for some of the claims.	Thank you for your interest in the proposed Marine Geophysical Survey off New Jersey. NSF believes that the potential impacts from the proposed activity have been conservatively reflected in Chapter IV of the Draft Amended EA. No significant impacts from the proposed activity would be expected on marine species from the proposed activity; serious injury and mortality and fish kills would not be expected. NSF notes that some claims are inconsistent with the research and other evidence collected and analyzed by NSF and the regulatory agencies that issued the IHA and the BO/ITS. No changes were made in the Final Amended EA in response to this comment.	No change

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23	Lincoln Hollister	Suggested that the benefits of conducting the proposed research exceed what little, if any, disturbance might be done to marine life.	Thank you for your comment. No changes were made in the Final Amended EA in response to this comment.	No change
29	COA et al.	Suggested that NMFS should consider the impact from the proposed activity on potential right whale critical habitat	The comment, although submitted to NSF, appears to be directed towards NMFS. NSF is unable to respond on behalf of NMFS. NSF, however, did consider potential impacts on North Atlantic right whales (NARWs) and designated critical habitat in the Draft Amended EA (see p. 14-17). As noted in the Draft Amended EA, p. 16, although there is a petition and a Proposed Rule (in February 2015) to revise critical habitat for NARWs, the revision does not include the migratory corridor off NJ. It is outside of NSF's authority to compel NMFS to amend the current status of North Atlantic right whale critical habitat that falls under their jurisdiction. The Final Amended EA has been updated to reflect this new information. Also, NARW habitat was identified by NMFS as an "important biological area" (IBA) in U.S. waters. A recent special issue of the journal Aquatic Mammals (February 2015) was devoted to the identification and description by NOAA of IBAs in U.S. waters; for an area to be biologically important for cetacean species, stocks, or populations, it needs to meet at least one of the following four criteria: reproductive area; feeding area; migratory corridor; or small and resident population. The NARW migratory corridor was designated an IBA, but only during March–April and November–December (LaBrecque et al. 2015)[8]. Regardless of the status of the critical habitat, no impacts would be expected upon North Atlantic right whale habitat from the proposed activity.	Chapter III, "North Atlantic Right Whale"
37	COA et al.	Suggested that the Draft Amended EA failed to describe the cumulative effects from other seismic surveys, including oil and gas seismic surveys, and sonar on the same stocks of marine mammals.	NSF did assess the cumulative effects of oil and gas (O&G) industry, military, research, and fisheries activities, vessel traffic, and marine mammal disease in the Draft Amended EA, p. 54-57. As noted in the Draft Amended EA, the proposed survey site is outside of the Bureau of Ocean Energy Management (BOEM) Atlantic Outer Continental shelf Proposed Geological and Geophysical Activities in the Mid-Atlantic and South Atlantic Planning Areas (BOEM 2014)[9]. No seismic surveys by the oil and gas industry are proposed off shore New Jersey in the foreseeable future. At	Chapter IV, "Cumulative Effects"

[8] LaBrecque, E., C. Curtice, J. Harrison, S.M. Van Parijs, and P.N. Halpin. 2015. Biologically important areas for cetaceans within U.S. waters—east coast region. p. 17-29 *In*: S.M. Van Parijs, C. Curtice, and M.C. Ferguson (eds.), Biologically important areas for cetaceans within U.S. waters. **Aquat. Mamm.** (Special Issue) 41(1). 128 p.
[9] BOEM (Bureau of Ocean Energy Management). 2014. Atlantic OCS proposed geological and geophysical activities: Mid-Atlantic and South Atlantic Planning Areas. Final Programmatic Environmental Impact Statement. U.S. Department of the Interior. Prepared under GSA Task Order No. M11PD00013 by CSA Ocean Sciences Inc. February 2014.

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		COA et al. stated, "The Navy Atlantic testing and training estimates 21.8 million instances of harm to marine mammals in the coming years.	the time the Draft Amended EA was prepared, it was unclear if and when any O&G related seismic surveys would be implemented in the future. A number of seismic surveys, however, have been proposed within the Mid-Atlantic and South Atlantic Planning Areas. At this time, the proposals are under various federal regulatory reviews and it is unclear if and when they would be approved to move forward. It remains unlikely, however, that the proposed survey would overlap in time with any of the proposed O&G industry seismic surveys. Although COA et al. also commented on potential harm to marine mammals from Navy activities, the comment does not cite the source for the data. It appears this may be the total of the behavioral, Temporary Threshold Shift (TTS), and PTS impacts (not necessarily number of individuals) from Table 3.4-15 to 3.4-18 of the 2013 U.S. Navy Atlantic Fleet Training and Testing Environmental Impact Statement/Overseas Environmental Impact Statement (AFTT EIS/OEIS). The AFTT EIS/OEIS covers a 5-year period and the study area is vast, 20–65°N, from the coast to 45°W, an area of 8.9 million km^2. The proposed survey, on the other hand, covers a 30-day period, and the survey area is ~600 km^2, 0.007% of the AFTT EIS/OEIS study area. The U.S. Navy activities described in the Cumulative Effects section of the Draft Amended EA are those that could occur at the Atlantic City Range Complex (ACRC) as there could be spatial and temporal overlap with the proposed activity relative to the cumulative impacts analysis. ACRC activities were included in the AFTT EIS/OEIS; the area of the ACRC is <0.2% of the AFTT study area. The Final Amended EA has been updated to reflect the current status of O&G related seismic surveys.	
50	NJDEP	Noted that the time of year, proposed location, and length of time for the survey are all significant negative factors that may likely adversely affect normal fisheries movement migration and availability. Stated that these impacts could lead to direct and indirect consequences to New Jersey's important commercial and recreational fishing industries.	NSF did consider potential impacts on fish and fisheries from seismic surveys in Sections 3.2.4 and 3.3.4 and Appendix D of PEIS, and in the Draft Amended EA, p. 50-53 and 56. Although NSF agrees with NJDEP that there could potentially be an effect on fish and fisheries within the survey area, NSF believes any impact would be short-term and localized, occurring only near the source vessel. The marine seismic survey would be conducted substantially outside of state waters and, therefore, would not overlap with fisheries activities inside the NJ coastal zone. Fisheries activities would not be precluded from operating within or around the survey area. During the proposed seismic survey, only a small fraction of the survey area would be ensonified by the source array at any given time (Draft Amended EA, p. 53) and the distance in which Level B harassment could be expected from the vessel is only 6.1 km from the source and would remain substantially outside of state waters. Given the proposed activity, no significant impacts on marine invertebrates, marine fish, their EFH, and	Chapter III, "Fisheries" and introduction

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			their fisheries would be expected. Similarly, given the distance to shore, direct and indirect consequences to New Jersey's commercial and recreational fishing industries would not be expected. NJDEP noted in its letter that, because of the time of year and project duration, the potential impacts could significantly affect fish harvest rates. On p. 2 of its letter, NJDEP provided information about two species based on data from May through August. The survey, however, is not proposed to occur in May but rather for a 30-day period within the June/July/August timeframe. Furthermore, the survey would only take place for ~30 days, not the entire summer season, and only a small portion of the entire survey area would be affected at any one time during seismic operations. As stated in the Draft Amended EA (p. 53), "the proposed survey area represents less than one half percent (0.28%) of the area of waters from the NJ shore to the EEZ..." The information presented by NJDEP in their letter, however, presumes the loss of an entire harvest season for particular species over the entire NJ coastal region. In the unlikely event the survey were to have an impact on harvest rates, it would impact a much smaller percentage of harvest than what was presented by NJDEP. To sample fishing vessel traffic during the proposed survey period off New Jersey, historical NAIS data from the USCG Navigation Center for June and July 2013 and 2014 were requested and evaluated. The number of fishing vessels equipped with AIS was 21–27 per month, with only 4–6 of those spending more than a few hours in the proposed survey area. Some, but not all, small recreational fishing vessels would be included, as the use of AIS systems is voluntary for small vessels. This information was added to the Final Amended EA. During 2014 survey activity, no actively operating fisheries vessels were encountered by the *Langseth* within the survey area (Draft Amended EA, p. 52). Past seismic surveys in the proposed survey area (2002, 1998, 1995, 1990) did not result in noticeable effects on commercial or recreational fish catches, based on a review of multi-year NMFS fish catch data in the months when seismic surveys were undertaken (Draft Amended EA, p. 53). The issuance of the Final EA, Finding of No Significant Impact (FONSI), IHA, and BO/ITS by NMFS in July 2014 further verified that significant impacts would not be expected from the proposed activity. Observations from the brief 2014 survey support this conclusion (RPS 2014a)[2]. Because of the nature of the proposed activity, no impacts would be anticipated on marine-related local business such as coastal restaurants, hotels, and bait and tackle shops; this clarification was added in the Chapter III of the Final Amended EA.	

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54	NJDEP	Identified a portion of the proposed survey area known as "The Fingers" as a recognized productive and historical fishing area under NJDEP's Prime Fisheries Area Mapping beyond state waters.	NSF updated the Final Amended EA to specifically identify "The Fingers" as a recognized productive and historical fishing area overlapping the survey area beyond state waters.	Chapter III, "Fisheries"
55	NJDEP	Asserted that, based on previous studies examining seismic surveys and fisheries disturbances, it is reasonably foreseeable that the proposed survey will have an impact from fisheries distribution, movement, migration and spawning perspectives that will lead to direct and indirect negative consequences to NJ's fishing industries. NJDEP specifically noted, "Svein Lokkeborg, et al., highlighted that "reduced catches on fishing grounds exposed to seismic survey activities have been demonstrated." [10] NJDEP also specifically noted, "The conclusions reached by the Løkkeborg study are further	NSF did consider potential impacts on fish and fisheries from seismic surveys in Sections 3.2.4 and 3.3.4 and Appendix D of PEIS, and in the Draft Amended EA, p. 50-53. Although NSF agrees with NJDEP that there could potentially be an effect on fish and fisheries within the survey area, NSF believes any impact would be short-term and localized, occurring only near the source vessel. The marine seismic survey would be conducted substantially outside of state waters, and would not preclude fisheries vessels from operating within or around the survey area. During the proposed seismic survey, only a small fraction of the survey area would be ensonified by the source array at any given time (Draft Amended EA, p. 53), and the conservatively predicted distance in which Level B harassment could be expected from the vessel is only 6.1 km from the source and would remain substantially outside of state waters. The reference in NJDEP's letter is a review in a book, "The effects of noise on aquatic life", whereas the reference in the EA is a paper in a journal that presents the results of a field experiment off Norway in 2009. As stated on p. 52 of the amended EA, Løkkeborg et al. (2012)[12] described in their introduction three studies in the 1990s that showed effects on fisheries. "In contradiction to these findings and fishermen's concerns" (Løkkeborg et al. 2012:1278), their study off Norway in 2009 showed that gillnet catches during seismic shooting were doubled for redfish (86% increase) and Greenland halibut (132%), whereas longline catches decreased (16% for Greenland halibut, 25% for haddock). These results were explained by greater swimming activity and lowered food search behaviour in fish exposed to airgun sound. Also, for all but one fish species (pollock), acoustic mapping did not suggest displacement from fishing grounds (Løkkeborg et al. 2012). Fewtrell and McCauley (2012) did not study catch rates, nor did they make any suggestions that their results were applicable to catch rates. Rather, as stated in the amended EA, they exposed squid, pink snapper, and trevally to pulses from a single	

[10] Løkkeborg, S., E. Ona, A. Vold, and A. Salthaug. 2012a. Effects of sounds from seismic air guns on fish behavior and catch rates. Advances in Experimental Medicine and Biology 730:415-419.

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		supported by other recent studies concluding that catch rates reduced in the presence of seismic studies."[11]	airgun. The received sound levels ranged from 120 to 184 dB re 1 dB re 1 $\mu Pa^2 \cdot s$ Sound Exposure Level (SEL). Increases in alarm responses were seen in the squid and fish at SELs >147–151 dB re 1 $\mu Pa^2 \cdot s$; the fish swam faster and formed more cohesive groups in response to the airgun sounds, and squid were seen to discharge ink or change their swimming pattern or vertical position in the water column. Given the proposed activity, no significant impacts on marine invertebrates, marine fish, their EFH, and their fisheries would be expected. Similarly, given the distance to shore, direct and indirect consequences to New Jersey's commercial and recreational fishing industries would not be expected. During 2014 survey activity, no actively operating fisheries vessels were encountered by the *Langseth* in the survey area (Draft Amended EA, p. 52). The number of fishing vessels equipped with AIS was 21–27 per month, with only 4–6 of those spending more than a few hours in the proposed survey area. Some, but not all, small recreational fishing vessels would be included, as the use of AIS systems is voluntary for small vessels. This information was added to the Final Amended EA. Past seismic surveys in the proposed survey area (2002, 1998, 1995, 1990) did not result in noticeable effects on commercial or recreational fish catches, based on a review of multi-year NMFS fish catch data in the months when seismic surveys were undertaken. The issuance of the Final EA, FONSI, IHA, and BO/ITS by NMFS in July 2014 further verified that significant impacts would not be expected from the proposed activity. Observations from the brief 2014 survey support this conclusion (RPS 2014a)[2].	
56	NJDEP	Noted that offshore waters serve as essential habitat for invertebrate species; "Studies have provided evidence that noise exposure during larval development produces body malformations in marine invertebrates. Scallop larvae exposed to playbacks of seismic	As stated on p. 51 of the amended EA, "Significant developmental delays and body abnormalities in scallop larvae exposed to seismic pulses were reported by de Soto et al. (2013). Their experiment used larvae enclosed in 60-ml flasks suspended in a 2-m diameter by 1.3-m water depth tank and **exposed to a playback of seismic sound at a distance of 5–10 cm**. [Emphasis added] This laboratory experiment would not, however, be representative of the proposed activity. Other studies conducted in the field have shown no effects on Dungeness crab larvae or snow crab embryos (Pearson et al. 1994; DFOC 2004 in NSF PEIS[14]). Moreover, a major annual scallop-	

[12] Løkkeborg, S., E. Ona, A. Vold, and A. Salthaug. 2012. Sounds from seismic air guns: Gear- and species-specific effects on catch rates and fish distribution. **Can. J. Fish. Aquat. Sci.** 69:1278-1291.

[11] Fewtrell, J.L. and R.D. McCauley. 2012. Impact of airgun noise on the behaviour of marine fish and squid. **Mar. Poll. Bull.** 64(5):984-993.

[14] NSF and USGS (National Science Foundation and U.S. Geological Survey). 2011. Final Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey. Accessed on 28 April 2015 at http://www.nsf.gov/geo/oce/envcomp/usgs-nsf-marine-seismic-research/nsf-usgs-final-eis-oeis-with-appendices.pdf.

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		pulses showed significant developmental delays and 46% developed body abnormalities. Similar effects were observed in all independent samples exposed to noise while no malformations were found in the control groups."[13]; and that a reduction in harvestable stock would result in further impacts to NJ commercial fisheries.	spawning period occurs in the Mid-Atlantic Bight during late summer to fall (August–October), although MacDonald and Thompson (1988 in NMFS 2004[15]) reported scallop spawning off New Jersey during September–November. Therefore, the timing of the proposed activity (June/July/August) would mainly avoid the scallop-spawning period.	
43	COA et al.	Suggested that the Draft Amended EA provides only broad information on commercial and recreational fishing activities that have historically occurred in the waters off New Jersey and was lacking site-specific detail, including how habitats may be affected and mitigation measures.	NSF disagrees with COA's comment. Significant detail regarding the specific types of fish habitat, fish, and fishing activities off the coast of NJ were included in the Draft Amended EA in Chapter 3, p. 29-33. Potential effects on fish, fish habitat, and commercial and recreational fisheries were included in detail in the Draft Amended EA, p. 50-53. Some fisheries information collected by NOAA is protected under proprietary/privacy laws, so the level of detail at a particular geographic location is not always publicly available. PSOs on board the vessel would monitor for all marine species, including fish, and although unexpected, would report any unusual behavior or observed impacts, such as fish kills. Should any such impacts be observed, PSOs would have the authority to shut down the airguns. Language was included in the Final Amended EA, Chapter II (3)(b) Operational Phase to identify the PSO monitoring and mitigation roles with respect to fish.	Chapter II, "Monitoring and Mitigation Measures"
44	COA et al.	Suggested that information and recommendations from recent studies on potential impacts on fish and shellfish from noise sources referenced in the Draft Amended EA were not adequately addressed, including mitigation recommendations, and were insufficient to meet the obligations to consult on EFH impacts and	NSF disagrees with COA et al.'s conclusion that the Draft Amended EA did not adequately address recently published literature and potential impacts and recommendations. The determination of sufficiency of information to consult under EFH was the responsibility and decision of NMFS. As NMFS issued an EFH determination, the information provided was sufficient. The Draft Amended EA and PEIS contained an extensive review of scientific literature on impacts from noise sources on the environment and analysis, allowing a firm basis for weighing the risks and benefits of the Proposed Action. No changes were made in the Final Amended EA in response to this comment.	No change

[13] de Soto, N.A, Delorme, N., Atkins, J., Howard, S., William, J., and M. Johnson. Anthropogenic noise causes body malformations and delays development in marine larvae. **Sci. Rep.** 3:2831. doi: 10.1038/srep02831.

[15] NMFS (National Marine Fisheries Service). 2004. Essential Fish Habitat source document: sea scallop, *Placopecten magellanicus*, life history and habitat characteristics. 2nd edit. NOAA Tech. Memo. NMFS-NE-189. 21 p. Accessed at http://www.nefsc.noaa.gov/publications/tm/tm189/tm189.pdf in June 2014.

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		comply with NEPA's hard look requirement.		
58	NJDEP	Suggested that a better comparison of the survey area would be the percent of survey area to the Exclusive Economic Zone (EEZ), where "During 2002-2006 (the last year reported), commercial catch in the EEZ along the U.S. east coast has only been landed by U.S. and Canadian vessels, with the vast majority of the catch (>99%) taken by U.S. vessels (Sea Around Us Project 2011)" or the distinct areas which the commercial fisheries target."	The Draft Amended EA describes the proposed survey area as less than one half percent (0.28%) of the water area between the NJ shore and the EEZ. The comment seems to suggest that the survey area be expressed as a percentage of (1) all U.S east coast waters to the EEZ or (2) the distinct areas that commercial fisheries target. The first percentage would be extremely small, but not relevant to NJ's fisheries. It is not possible to calculate the second percentage because the distinct areas targeted by commercial fisheries are not known; as a result, potential impacts on fisheries were assessed on all commercial fisheries in NJ waters based on available scientific literature. No changes were made in the Final Amended EA in response to this comment.	No change
59	NJDEP	Identified NJ's Atlantic Ocean waters as a migration corridor for marine species. Noted that noise pollution may adversely impact marine species; behavioral alterations may jeopardize individuals survival; animals distressed by sound may be more susceptible to disease; and that the proposed activity would add to existing and increasing cacophony of anthropogenic noise pollution, including to North Atlantic right whales which have been detected to be present within 37 km of the shoreline during all seasons, and other marine mammals such as humpback whales, fin whales, and harbor porpoises.	NSF mainly agrees with NJDEP's comment, and these points were also identified in the Draft Amended EA. The proposed activity, however, as described in the Draft Amended EA, would not be expected to have significant impacts on marine species or their habitats. The proposed survey is expected to result in only minor behavioral disturbances that would be expected to have only negligible impacts both on individual marine mammals and on the associated species and stocks. The type of effects described by NJDEP would only occur if marine mammals were excluded from critical areas for migration, feeding, or breeding at critical times, and that would not be the case off NJ in summer. NJDEP also stated, "Acoustic detections of whale calls by Geo-Marine, Inc. confirmed the presence of right whales within 37 km of the shoreline, approximately between Seaside Park and Stone Harbor, during all seasons, concluding that some individual right whales occur in the nearshore waters off New Jersey either transiently or regularly." Whereas it is possible, it is not likely that a small number of North Atlantic right whales (NARWs) could be off New Jersey in June. Geo-Marine, Inc.'s (GMI's) acoustic recording effort was in March, June, September, and December 2008, and March and August 2009. The majority of acoustic detections of NARWs were in March 2008 (78 or 60%), whereas there were only 7 detections in March 2009, indicating annual differences or, more likely, methodological limitations. There were 12 acoustic detections in June 2008. NARW sightings were few: during the	No change

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			study period (aerial and vessel surveys once or twice monthly between February 2008 and June 2009), there were a total of 4 sightings during November, December, and January. As stated on page 8 of the Draft Amended EA, "Special mitigation measures were considered for this cruise. Although it is very unlikely that a NARW would be encountered, the airgun array would be shut down if one is sighted at any distance from the vessel because of the species' rarity and conservation status." A recent special issue of the journal *Aquatic Mammals* (February 2015) was devoted to the identification and description by NOAA of "important biological areas" (IBAs) in U.S. waters; for an area to be biologically important for cetacean species, stocks, or populations, it needs to meet at least one of the following four criteria: reproductive area; feeding area; migratory corridor; or small and resident population. The only IBA off New Jersey is the NARW migratory corridor during March–April and November–December[10], which the timing of the proposed 2015 survey in June/July/August would avoid. No changes were made in the Final Amended EA in response to this comment.	
60	NJDEP	Suggested that sound is important for sea turtles, referring to Piniak et al. (2012), and that they might be impacted by anthropogenic sound and that the waters off New Jersey provide critical migration and feeding areas for sea turtles. Noted that the Draft Amended EA failed to include the numerous sea turtle sightings reported from the Oyster Creek Nuclear Generating Station located in Forked River, NJ. Identified that the sea turtles may be migrating through the study location during the critical June-July period, making them susceptible not	Thank you for identifying additional sources of sea turtle data. Although the full reference was not provided, Piniak et al. 2012[16] was reviewed and its conclusions were taken into consideration when preparing the Final Amended EA. Sightings reported from the Oyster Creek Nuclear Generating Station[17] located in Forked River, NJ were reviewed and taken into consideration when preparing the Final Amended EA. As was noted in the Draft Amended EA, NSF agrees with NJDEP that sea turtles could migrate through the study location during the proposed survey period. PSOs, however, would monitor for sea turtles around the vessel and would employ power down and shut down mitigation measures if sea turtles were to approach or enter the 180-dB EZ. Because of the design of the seismic equipment used on the R/V *Langseth*, sea turtle entanglement in the gear is highly unlikely. Similarly, sea turtle injury or mortalities as a result of ship strike by the *Langseth* would be highly unlikely given the slow operating speed during seismic operations. As stated on p. 50 of the Draft Amended EA, "In decades of seismic surveys carried out by the R/V *Langseth* and its predecessor, the R/V *Ewing*, Protected Species Observers (PSOs) and other	Chapter IV, "Summary of Potential Effects of Airgun Sounds"; Chapter III, "Sea Turtles"

[16] Piniak, W.E.D., D.A. Mann, S.A. Eckert, and C.A. Harms. 2012a. Amphibious hearing in sea turtles. p. 83-88. *In*: A.N. Popper and A. Hawkins (eds.), The effects of noise on aquatic life. Springer, New York. 695 p.
[17] Houlahan, K. and K. Paez. 2014. Annual report of sea turtle incidental takes—2014, Oyster Creek Nuclear Generating Station. Rep. from Exelon Generation, Oyster Creek, NJ, for National Marine Fisheries Service Northeast Region, Gloucester, MA. December 2014.

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		only to impacts from seismic activity but to entanglement in the seismic array gear, and injury/mortality due to ship strikes.	crew members have seen no seismic sound-related sea turtle injuries or mortality, including during 2014 survey activities [off New Jersey].”	
61	NJDEP	Stated that many of the sea turtles migrating near NJ during the proposed project period are juveniles. Claimed that the effects from airgun noise to smaller turtles will undoubtedly be greater than those observed in monitoring studies while their ability to swim away/avoid the airgun array because of their size will be reduced.	Although NJDEP suggests, “Effects from air gun noise to smaller turtles will undoubtedly be greater than those observed in monitoring studies...”, no scientific references were provided to support this conclusion, nor were specific references provided to identify which “monitoring studies” NJDEP was referring. Whereas smaller sea turtles might be slightly more disadvantaged at swimming away from the source, because of the vessel operating speed, the ship would pass by any sea turtle relative quickly regardless of turtle size. PSOs would also monitor and mitigate for sea turtles around the vessel. No changes were made in the Final Amended EA in response to this comment.	No change
62	NJDEP	Stated that they are encouraged that the researchers plan to reduce the sonic signature to a more reasonable level than was previously proposed by using the smaller source array.	Thank you for your comment. Based on information gathered during the 2014 survey, the 700-in^3 source was viewed sufficient to meet the research goals. No changes were made in the Final Amended EA in response to this comment.	No change
Preparation of an EIS				
25	COA et al.	Suggested that the proposed activity warrants preparation of an EIS.	NSF prepared a PEIS for marine seismic research in June 2011 and issued a Record of Decision in June 2012. The PEIS evaluated the potential effects of marine seismic research at both a broad and detailed level. The PEIS was aimed to minimize the duplication of effort in environmental documentation and to address the potential for cumulative effects of NSF-funded marine seismic research on the environment. The PEIS assembled and analyzed the broadest range of direct, indirect, and cumulative impacts associated with all NSF-funded marine seismic research activities in addition to other past, present, and reasonably foreseeable projects in the region of influence. The PEIS serves as a strong technical basis for a more global assessment of the potential cumulative impacts of NSF-funded activities in the future. As noted in the PEIS, Chapter 1, Section 1.4, the PEIS sets up a framework for streamlining the preparation of subsequent environmental documents where needed for site specific surveys. In addition, the PEIS notes that time- and location-specific documents	No change

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			would be addressed in EIS supplements, tiered EAs, or other appropriate environmental documentation that would follow the publication of the PEIS (per Council for Environmental Quality regulations at 40 CFR 1502.20). Tiering of environmental documentation makes subsequent documents of greater use and meaning without duplicating previous paperwork and environmental analyses. In addition, the PEIS identified an appropriate and prudent set of standard mitigation measures to be integrated into future NSF-funded seismic surveys. One of the sites evaluated in detail in the PEIS included a survey at approximately the same location as the proposed site. Information about this Detailed Analysis Area (DAA), the Northwestern Atlantic (NW Atlantic), can be found throughout the various Chapters of the PEIS. Because of slight differences between the Proposed Action and the NW Atlantic DAA presented in the PEIS (e.g. source size and water depth), site-specific environmental analysis was prepared for the proposed activity to more accurately evaluate potential effects. For the 2014 survey, Draft and Final EAs were prepared that tiered to the PEIS. A Draft Amended EA was prepared for the proposed 2015 survey, which tiered to both the 2014 Final EA and the PEIS. The Draft Amended EA is consistent with the analytical framework established in the PEIS, including the incorporation of the standard mitigation measures. The Draft Amended EA, the 2014 Final EA, and the PEIS, included analysis of the direct, indirect and cumulative impacts, and alternatives, and were made available for public comment periods; the Draft Amended EA, in particular, was open for a 52-day public comment period, 22 days more than the NSF standard 30-day public comment period for Draft EAs. Based on the analysis presented in the Draft Amended EA, the 2014 Final EA, and the PEIS, significant impacts on the environment are not expected from the proposed activity. As significant impacts are not expected from the proposed activity, the preparation of an EIS is not warranted. No changes were made in the Final Amended EA in response to this comment.	
Regulations				
26	COA et al.	Suggested that NSF should comply with Coastal Zone Management Act (CZMA).	NSF has complied with the requirements of the CZMA. NSF submitted a Consistency Determination to the States of New Jersey and New York for the Proposed Action pursuant to CZMA. Additional information regarding the CZMA process can be found in the Final Amended EA, Chapter IV (8). No changes were made in the Final Amended EA in response to this comment.	No change
27 30	COA et al. COA et al.	Suggested that NSF and LDEO should consult under ESA, fully comply, develop a robust biological	NSF did consult under ESA Section 7 with NMFS and USFWS for the proposed activity. USFWS concurred with NSF that the proposed activity may affect but was not likely to adversely affect species under their jurisdiction. Section 7 consultation for the	No change

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		opinion, and adopt robust mitigation measures "such as those described in the alternatives section described above."	proposed 2015 survey resulted in the issuance of a BO/ITS by NMFS. NSF's intent to consult under ESA Section 7 with NMFS and USFWS for the proposed 2015 survey was noted in the Draft Amended EA, p. 57-59. Updated information about the ESA consultations conducted for the 2015 survey activity has been incorporated into the Final Amended EA in Chapter IV (8). The Draft Amended EA also noted that NSF had consulted under ESA Section 7 with NMFS and USFWS for the 2014 survey. The 2014 survey activity consultations resulted in concurrence from USFWS that the proposed activity may affect but was not likely to adversely affect species under their juris-diction, and issuance of a BO/ITS by NMFS. COA states in its letter on page 3, "More-over, NSF and Rutgers should adopt robust mitigation measures such as those des-cribed in the alternatives section above to avoid adverse impacts to listed species." There does not appear to be an 'alternatives section' above that sentence in the letter, however, so it was unclear to NSF to which robust mitigation measures COA was referring. Robust monitoring and mitigation measures for the proposed activity were, however, described in the Draft Amended EA, p. 5-8, and 45. NSF would also implement the monitoring and mitigation measures defined in the BO/ITS and in the USFWS concurrence letter. No changes were made in the Final Amended EA in response to this comment.	
28	COA et al.	Suggested that NMFS's reliance on the 160-dB Level B and 180/190-dB Level A thresholds do not reflect best available science (as described above).	The ESA process requires conformity with current NMFS policy; therefore, the Draft Amended EA was prepared in accordance with the current acoustic guidance established by NMFS. As noted in the Draft Amended EA, in December 2013, NOAA published revised draft acoustic guidelines for assessing the effects of anthropogenic sound on marine mammals; however, the date of release of the final guidelines and how they would be implemented are unknown. Therefore, the Final Amended EA also reflects the current acoustic guidance established by NMFS. It is outside of NSF's authority to change NMFS's acoustic guidelines and policies. NMFS provided an explanation of why it applies the current thresholds in the notice of intent to issue an IHA for the 2015 survey (Federal Register Notice 13962, March 17, 2015) and the notice of intent to issue an IHA and response to comments for the IHA issued for the 2014 survey (Federal Register Notice 14779, March 17, 2014 and Federal Register Notice 38504, July 8, 2014). COA states in its letter on p. 3, "NMFS' reliance on the 160-dB Level B and 180/190 Level A thresholds do not reflect the best available science. As described above, the best available science supports lower thresholds for many marine species." There is, however, no discussion or reference above those two sentences in the letter regarding thresholds; therefore, NSF is unable to specifically address that point. NSF would implement the monitoring and mitigation measures required by the BO/ITS.	No change

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			No changes were made in the Final Amended EA in response to this comment.	
42	COA et al.	Noted that agencies have a statutory obligation to consult on the impact of federal activities on essential fish habitat under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA).	NSF did consult under MSFCMA with NOAA for EFH for the proposed survey and the 2014 survey. NOAA concluded for both the proposed survey and the 2014 survey that some level of adverse effects to EFH may occur as a result of the proposed activity, however no project-specific EFH conservation recommendations were provided. NOAA recommended additional research and monitoring to gain a better understanding of the potential effects that seismic surveys may have on EFH, federal managed species, their prey, and other NOAA trust resources for future NSF activities, however, this was not a consultation requirement. In response to this recommendation, NSF provided federal funds for an international conference in March 2015 designed to address impact of sound on the marine environment. NSF's intent to consult under MSFCMA for EFH for the proposed survey was noted in the Draft Amended EA, p. 58. Updated information about the MSFCMA for EFH consultation conducted for the 2015 survey activity was included in the Final Amended EA. The Draft Amended EA also noted that NSF had consulted under MSFCMA for EFH for the 2014 survey.	Chapter IV, "Public Involvement and Coordination with Other Agencies and Processes"
65	NJDEP	Noted that the Division of Land Use Regulation is currently reviewing a Federal Consistency for the pro-posed NSF marine geophysical survey, submitted on 22 December 2014. A final determination was expected to be provided by 19 February or 5 March 2015 if a 15-day extension is requested.	After receiving and approving a 15-day extension request, NSF received a federal consistency review from NJDEP on March 6, 2015. Additional information regarding the CZMA process can be found in the Final Amended EA, Chapter IV (8).	No change
Take estimates and Modeling				
31	COA et al.	Suggested that the methodology to develop exclusion and buffer zones and estimate marine mammal takes was a broad methodology and the same used in the March 2014 Draft EA, "...despite several concerns raised by the Marine Mammal Commission and others during the comment period on the draft IHA. COA shares many of the MMC	In the comment, NSF assumes that "draft IHA" means the March 17, 2014 notice of intent to issue an IHA by NMFS. In the comment, COA et al. also state they agree with "many" of the concerns raised by the Marine Mammal Commission (MMC) on the 2014 "draft IHA", however, it is unclear to NSF specifically which concerns they are in agreement with and which ones they are not. In addition, in the statement it is unclear which other commenters during the 2014 IHA public comment period COA et al. considers "experts." NSF disagrees with COA that the methodology to develop exclusion and buffer zones and take estimates followed a broad methodology. The methodology used was very specific and was described in detail in the Draft Amended EA. The methodology used to develop exclusion zones were described in	No change

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		concerns and recommends that the Draft Amended EA be revised to account for expert recommen-dations."	detail in the Draft Amended EA, Chapter II (p. 6-7) and Appendix A. The specific methodology to develop take estimates was described in the Draft Amended EA, Chapter IV (p. 45-49). NMFS provided detailed responses to comments received on the March 17, 2014, notice of intent to issue an IHA, including comments by MMC, in the Federal Register notice of IHA issuance for the 2014 survey (Federal Register Notice 38504, July 8, 2014). No changes were made in the Final Amended EA in response to this comment.	
32	COA et al.	Suggested that the NMFS acoustic criteria threshold, 160 dB and 180/190 dB, used to determine take are not based on the best available science, and refers to authorizations issued to the Navy for naval sonar activities which incorporate linear risk functions to account for risk and individual variability as an example.	As the IHA process requires conformity with current NMFS policy, the Draft Amended EA and IHA application were prepared in accordance with the current acoustic guidance established by NMFS. As noted in the Draft Amended EA, in December 2013, NOAA published revised draft acoustic guidelines for assessing the effects of anthropogenic sound on marine mammals for public review and comment, however, the date of release of the final guidelines and how they would be implemented are unknown. Therefore, the Final Amended EA also reflects the current acoustic guidance established by NMFS. It is outside of NSF's authority to change NMFS's acoustic guidelines and policies. No changes were made in the Final Amended EA in response to this comment.	No change
33	COA et al.	Suggested that the agency's approach to estimating impact thresholds for injury to marine mammals is "non-conservative" and therefore more marine mammals would be harmed than estimated.	As the IHA process requires conformity with current NMFS policy, the Draft Amended EA and IHA application were prepared in accordance with the current acoustic guidance established by NMFS. As noted in the Draft Amended EA, in December 2013, NOAA published for public review and comment revised draft acoustic guidelines for assessing the effects of anthropogenic sound on marine mammals, however, the date of release of the final guidelines and how they would be implemented are unknown. Therefore, the Final Amended EA also reflects the current acoustic guidance established by NMFS. It is outside of NSF's authority to change NMFS's acoustic guidelines and policies. Although the commenter assumes that a change in acoustic guidance thresholds would result in increased take for species for the proposed activity, this assumption may be incorrect, as a change in thresholds based on marine mammal TTS, the expected offset between the TTS and PTS thresholds, differences in the acoustic frequencies to which different marine mammal groups are sensitive, and other factors, in fact, would likely result in a decrease of take for some species. No changes were made in the Final Amended EA in response to this comment.	No change
34	COA et al.	Recommended that the applicant rectify inconsistencies between the	Although COA et al. have suggested NSF rectify the inconsistencies between the Draft Amended EA and the 2014 IHA issued by NMFS, it is unclear to which issues	No change

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		Draft Amended EA and the 2014 IHA issued by NMFS.	exactly they are referring. NSF is therefore unable to address these concerns more specifically; however, if these inconsistencies were identified in more detail elsewhere in their comments, (such as issues related to calculating the exclusion zone and take estimates), NSF may have subsequently addressed them. The only operational and procedural difference between the 2014 survey and the proposed 2015 survey would be the use of the smaller source size (700 in^3); therefore, the analysis included in the Draft Amended EA was based only on that source size, whereas the 2014 IHA analysis was based on the larger (1400 in^3). In addition, the Draft Amended EA noted in various places differences in analytical approach (e.g., p. 47) between it and the 2014 IHA. The analytical approach in the 2015 IHA (and the associated NMFS EA), differed slightly from the approach in the 2014 survey; these differences were addressed in the Final Amended EA as well. Regardless of any differences in analytical approach between the Draft Amended EA and the 2014 IHA, NSF would comply with all requirements of the IHA issued in 2015 for the proposed activity. No changes were made in the Final Amended EA in response to this comment.	
35	COA et al.	Suggested that exclusion and buffer zones were developed via a simplistic model. Recommends that the applicant re-estimate exclusion and buffer zones after inputting project specific operational details (including tow-depth, airgun source intensity, and number of firing airguns) and environmental parameters (including water depth, seafloor geology, and how sound refracts in the water column) into its sound propagation model.	For the proposed shallow water survey, use of a model with environmental characteristics of the specific study area is unnecessary as the predicted operational mitigation radii were based on empirical results (see Draft Amended EA, Appendix A) and confirmed by in situ measurements (Crone, pers. comm. 2015). For shallow-water surveys, such as for the proposed activity, analysis of field measurements collected during calibration studies in shallow water of the Gulf of Mexico demonstrated that they are appropriate to use to derive mitigation radii in other shallow water environments. Preliminary analysis by Crone (pers. comm. 2015) of data collected during the 2014 survey off NJ, confirmed that in situ measurements and estimates of the 160- and 180-dB distances collected by the *Langseth* hydrophone streamer were significantly smaller than the predicted operational mitigation radii. This analysis, therefore, confirmed the predicted mitigation radii were conservative and appropriate for mitigation use. This analysis also confirmed the effectiveness of the use of scaling factors. Preliminary analysis results for the proposed shallow water survey site are consistent with analysis conducted of a shallow water site off the Washington coast (Crone et al. 2014)[18]. The analysis by Crone (pers. comm. 2015) also demonstrates that an additional 3-dB buffer added to the exclusion zone, which was required by NMFS for the 2014 survey, would be	No change

[18] Crone, T.J., M. Tolstoy, and H. Carton. 2014. Estimating shallow water sound power levels and mitigation radii for the R/V *Marcus G. Langseth* using an 8 km long MCS streamer. **Geochem. Geophys. Geosyst.** 15(10):3793-3807. doi:10.1002/2014GC005420.

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			unnecessary and scientifically unjustified. Although smaller mitigation radii might be warranted based on the scientific analysis in Crone et al. (2014)[22] and Crone (pers. comm. 2015), NSF would remain committed to implementing the conservative radii originally presented in the Draft Amended EA and incorporated in the IHA. No changes were made in the Final Amended EA in response to this comment.	
36	COA et al.	Suggested that the EA underestimates the impact on marine mammal takes, and on all marine life, in the small ocean area affected, because the calculation method does not take into account the fact that areas will be ensonified on multiple occasions over the 30-day project period; the EA should include an assessment of the total multiplied ensonified area for a given day and the total number of survey days.	NSF disagrees that we have underestimated take, as this same methodology for estimating take (and not substantially overestimating take) has been used for most previous NSF-funded seismic surveys. NMFS does not provide specific guidance to IHA applicants on estimating take, therefore, there is variability in methodological approaches. In fact, NMFS has used the NSF/LDEO methodology to estimate take for past surveys. In a survey such as this where areas are ensonified on multiple occasions, the same individuals might be exposed more than once. For the 2014 survey, NMFS added an additional 25% to the estimated take to account for the turnover of marine mammals in the survey area. For the proposed survey, NMFS included a 25% contingency factor in the take analysis described in their EA for the IHA. As described in the Final Amended EA, NMFS introduced a new approach for calculating takes: with some exceptions, "The modeled number of instances of exposures to sound levels ≥ 160 dB re: 1 µPa is the product of the species density (where available), the daily ensonified area of 1,226 km2, and the number of survey days (30 plus 25 percent contingency for a total of 38 days)". The use of the numbers of exposures, not the numbers of individuals, to calculate take authorization differs from NMFS' practice for more than a decade for NSF-related seismic surveys. For those species, as a result of this different methodology, authorized takes are 1.8–214 times what they were in 2014, despite the smaller airgun array being used in 2015. Whereas NSF believes that NMFS's methodology results in an overestimation of take and of potential impacts to marine species from the Proposed Action, NSF would adhere to the requirements of the IHA. As described in the Final Amended EA, during an NSF-funded, ~5000-km, two dimensional (2-D) seismic survey from the *Langseth* off the coast of North Carolina in September–October 2014, only 296 cetaceans were observed within the predicted 160-dB zone and potentially taken, representing <2% of the 15,498 authorized takes (RPS 2015)[19]. During an USGS, ~2700 km, 2-D seismic survey from the *Langseth* along the U.S. east coast in August–September 2014, only 3 unidentified dolphins	Chapter IV, 1(e)

[19] RPS. 2015. Protected species mitigation and monitoring report: East North American Margin (ENAM) 2-D seismic survey in the Atlantic Ocean off the coast of Cape Hatteras, North Carolina, 16 September–18 October 2014, R/V *Marcus G. Langseth*. Rep. from RPS, Houston, TX, for Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY.

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			were observed within the predicted 160-dB zone and potentially taken, representing <0.03% of the 11,367 authorized takes (RPS 2014b)[20]. A discussion of the difference in approach on calculating take estimates between the Draft Amended EA and the NMFS EA for the 2014 survey is given in the Draft Amended EA, p. 47 and 49. A discussion of the difference in approach on calculating take estimates between the Draft Amended EA and the IHA for the proposed survey is presented in the Final EA.	
		Suggested that, "these concentrated multiplied affects must be evaluated for all marine life species, not just mammals and turtles."	It is not clear what is meant by COA et al.'s comment, "these concentrated multiplied affects must be evaluated for all marine life species, not just mammals and turtles." The potential effects of the survey are taken into account for all marine species in the Draft Amended EA, Chapter IV. Take estimates, however, are only applicable and calculated for marine mammals and, only by NMFS, for sea turtles. No changes were made in the Final Amended EA in response to this last comment.	
38	COA et al.	Stated that no explanation is provided in the Draft Amended EA for why a 1.25 turnover estimate is omitted since it was included in the 2014 IHA and that it is essential to include.	NSF has used the same methodology for estimating take (and not substantially overestimating take) for most previous NSF-funded seismic surveys. NMFS does not provide specific guidance to IHA applicants on estimating take, therefore, there is variability in methodological approaches. In fact, NMFS has used the NSF/LDEO methodology to estimate take for past surveys. In a survey such as this where areas are ensonified on multiple occasions, the same individuals might be exposed more than once. For the 2014 survey, NMFS added an additional 25% to the estimated take to account for the turnover of marine mammals in the survey area. For the proposed survey, NMFS included a 25% contingency factor in the take analysis described in their EA for the IHA. As described in the Final Amended EA, NMFS introduced a new approach for calculating takes: with some exceptions, "The modeled number of instances of exposures to sound levels ≥ 160 dB re: 1 µPa is the product of the species density (where available), the daily ensonified area of 1,226 km2, and the number of survey days (30 plus 25 percent contingency for a total of 38 days)". The use of the numbers of exposures, not the numbers of individuals, to calculate take authorization differs from NMFS' practice for more than a decade for NSF-related seismic surveys. For those species, as a result of this different methodology, authorized takes are 1.8–214 times what they were in 2014, despite the smaller airgun array being used in 2015. Whereas NMFS' analysis does result in an increase in take from 2014 and 2015, the number of takes for both years falls well within the range of insignificance and meets the criteria for issuing an IHA.	Chapter IV, 1(e)

[20] RPS. 2014b. Draft protected species mitigation and monitoring report: U.S. Geological Survey 2-D seismic reflection scientific research survey program: mapping the U.S. Atlantic seaboard extended continental margin and investigating tsunami hazards, in the northwest Atlantic Ocean, Phase 1, 20 August 2014–13 September 2014, R/V *Marcus G. Langseth*. Rep. from RPS, Houston, TX, for Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY.

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			Whereas, based on recent data, NSF believes NMFS' methodology results in an overestimation of take and of potential impacts to marine species from the Proposed Action, NSF would adhere to the requirements of the IHA. As described in the Final Amended EA, during an NSF-funded, ~5000-km, 2-D seismic survey from the *Langseth* off the coast of North Carolina in September–October 2014, only 296 cetaceans were observed within the predicted 160-dB zone and potentially taken, representing <2% of the 15,498 authorized takes (RPS 2015)[23]. During an USGS, ~2700 km, 2-D seismic survey from the *Langseth* along the U.S. east coast in August–September 2014, only 3 unidentified dolphins were observed within the predicted 160-dB zone and potentially taken, representing <0.03% of the 11,367 authorized marine mammal takes (RPS 2014b)[24]. A discussion of the difference in approach on calculating take estimates between the Draft Amended EA and the NMFS EA for the 2014 survey is given in the Draft Amended EA, p. 47 and 49. A discussion of the difference in approach on calculating take estimates between the Draft Amended EA and the IHA for the proposed survey is presented in the Final EA.	
39	COA et al.	Recommended that updated species information and take estimates be provided for the three pinniped species that were included in the 2014 IHA.	No pinnipeds were included in the 2014 NSF Final EA or in the Draft Amended EA; as stated on p. 12 of the Draft Amended EA, harp seals and hooded seals are rare in the proposed survey area, and gray and harbor seals have a more northerly distribution during the summer and are therefore not expected to occur there during the survey. No pinnipeds were observed during the 13-day cruise in 2014. Information on grey, harbor, and harp seals were included in the 2014 NMFS EA, and were incorporated into the 2014 NSF Final EA and Draft Amended EA by reference as if fully set forth therein; the Final Amended EA for the proposed survey also incorporated information from the 2014 and 2015 NMFS EA. NSF believes NMFS has taken a conservative approach by including potential takes for pinnipeds. Although NSF disagrees with NMFS that there is potential for pinniped takes, NSF would, however, adhere to the requirements of the IHA. No changes were made in the Final Amended EA in response to this comment.	No change
40	COA et al.	Noted that the 2014 IHA and Biological Opinion included a more conservative exclusion zone for marine mammals and sea turtles of 177-dB rather than the standard 180-dB zone required by NMFS guidance of all other seismic	For the 2014 survey, NMFS required NSF to include a 3-dB buffer, adding ~50%, to the 180-dB (for cetaceans and sea turtles) and 190-dB (for pinnipeds) exclusion zones during operational mitigation. Preliminary analysis by Crone (pers. comm. 2015) of data collected during the 2014 survey off NJ confirmed that in situ measurements and estimates of the 160- and 180-dB isopleths collected by the *Langseth* hydrophone streamer were significantly smaller than the predicted operational mitigation radii. This analysis, therefore, confirmed the predicted mitigation radii	No change

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		surveys. Stated that the EA should be amended to include updated estimates of marine mammal and sea turtle impacts under the 177-dB exclusion zone approach.	were conservative and appropriate for mitigation use. Preliminary analysis results for the proposed shallow water survey site are consistent with analysis conducted of a shallow water site off the Washington coast (Crone et al. 2014)[22]. The analysis by Crone (pers. comm. 2015) also demonstrates that an additional 3-dB buffer added to the exclusion zone, which was required by NMFS for the 2014 survey, would be unnecessary and scientifically unjustified. Ultimately, NMFS did not require a 3-dB buffer in the IHA and BO/ITS issued for the proposed survey. Although smaller mitigation radii might be warranted based on the scientific analysis in Crone et al. (2014)[22] and Crone (pers. comm. 2015), NSF would remain committed to implementing the conservative radii originally presented in the Draft Amended EA and incorporated in the IHA for the proposed survey. As is standard practice, marine mammal takes for the 2014 survey were based on the 160-dB radii, not the expanded 177-dB and 187-dB exclusion zones used for operational mitigation (i.e., shut downs/power downs). Marine mammal takes calculated for the 2015 survey were also based on the 160dB radii. NSF and NMFS were consistent in this approach for calculating take. No changes were made in the Final Amended EA in response to this comment.	
Evaluation of Alternative Actions/No Action				
24	Lincoln Hollister	Noted that the negative impact of stopping an academic seismic survey includes the loss of scientific data and knowledge of sea level rise for informing public policy, research programs, and the impairment of student education and future scientific careers.	The consequences of not conducting the proposed research activity are described in the Draft Amended EA, p. 60. The Draft Amended EA appears to reflect the effects described in the comment submitted. No changes were made in the Final Amended EA in response to this comment.	No change
47	COA et al.	Stated that the Draft Amended EA did not provide sufficient evaluation of the No-Action Alternative and suggests conducting the research using existing core samples and 2-dimensional seismic data previously obtained within the project area.	The No-Action Alternative was described in the Draft Amended EA, p. 8 and 60. The proposed research cannot be conducted using existing core samples and 2-D seismic data previously obtained in the project area. As discussed in the Draft Amended EA, p. 2, features such as river valleys cut into coastal plain sediments, now buried under a km of younger sediment and flooded by today's ocean, cannot be resolved in existing 2-D seismic data to the degree required to map shifting shallow-water depositional settings in the vicinity of clinoform rollovers. This is the basis for the proposal to use a three dimensional (3-D) reflection survey to map sequences at the proposed survey site around existing International Ocean Discovery Program (IODP) Expedition 313 drill sites and analyze their spatial/temporal evolution. As noted in	No change

Com-ment #	Commenter	Comment	Response	Final Amen-ded EA Page # or Section
		Suggested that as the project would occur in public waters, a comparison of the potential environmental and socioeconomic harm from the seismic activity against the potential contribution of the study result to scientific understanding is critical.	the Draft Amended EA, p. 60, "Existing seismic profiles occur at intervals too coarse to achieve the proposed scientific goals of this project. To the larger spacing and the limitations inherent in processing 2-D seismic data preclude identification of key features of the past margin such as river or delta channels and shoreline adjustments. Only dense, 3-D seismic acquisition and processing can provide continuity of imaging to enable confident identification of these features, whose distributions are expected to evolve throughout the time period recorded in the sediments targeted. The No-Action Alternative would not meet the purpose and need for the proposed activities." The purpose and objectives of the proposed research were described in the Draft Amended EA, p.1. Potential environmental impacts, including any potential socioeconomic impacts, from the Proposed Action, Alternative Action, and No-Action Alternative were described in the Draft Amended EA, p. 10-11 and 34-60. The research proposal, which provides greater detail about the proposed activity, has been included as Appendix B in the Final Amended EA. The research proposal was also included as an Appendix in the NSF Final EA for the 2014 survey (Appendix B). No changes were made in the Final Amended EA in response to this comment; however, the research proposal, which provides greater detail about the proposed activity, has been included as Appendix B in the Final Amended EA.	
48	COA et al.	Stated that the Draft Amended EA contains only a brief discussion of conducting the survey at another time; questions why summer months have again been identified as the only viable timeframe for the project; and recommended incorporation of information from experts in marine mammal biology and fisheries in its evaluation of alternate times of year from the study. This recommendation was based on the statement that, "recent research has confirmed the year-round presence of North Atlantic right whales off the New Jersey coast,	In addition to the proposed activity occurring in summer 2015, the Draft Amended EA did identify conducting the survey at another time as an Action Alternative, (p. 8 and 59). Reasons why June/July/August was chosen as the survey timing were discussed in the Draft Amended, p. 6. Weather conditions, the availability of personnel (including scientists), vessel, and equipment, were factors considered when developing the timing of the Proposed Action and Action Alternative. The Draft Amended EA does take into consideration information from experts in marine mammal biology and fisheries in its evaluation of alternative times for the Proposed Action. Although recent research demonstrates that NARWs could be present year round off New Jersey, they are more likely to be present during November–April; thus, a survey during that period would have a greater chance of encountering a NARW. Acoustic recordings off New Jersey were made between March 2008 and November 2009. In fact, monthly numbers of NARW detections were highest in March, April, and May (**not** June) 2008 (10, 25, and 37), and much lower in the other months (0–7). The high numbers in March–May 2008 are, in part, attributable to the fact that beginning in June 2008, at least half of the recording devices were configured for	No change

Com-ment #	Commenter	Comment	Response	Final Amen-ded EA Page # or Section
		and furthermore, that the numbers of up-call detections per day were highest in the March through June time period.[21]" Stated that, "Given that weather issues (including Hurricane Arthur and "equipment damage from rough seas") are identified in the Draft Amended EA as a primary contributor to the failure of the researchers to complete the survey within the time allotted last summer, it is questionable why the summer months have again been identified as the only viable timeframe for the project."	odontocete (higher frequency) sounds (Whitt et al. 2013). Also, despite very intense vessel and aerial survey effort off New Jersey between January 2008 and December 2009 (12,893 km and 12,222 km, respectively), there were only a total of 4 sightings, in May 2008, November 2008, January 2009, and December 2009). Whereas hurricanes can occur in the summer, peak hurricane season starts in mid-August and extends until mid-October[22]; some of NJ's deadliest recorded storms have occurred during September/October. The most recent deadly hurricane that hit the NJ shoreline was Hurricane Sandy which impacted the state from October 26, 2012 to November 8, 2012. It was declared a major disaster on October 30, 2012.[23] Hurricane Sandy was responsible for 73 deaths in the United States and cost billions of dollars in assistance.[24] The rough weather encountered by the *Langseth* during the 2014 survey demonstrates the challenges of conducting oceanographic research even during optimal weather periods, and similarly, highlights the potential safety hazards of operating during suboptimal weather periods. No changes were made in the Final Amended EA in response to this comment.	
57	NJDEP	Suggested September/October to be an appropriate time of year to conduct the survey as it is outside of North Atlantic right whale migration and winter weather. Recommended rescheduling the survey to a future time in September/October when the vessel, personnel, and equipment are available.	NJDEP suggested shifting the survey to a September/October timeframe for 2015, or to a September/October timeframe of a future year. Whereas NSF has taken into consideration alternative times to conduct the survey, NJDEP has disregarded reasons provided in the Draft Amended EA for survey scheduling limitations, including presence of marine species, weather, and personnel and equipment availability. There is no indication in seasonal marine mammal density data that September/October would be preferable to June through August. NJDEP has failed to identify how the September/October timeframe is more optimal and less impactful to marine mammals than the June/July/ August timeframe proposed by NSF, a timeframe that federal agencies with jurisdiction over endangered and threatened species in the area have also found to be optimal to operate with respect to marine mammals. These agencies also found in 2014 that the 2014 survey, also authorized to occur during the June/July/August timeframe, would not result in significant impacts to marine species, including endangered or threatened species, and their habitats, and	No change

[21] Whitt, A.D., K. Dudzinski, and J.R. Laliberté. 2013. North Atlantic right whale distribution and seasonal occurrence in nearshore waters off New Jersey, U.S.A., and implications for management. **Endang. Species Res.** 20:59-69.
[22] http://climate.rutgers.edu/stateclim/?section=menu&%20target=nj_hurricane_history
[23] http://www.fema.gov/disaster/4086
[24] http://www.fema.gov/sandy-recovery-office

Com-ment #	Commenter	Comment	Response	Final Amen-ded EA Page # or Section
			met the criteria for obtaining an IHA. At most, with implementation of monitoring and mitigation measures, the proposed activity, like the 2014 survey, could result in Level B harassment (behavior modification) to marine mammals. Given that the federal agencies charged with protecting marine mammals and endangered and threatened species authorized the same activity during the June/July/ August time-frame in 2014, it is logical that NSF has proposed that the project occur within the same time period in 2015. September/October is actually peak season for hurricanes[22]; some of NJ's deadliest recorded storms have occurred during September/October. The most recent deadly hurricane that hit the NJ shoreline was Hurricane Sandy, which impacted the state from October 26, 2012 to November 8, 2012. It was declared a major disaster on October 30, 2012.[23] Hurricane Sandy was responsible for 73 deaths in the United States and cost billions of dollars in assistance.[24] The rough weather encountered by the *Langseth* during the 2014 survey demonstrates the challenges of conducting oceanographic research even during optimal weather periods (summer), and similarly, highlights the potential safety hazards of operating during suboptimal weather periods. During the September/October 2015 timeframe, the lead Principal Investigator (PI) and a collaborating PI have teaching obligations, and two collaborating PIs are scheduled to conduct field work at sea on other research cruises. Although the *Langseth* has been in the North Atlantic for the last year and a half in support of academic research activities, this is the first time it has operated along the U.S. east coast since it began science operations in 2008. At present, the *Langseth* is scheduled to support other research activities in 2015, including a research activity in the Mediterranean Sea; the *Langseth* is scheduled to depart in support of that activity in September. After that survey, the vessel is scheduled to transit to the east coast of South America, the west coast of South America, then on to the southwest Pacific Ocean. Therefore, it is not a reasonable assumption that the *Langseth* would be available to work along the U.S. east coast in the foreseeable future. As a U.S. government-owned national asset, it is NSF's responsibility to operate the vessel in the most efficient way possible; thus, when scheduling the vessel in support of research activities, factors such as minimizing transits are considered. NJDEP has suggested that the geologic formations at the target depths of interest are static and not likely to change if the proposed activity were rescheduled to September to October in a future year in which the personnel and equipment essential to meet the overall project objectives are available. This suggestion, however, does not	

Com-ment #	Commenter	Comment	Response	Final Amen-ded EA Page # or Section
			take into account that the research was proposed by researchers and students whose professional and academic careers depend upon the collection of these data and successful completion of the survey. In other words, there is a timeliness factor involved with the proposed activity, as well as a desire to have the scientific results incorporated into the broader scientific community in the near term. No changes were made in the Final Amended EA in response to this comment.	
66	NJDEP	Claimed that the Alternative Action is inadequate in minimizing or avoiding certain environmental impacts. Notes that the Draft Amended EA failed to consider this as part of any alternative.	Thank you for your comment; NSF acknowledges NJDEP's opinion that the Action Alternative does not minimize or avoid certain environmental impacts. For clarification, under NEPA, Action Alternatives are not required to "minimize or avoid impacts" but rather are alternatives to the Proposed Action that also meet the purpose and need of the agency. The environmental consequences of the Proposed Action, Action Alternatives, and No-Action Alternative, including those that may or may not avoid or minimize adverse impacts or enhance the quality of the human environment, are then considered to assist in agency decision-making. No changes were made in the Final Amended EA in response to this comment.	No change
67	NJDEP	Noted that the Amended EA did not incorporate any changes to the scope or timing of the study between last year and this year.	For clarification, NSF received no comments during the open public comment period on the Draft EA for the 2014 survey. Whereas NSF did consider comments that were submitted as part of the IHA process associated with the 2014 survey, and there were some suggestions to move the survey to other time periods (such as winter), NSF did not find compelling scientific reasons to alter the timing of the Proposed Action, and there were logistical and safety issues associated with moving the survey to alternative time frames. All authorizations for conducting the survey during the June/July/August period in 2014 were received from the federal regulatory agencies with jurisdiction over the survey area, and those same agencies also issued authorizations for the proposed activity this year. In addition, as noted in the Draft Amended EA, weather conditions and the availability of personnel, vessel, and equipment were considered when developing the timing of the Proposed Action and Action Alternative. The Action Alternative proposed in the Draft Amended EA was proposed to consider alternative timeframes for conducting the survey. It is unclear what types of changes to the project scope NJDEP felt should have been considered in the Action Alternative; therefore, NSF is unable to provide a more specific response to this concern. No changes were made in the Final Amended EA in response to this comment.	No change
68	NJDEP	Commented that the project was not amended to change the study	For clarification, NSF received no comments during the open public comment period on the Draft EA for the 2014 survey. Whereas NSF did consider comments that were	Chapter II, "Monitoring

Com-ment #	Commenter	Comment	Response	Final Amen-ded EA Page # or Section
		period or incorporate other "harm minimization strategies like additional monitoring".	submitted as part of the IHA process associated with the 2014 survey, and there were some suggestions to move the survey to other time periods (such as winter), NSF did not find compelling scientific reasons to alter the timing of the Proposed Action, and there were logistical and safety issues associated with moving the survey to alternative time frames. All authorizations for conducting the survey during the June/July/August period in 2014 were received from the federal regulatory agencies with jurisdiction over the survey area, and those same agencies also issued authorizations for the proposed activity this year. In addition, as noted in the Draft Amended EA, weather conditions and the availability of personnel, vessel, and equipment were considered when developing the timing of the Proposed Action and Action Alternative. The Action Alternative proposed in the Draft Amended EA was proposed to consider alternative timeframes for conducting the survey. It is unclear to NSF which 2014 public comments provided on "harm minimizing strategies like additional monitoring" received during the NMFS IHA process NJDEP feels should have been incorporated into the Draft Amended EA. The Action Alternative included the same monitoring and mitigation measures as the Proposed Action. These monitoring and mitigation measures were consistent with the PEIS and previous monitoring and mitigation measures included in many IHAs issued for NSF funded seismic surveys. In addition to these standard monitoring and mitigation measures, NMFS did include two additional mitigation measures in the IHA issued for the 2015 survey: (1) a 1-min shot interval for the mitigation airgun; and (2) shutdowns of the source for large (6 or more) groups of whales. These changes were noted in the Final Amended EA.	and Mitigation Measures"
69	NJDEP	Noted that the current project still does not incorporate suggestions offered by NMFS in a letter dated June 18, 2014 that specifies: "some level of adverse effect to [Essential Fish Habitat (EFH)] may occur"; and "additional research and monitoring is needed to gain a better under-standing of the potential effects these activities may have on EFH ... and should be a component of future NSF funded seismic survey activities." Noted that the Amended EA failed to consider these elements	NSF did consult under MSFCMA with NOAA for Essential Fish Habitat for the 2014 survey and 2015 proposed activity. NOAA concluded for the 2014 survey and the 2015 proposed activity that some level of adverse effects to EFH may occur as a result of the proposed activity, however no project-specific EFH conservation recommendations were provided. NOAA recommended additional research and monitoring to gain a better understanding of the potential effects that seismic surveys may have on EFH, federal managed species, their prey, and other NOAA trust resources for future NSF activities, however, this was not a consultation require-ment. In response, NSF provided federal funds to an international conference designed to address the impacts of sound on the marine environment. NSF's intent to consult under MSFCMA for EFH for the proposed 2015 survey was noted in the Draft Amended EA, p. 58. Updated information about the MSFCMA for EFH consultation conducted for the 2015 survey activity was incorporated into the	Chapter II, "Monitoring and Mitigation Measures"

Com-ment #	Commenter	Comment	Response	Final Amen-ded EA Page # or Section
		as part of any alternative.	Final Amended EA in Chapter IV (8). For both the Proposed Action and Action Alternative (Survey at Another Time), PSOs on board the vessel would monitor for all marine species, including fish, and although unexpected, would report any unusual behavior or observed impacts, such as fish kills. Should any such impacts be observed, PSOs would have the authority to shut down the airguns. Language was included in the Final Amended EA to identify the PSO monitoring and mitigation roles with respect to fish.	
70	NJDEP	Stated that the No-Action Alternative does not adequately explain the need for conducting the seismic study and fails to substan-tiate how the data collected are necessary.	The need for conducting the Proposed Action and the purpose for collecting data was appropriately described in the Draft Amended EA, p. 1. Whereas the No-Action Alternative is not considered a reasonable alternative because it does not meet the purpose and need for the Proposed Action, as required under Council of Environmental Quality (CEQ) regulations (40 CFR 1502.14[d]), the No-Action Alternative is carried forward for analysis. The No-Action Alternative (i.e., do not issue an IHA and do not conduct the research operations) was described in the Draft Amended EA, p. 8, and the environmental consequences of implementing the No-Action Alternative were described on p. 60. The proposed research cannot be conducted using existing core samples and 2-D seismic data previously obtained within the project area. As discussed in the Draft Amended EA, p. 2, features such as river valleys cut into coastal plain sediments, now buried under a km of younger sediment and flooded by today's ocean, cannot be resolved in existing 2-D seismic data to the degree required to map shifting shallow-water depositional settings in the vicinity of clinoform rollovers. This is the basis for the proposal to use a 3-D reflection survey to map sequences at the proposed survey site around existing IODP Expedition 313 drill sites and analyze their spatial/temporal evolution. As noted in the Draft Amended EA, p. 60, "Existing seismic profiles occur at intervals too coarse to achieve the proposed scientific goals of this proposed activity. To the larger spacing and the limitations inherent in processing 2-D seismic data preclude identification of key features of the past margin such as river or delta channels and shoreline adjustments. Only dense and 3-D seismic acquisition and processing can provide continuity of imaging to enable confident identification of these features, whose distributions are expected to evolve throughout the time period recorded in the sediments targeted. The No-Action Alternative would not meet the purpose and need for the proposed activities." No changes were made in the Final Amended EA in response to this comment.	No change
71	NJDEP	Noted that the Draft Amended EA failed to explain the need to conduct	The Proposed Action and timing were described in detail in the Draft Amended EA, p. 2-8. In particular, survey timing was considered during the planning stages of the	No change

Com-ment #	Commenter	Comment	Response	Final Amen-ded EA Page # or Section
		the survey in summer months and in this year. Recommends that based on NJDEP's concerns expressed in response to the marine geophysical survey proposed last year, the proposed survey should have been moved to fall/winter months. Recommends the survey be conducted in September-October 2015, or future year, to reduce the impact to fisheries and marine mammals.	survey, as described on p. 6 of the Draft Amended EA. Factors that were taken into consideration for the proposed survey timing included environmental conditions (such as the seasonal presence of marine mammals, sea turtles, seabirds), weather conditions, equipment and personnel availability, and optimal timing for other proposed surveys on the *Langseth*. For clarification, NSF received no comments from NJDEP during the open public comment period on the Draft EA for the 2014 survey. Whereas NSF did consider comments that were submitted as part of the IHA process associated with the 2014 survey, and there were some suggestions to move the survey to other time periods (such as winter), NSF did not find compelling scientific reasons to alter the timing of the Proposed Action, and there were logistical and safety issues associated with moving the survey to alternative time frames. There is no indication in seasonal marine mammal density data that September/ October would be preferable to June through August. NJDEP has failed to identify how the September/October timeframe is more optimal and less impactful than the June/July/August timeframe proposed by NSF, a timeframe that federal agencies with jurisdiction over endangered and threatened species in the area have also found to be of an optimal period to operate with respect to marine mammals. These agencies also found in 2014 that the 2014 survey, also authorized to occur during the June/July/August timeframe, would not result in significant impacts to marine species, including endangered or threatened species, and their habitats, and met the criteria for obtaining an IHA. At most, with implementation of monitoring and mitigation measures, the proposed activity, like the 2014 survey could result in Level B harassment (behavior modification) to marine mammals. Given that the federal agencies charged with protecting marine mammals and endangered and threatened species authorized the same activity during the June/July/August timeframe in 2014, it is logical that NSF has proposed that the project occur within the same time period in 2015. Importantly, September/October is actually peak season for hurricanes[22]; some of NJ's deadliest recorded storms have occurred during September/October. The most recent of these that hit the NJ shoreline was Hurricane Sandy, which impacted the state from October 26, 2012 to November 8, 2012. The hurricane was declared a major disaster on October 30, 2012.[23] Hurricane Sandy was responsible for 73 deaths in the United States and cost billions of dollars in assistance.[24] The rough weather encountered by the *Langseth* during the 2014 survey demonstrates the challenges of conducting oceanographic research even during optimal weather periods (summer), and similarly, highlights the potential safety hazards of operating	

Com-ment #	Commenter	Comment	Response	Final Amen-ded EA Page # or Section
			during suboptimal weather periods. During the September/October timeframe, the lead PI and a collaborating PI have teaching obligations, and two collaborating PIs are scheduled to conduct field work at sea on other research cruises. Although the *Langseth* has been in the North Atlantic for the last year and a half in support of academic research activities, this is the first time it has operated along the U.S. east coast since it began science operations in 2008. At present, the *Langseth* is scheduled to support other research activities in 2015, including a research activity in the Mediterranean Sea; the *Langseth* is scheduled to depart in support of that activity in September. After that survey, the vessel is scheduled to transit to the east coast of South America, the west coast of South America, then on to the southwest Pacific Ocean. Therefore, it is not a reasonable assumption that the *Langseth* would be available to work along the U.S. east coast in the foreseeable future. As a U.S. government-owned national asset, it is NSF's responsibility to operate the vessel in the most efficient way possible; thus, when scheduling the vessel in support of research activities, factors such as minimizing transits are considered. NJDEP has suggested that the geologic formations at the target depths of interest are static and not likely to change if the proposed activity were rescheduled to September to October in a future year in which the personnel and equipment essential to meet the overall project objectives are available. This suggestion, however, does not take into account that the research was proposed by researchers and students whose professional and academic careers depend upon the collection of these data and successful completion of the survey. In other words, there is a timeliness factor involved with the proposed activity, as well as a desire to have the scientific results incorporated into the broader scientific community in the near term. All authorizations for conducting the survey during the June/July/August period in both 2014 and 2015 were received from the federal regulatory agencies with jurisdiction over the survey area. In addition, as noted in the Draft Amended EA, weather conditions and the availability of personnel, vessel, and equipment were considered when developing the timing of the Proposed Action and Action Alternative. The Action Alternative proposed in the Draft Amended EA was proposed to consider alternative timeframes for conducting the survey. No changes were made in the Final Amended EA in response to this comment.	

APPENDIX H
USFWS LETTER OF CONCURRENCE

Smith, Holly E.

From: Thogerson, Collette <collette_thogerson@fws.gov>
Sent: Wednesday, January 14, 2015 10:35 AM
To: Smith, Holly E.
Subject: Re: NSF NJ survey

Hi Holly,

Thank you for your patience. I apologize for the delayed response. I will update our admin record to reflect the new dates. Please add this email to your admin record to reflect that the Service is acknowledging this date change and we do not feel the date change change's the effect of the action on the species. Our concurrence on this action remains the same. Should any further changes occur that might change the impacts on the species that we did not consider, please let us know. This concurrence is based the power down and avoidance procedures discussed in the concurrence letter that will occur when and if you see a listed species in the action area. We appreciate your continued collaboration and coordination on this project. Please let me know if you have any further questions.

Kind regards,
Collette

Collette Thogerson, Ph.D.
National Section 7 Coordinator
Branch of Consultations & Habitat Conservation Plans
Ecological Services
U.S. Fish and Wildlife Service Headquarters
MS: ES
5275 Leesburg Pike
Falls Church, VA 22041-3803
PHONE: 703/358-2103
collette_thogerson@fws.gov

On Mon, Oct 27, 2014 at 9:44 AM, Smith, Holly E. <hesmith@nsf.gov> wrote:

Collette – We had to postpone the seismic survey off the coast of New Jersey that we planned for 2014 due to mechanical issues with the vessel. Attached is the letter of concurrence from USFWS for that survey. We would like to reschedule the survey for a 30 day period in June/July/August 2015. Even though the action has essentially not changed, NMFS has informed us that a new IHA is required for the activity, so we are preparing documentation for that process, including a Draft Amended Environmental Assessment. One difference, however, between 2014 and 2015, would be that rather than two source levels considered, only the smaller source will be considered (700 cu. in. source vs 1400 cu. in.). This is a result of 2014 activities which verified that the 700 cu. in. source was sufficient for data collection.

We were wondering what steps we might need to take for USFWS for ESA Section 7 compliance. Should we re-initiate consultation or start over, or does the letter of concurrence still apply? I understand we may need to provide you some more details, feel free to let me know if you'd like to discuss this further, or what else we can provide you to assist with a decision.

Thanks for your assistance,

Holly

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington, D.C. 20240

In Reply Refer To:
FWS/AES/DER/BCH/056843
FWS 2014-I-0002

MAR 05 2014

Holly Smith
National Science Foundation
Division of Ocean Sciences
4201 Wilson Blvd., Suite 25
Arlington, VA 22230

Subject: Informal Consultation on the High-Energy, 3-D Marine Geophysical Survey in the Atlantic Ocean off the Coast of New Jersey

Dear Ms. Smith:

This letter is in response to your February 3, 2014, email requesting the U.S. Fish and Wildlife Service's (Service) concurrence that the proposed high-energy, 3-D marine geophysical survey in the Atlantic Ocean off the coast of New Jersey is not likely to adversely affect the endangered roseate tern (*Sterna dougallii*) and the threatened piping plover (*Charadrius melodus*), pursuant to section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531 -1544), as amended (ESA). This consultation is based on the draft Environmental Assessment entitled a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, June – July 2014.

Lamont-Doherty Earth Observatory (L-DEO), with funding from the U.S. National Science Foundation (NSF) plans to conduct high-energy, 3-D geophysical surveys in the northwest Atlantic Ocean approximately 25-85 kilometers from the coast of New Jersey, outside of U.S. waters and within the U.S. Exclusive Economic Zone (located between approximately 39.3 and 39.7°N and approximately 73.2 and 78.8°W). The seismic survey will take place from June through July, 2014, and will take place in water depths between 30 to 75 meters.

The goal of the proposed research is to collect and analyze data on the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to present. The procedures to be used for the surveys would be similar to those used during previous seismic
surveys by L-DEO and would use conventional seismic methodology. The surveys would involve one source vessel, the R/V *Langseth*. The *Langseth* would deploy a small towed subarray of 4 or 8 airguns with a total discharge volume of approximately 700 to 1400 cubic

inches. The receiving system would consist of four 3000 meter hydrophone streamer. As the airguns are towed along the survey lines, the hydrophone streamer would receive the returning acoustic signals and transfer the data to the on-board processing system.

A total of approximately 4,900 kilometers of 3-D survey lines, including turns, would be shot and some additional seismic operations associated with airgun testing and repeat coverage will occur. In addition to the operations of the airgun array, a multibeam echosounder, a subbottom profiler, and an acoustic Doppler current profiler will be operated from the *Langseth* continuously throughout the survey. All planned geophysical data acquisition activities would be conducted by L-DEO with on-board assistance by the scientists who have proposed the study. The vessel would be self-contained and the crew would live aboard the vessel with some personnel transfer on or off the *Langseth* by a small vessel.

Although unlikely to be encountered, the roseate tern and the piping plover could occur at or near the project site. The roseate tern breeds on islands along the northeast coast of the U.S from New York to Maine and north into Canada, and historically as far south as Virginia. During the breeding season, roseate terns forage over shallow coastal waters, especially in water depths less than 5 meters, sometimes near the colony and at other times at distances of over 30 kilometers away. They usually forage over shallow bays, tidal inlets and channels, tide rips, and sandbars. Because of its distribution during the breeding season, the roseate tern likely would not be encountered at the proposed survey site.

The piping plover breeds on coastal beaches from Newfoundland to North Carolina during March-August. Its marine nesting habitat consists of sandy beaches, sandflats, and barrier islands. Feeding areas include intertidal portions of ocean beaches, mudflats, sandflats, and shorelines of coastal ponds, lagoons, or salt marshes. Because it is strictly coastal, the piping plover likely would not be encountered at the proposed survey site.

In the rare event one of these species is in the vicinity of the survey area, there is the potential that the bird might be affected slightly by seismic sound from the proposed study. The impact would not be expected to be significant to the individual bird or their population because the majority of observed sound levels are below the water surface. Additionally, the proposed action includes precautionary measures of powering or shutting down the airguns if a listed bird is seen diving in the area.

Based upon the unlikely chance a bird of either species will be in the action area as well as the precautionary measures in place, we do not anticipate any adverse impacts to the listed roseate tern or piping plover. Thus, we concur that the activities covered under the NSF's proposed high-energy, 3-D marine geophysical survey "may affect" but "are not likely to adversely affect" the roseate tern or piping plover. Coordination with National Marine Fisheries Service on listed species under their jurisdiction is still required.

We are pleased that NSF, L-DEO and its contractors are committed to applying proactive protective measures in order to minimize effects on marine animals. We appreciate the collaboration your staff has provided. If you have any question please contact Dr. Collette Thogerson of my office at (703) 358-2103.

Sincerely,

Patrice Ashfield
Chief, Branch of Consultation and Habitat
Conservation Plans, Ecological Services

NATIONAL SCIENCE FOUNDATION
4201 WILSON BOULEVARD
ARLINGTON, VIRGINIA 22230

February 3, 2014

Rick Sayers
Chief, Division of Environmental Review
U.S. Fish & Wildlife Service-- Ecological Services
4401 N. Fairfax Dr., Rm 420
Arlington, VA 22203

RE: NSF Marine Geophysical Survey in the Atlantic Ocean off the Coast of New Jersey
OCE# 1260237 (PI: Mountain)

Dear Mr. Sayers:

The National Science Foundation (NSF) has proposed a marine geophysical survey on the research vessel Marcus G. *Langseth (R/V Langseth),* June-July 2014, in the Atlantic Ocean, within the Exclusive Economic Zones of the United States and outside state waters. The R/V *Langseth* would deploy an airgun array of either 700 in^3 or 1400 in^3 total discharge volume in water depths ranging from 30 to 75 meters. The receiving system for the returning acoustic signals would consist of four 3000 meter hydrophone streamers.

We have attached a copy of our Draft Environmental Assessment (Draft EA) pursuant to the National Environmental Policy Act prepared on our behalf by LGL, Ltd for the survey (file: Mountain 2014 Draft EA 2013 Dec 17.pdf). The Draft EA tiers to the NSF Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey (NSF-USGS PEIS: http://www.nsf.gov/geo/oce/envcomp/index.jsp) and is consistent with the findings and conclusions of that document. Figure 1 of the Draft EA illustrates the survey area, and the specific location of the proposed survey site and tracklines. Although unlikely to be encountered, the ***endangered*** roseate tern and ***threatened*** piping plover have been identified as species that could occur at or near the proposed survey site.

The Draft EA notes the following information regarding the roseate tern and piping plover (see attached Draft EA, page 26-27):

> **Piping Plover (*Charadrius melodus*):** The Atlantic Coast Population of the piping plover is listed as ***Threatened*** under the U.S. ESA, and the species is listed as ***Near Threatened*** on the IUCN Red List of Threatened Species (IUCN 2013). It breeds on coastal beaches from Newfoundland to North Carolina during March–August and it winters along the Atlantic Coast from North Carolina south, along the Gulf Coast, and in the Caribbean (USFWS 1996). Its marine nesting habitat consists of sandy beaches, sandflats, and barrier islands (Birdlife International 2013). Feeding areas include intertidal portions of ocean beaches, mudflats, sandflats, and shorelines of coastal ponds, lagoons, or salt marshes (USFWS 1996). Wintering plovers are generally found on barrier islands, along sandy peninsulas, and near coastal inlets (USFWS 1996).

Because it is strictly coastal, the piping plover likely would not be encountered at the proposed survey site.

Roseate Tern (*Sterna dougallii*): The Northeast Population of the roseate tern is listed as ***Endangered*** under the U.S. ESA, and the species is listed as ***Near Threatened*** on the IUCN Red List of Threatened Species (IUCN 2013). It breeds on islands along the northeast coast of the U.S from New York to Maine and north into Canada, and historically as far south as Virginia (USFWS 1998, 2010). It is thought to migrate beginning in mid-September through the eastern Caribbean and along the north coast of South America, and to winter mainly on the east coast of Brazil (USFWS 2010). During the breeding season, roseate terns forage over shallow coastal waters, especially in water depths <5 m, sometimes near the colony and at other times at distances of over 30 km. They usually forage over shallow bays, tidal inlets and channels, tide rips, and sandbars (USFWS 2010).

Because of its distribution during the breeding season, the roseate tern likely would not be encountered at the proposed survey site.

In the rare event a roseate tern or piping plover is observed during the survey, the bird might be affected slightly by seismic sound from the proposed study, but the impacts would not be expected to be significant to the individual bird or their populations (see attached Draft EA, pages 41 and Section 3.5.4 of the NSF-USGS PEIS). Mitigation measures proposed for the survey would reduce risks to species within the survey area. In the rare event that either sea bird species were observed diving within the Exclusion Zone (EZ), the seismic airguns would be powered down (so that the bird remained outside of the EZ) or shutdown, as appropriate.

This letter requests concurrence that the proposed marine geophysical survey is not likely to adversely affect species or critical habitat under U.S. Fish & Wildlife Service (FWS) jurisdiction pursuant to Section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531- 1544), as amended (ESA), and that no consultation with FWS is required. For discussions regarding this proposed survey, including any discussions regarding special mitigation protocols that may be needed to ensure that the project can proceed without negative impacts on listed species, please contact me or Holly Smith (hesmith@nsf.gov).

We have initiated formal Section 7 consultation with National Marine Fisheries Service under the ESA, and the ship operator of the R/V *Langseth* is seeking an Incidental Harassment Authorization under the Marine Mammal Protection Act (MMPA) for the survey.

Sincerely,

Holly Smith for

Bauke (Bob) Houtman
Section Head, Integrative Programs Section

Attachment:
Draft Environmental Assessment (file: Mountain 2014 Draft EA 2013 Dec 17.pdf)

APPENDIX I

EFH CONSULTATION LETTER

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930-2276

FEB 11 2015

Ms. Holly E. Smith
Environmental Compliance Officer
National Science Foundation
4201 Wilson, Blvd, Room 725
Arlington, VA 22230

Dear Ms. Smith:

Reference is made to your letter dated December 22, 2014, regarding the reinitiation of the essential fish habitat (EFH) consultation for the marine geophysical survey proposed in the Atlantic Ocean offshore of New Jersey for the summer of 2015. The proposed seismic survey would be conducted on the National Science Foundation (NSF) owned *R/V Langseth* operated on NSF's behalf by Columbia University's Lamont-Doherty Earth Observatory. The survey would be conducted within the Exclusive Economic Zones (EEZ) of the United States and outside of state waters. The R/V *Langseth* would deploy an air gun array of 700 in^2 total discharge volume in water depths ranging from 20 to 75 meters. The receiving system for the returning acoustic signals would consist of hydrophone streamers. No anchoring of the vessel or placement of equipment on the sea floor would be anticipated during the survey.

In 2014, the NSF funded a research project lead by scientists at Rutgers University and the University of Texas - Austin to study sea level rise in the Atlantic Ocean off the coast of New Jersey using the *R/V Langseth* to conduct a high energy, 3-D seismic survey. The work was planned to take place June and July 2014. EFH consultation pursuant to Section 305 (b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) was completed in June 2014. Due to mechanical issues with the vessel, the survey was not able to be completed in 2014. You are proposing to reschedule the survey for a 30-day period between June and August 2015, approximately the same time frame as originally planned and authorized in 2014. You have prepared a draft amended environmental assessment (EA) to address your requirements under the National Environmental Policy Act (NEPA) and in support of a new Incidental Harassment Statement from NOAA. The EA also reinitiates the EFH consultation with us pursuant to the MSA. According to the information contained in the EA, there are no changes to the proposed research activities other than the reduction of the seismic source level from 1400 in^2 to 700 in^2.

In accordance with the MSA, EFH has been identified and described in the EEZ portions of the study area by the New England, Mid-Atlantic, and South Atlantic Fishery Management Councils and the National Marine Fisheries Service (NMFS). The MSA specifies consultation with NMFS is required for federal actions which may adversely affect EFH. As the federal action agency for this matter, you have determined that the seismic study may affect EFH but that any adverse effects would be localized and transitory and therefore not likely to be significant.

As stated in our letter dated June 18, 2014, it appears that some level of adverse impact to EFH may occur as a result of the seismic survey, but because much of the research available to date on the adverse effects of seismic survey methods on aquatic resources has been focused on marine mammals, not fish and benthic organisms, we cannot offer specific EFH conservation recommendations pursuant to Section 305(b) (2) of the Magnuson-Stevens Act at this time. Further EFH consultation on this matter by you is not necessary unless future modifications to the survey are proposed and such actions may result in adverse impacts to EFH.

As recommended in our previous letter, additional research and monitoring should be undertaken to gain a better understanding of the potential effects these activities may have on EFH, federally managed species, their prey and other NOAA trust resources. This research should be a component of future NSF funded seismic survey activities. This will aid in the development of site and project specific EFH conservation recommendations for future projects as appropriate.

Be advised that separate correspondence will be provided by NMFS Office of Protected Resources regarding their evaluation of the Incidental Harassment Authorization request and Section 7 of the Endangered Species Act consultation for this action. For additional information on the status of these evaluations please contact Jeannine Cody at (301) 427-8401 or jeannine.cody@noaa.gov.

If you have any questions or need additional information, please do not hesitate to contact Karen Greene at 732 872-3023 or karen.greene@noaa.gov.

Sincerely,

Louis A. Chiarella
Assistant Regional Administrator
Habitat Conservation Division

cc:
F/SER, David.Dale@noaa.gov
F/GAR, Karen.Greene@noaa.gov
F/HC, Terra.Lederhouse@noaa.gov
F/PR, Jeanne Cody@noaa.gov
MAFMC, Christopher Moore

NATIONAL SCIENCE FOUNDATION
4201 WILSON BOULEVARD
ARLINGTON, VIRGINIA 22230

December 22, 2014

Karen Greene
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Habitat Conservation Division
James J. Howard Marine Sciences Laboratory
74 Magruder Rd
Highlands, NJ 07732

RE: EFH Consultation for Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015

Dear Ms. Greene:

In 2014, the National Science Foundation (NSF) funded a research project proposed by lead Principal Investigator (PI) Dr. Gregory Mountain of Rutgers University and collaborators Drs. J. Austin, C. Fulthorpe, and M. Nedimovic of University of Texas Austin to study sea level rise in the Atlantic Ocean off of the coast of New Jersey which included a marine geophysical survey. NSF's environmental compliance, including all federal regulatory obligations, was completed for the research activity on July 1, 2014, and the survey commenced. Unfortunately due to mechanical issues with the vessel, the survey was unable to be completed during the effective periods of the Incidental Harassment Authorization (IHA) and Incidental Take Statement (ITS) issued for the survey. NSF is interested in rescheduling the research survey for a 30 day period during June-August 2015, approximately the same time frame as originally planned and authorized in 2014. NSF has prepared a Draft Amended Environmental Assessment (EA) (Attachment 1) to address NSF's requirements under the National Environmental Policy Act (NEPA) of 1969, as amended, for the proposed NSF federal action and in support of other necessary regulatory processes, including Essential Fish Habitat consultation.

The proposed collaborative research objectives and efforts remain unchanged from those planned in 2014. The proposed research efforts would include the collection and analysis of data on the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to present. Despite their existence being clearly indicated in sediment cores recovered during International Ocean Discovery Program (IODP) Expedition 313, features such as river valleys cut into coastal plain sediments, now buried under a kilometer (km) of younger sediment and flooded by today's ocean, cannot be resolved in existing 2-D seismic data to the degree required to map shifting shallow-water depositional settings in the vicinity of clinoform rollovers. To achieve the project's goals, the PIs propose to use a 3-D seismic reflection survey to map sequences around existing IODP Expedition 313 drill sites and analyze their spatial/temporal evolution. Objectives that would then be met include establishing the impact of known Ice House base-level changes on the stratigraphic record; providing greater understanding of the response of nearshore environments to changes in elevation of global sea level; and determining the amplitudes and timing of global sea-level changes during the mid-Cenozoic era or time period.

The proposed seismic survey would be conducted on the NSF-owned research vessel (R/V) *Marcus G. Langseth (Langseth)*, which is operated on our behalf by Columbia University's Lamont-Doherty Earth Observatory (LDEO) under an existing Cooperative Agreement. The survey would be conducted during a 30 day period between June - August, 2015, within the Exclusive Economic Zones of the United States and outside state waters. The R/V *Langseth* would deploy an airgun array of 700 in^3 total discharge volume in water depths ranging from 20 to 75 meters. A larger source of 1400-in^3 was originally proposed in 2014, however, limited data collected in 2014 did allow confirmation that the smaller 700-in^3 source array would be suitable for the project, thus eliminating potential use of the larger source in 2015. The receiving system for the returning acoustic signals would consist of hydrophone streamers. No anchoring of the vessel or placement of equipment on the seafloor would be anticipated during the survey. Protected Species Vessel Observers (PSVOs) would be on duty during seismic operations to monitor and mitigate for any potential impacts to marine species as a result of the proposed activities.

Additional details about the project and the proposed activities can be found in Chapters I & II of the Draft Amended EA (Attachment 1). Information about Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC) were identified within the survey area and were described in the Draft Amended EA (page 29). Potential effects on EFH and HAPC were also considered and included in the Draft Amended EA (pages 50-53). Although the proposed activities may affect EFH and HAPC, the Draft Amended EA concludes that any adverse effects would be localized and transitory and therefore would not likely be significant. Monitoring and mitigation measures for the survey have been proposed in the Draft Amended EA (pages 5-8, and 45). With the proposed monitoring and mitigation measures, no long-term or significant effects would be expected on individual marine mammals, sea turtles, seabirds, fish, the populations to which they belong, or their habitats.

NSF contacted the EFH Regional Coordinator of the National Oceanic and Atmospheric Administration (NOAA) Greater Atlantic Regional Fisheries Office regarding the 2014 survey activity. While the EFH Regional Coordinator concluded in a letter dated 18 June 2014, that some level of adverse effects to EFH may occur as a result of the proposed activities, no project-specific EFH conservation recommendations were provided. Additional research and monitoring to gain a better understanding of the potential effects that seismic surveys may have on EFH, federal managed species, their prey, and other NOAA trust resources was recommended for future NSF activities and consultation was concluded. Although NSF anticipates no significant impacts to EFH and HAPC, as the proposed 2015 activities may affect EFH and HAPC, in accordance with the Magnuson-Stevens Fishery Conservation and Management Act (MSA) NSF requests re-initiation of consultation. Given there are no changes to the proposed research activities other than the reduction of seismic source level, we request confirmation of the previous determination.

We look forward to consulting with you on this proposed action. Please contact me if you have any questions or concerns regarding the request or the supporting information included in the Draft Amended EA.

Sincerely,

Holly E. Smith
Environmental Compliance Officer

Attachment: Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015

Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015

Prepared for

Lamont-Doherty Earth Observatory
61 Route 9W, P.O. Box 1000
Palisades, NY 10964-8000

and

National Science Foundation
Division of Ocean Sciences
4201 Wilson Blvd., Suite 725
Arlington, VA 22230

by

LGL Ltd., environmental research associates
22 Fisher St., POB 280
King City, Ont. L7B 1A6

18 December 2014

LGL Report TA8349-3

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ABSTRACT

The State University of New Jersey at Rutgers (Rutgers), with funding from the U.S. National Science Foundation (NSF), proposes to conduct a high-energy, 3-D seismic survey on the R/V *Marcus G. Langseth* in the northwest Atlantic Ocean ~25–85 km from the coast of New Jersey in summer 2015. The NSF-owned *Langseth* is operated by Columbia University's Lamont-Doherty Earth Observatory (L-DEO) under an existing Cooperative Agreement. Although the *Langseth* is capable of conducting high energy seismic surveys using up to 36 airguns with a discharge volume of 6600 in^3, the proposed seismic survey would only use a small towed subarray of 4 airguns with a total discharge volume of ~700 in^3. The seismic survey would take place outside of U.S. state waters within the U.S. Exclusive Economic Zone (EEZ) in water depths ~20–75 m.

NSF, as the funding agency, has a mission to "promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense…". The proposed seismic survey would collect data in support of a research proposal that has been reviewed under the NSF merit review process and identified as an NSF program priority. It would provide data necessary to study the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to present and enable follow-on studies to identify the magnitude, time, and impact of major changes in sea level.

The survey was originally proposed for implementation in 2014. NSF environmental compliance, including all federal statutory and regulatory obligations, was completed for the survey on 1 July 2014, and the survey commenced. Because of mechanical issues with the vessel, the survey was unable to be completed during the effective periods set forth in the Incidental Harassment Authorization (IHA) and Incidental Take Statement (ITS) issued for the survey. According to the U.S. National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS), although the survey has not changed from what was approved in 2014, a new IHA will be required to conduct the same survey during a rescheduled time in 2015. This Draft Amended Environmental Assessment (Draft Amended EA) has been prepared on behalf of NSF pursuant to the National Environmental Policy Act (NEPA) to address any impacts associated with the rescheduled time for the survey, and in support of other necessary regulatory processes, including the IHA process.

As operator of the *Langseth,* L-DEO has requested an Incidental Harassment Authorization (IHA) from the U.S. National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) to authorize the incidental, i.e., not intentional, harassment of small numbers of marine mammals should this occur during the seismic survey. The analysis in the Draft Amended EA also supports the IHA application process and provides information on marine species not addressed by the IHA application, including seabirds and sea turtles that are listed under the U.S. Endangered Species Act (ESA), including candidate species. As analysis on endangered/threatened species was included, the Draft Amended EA is being used to support ESA Section 7 consultations with NMFS and U.S. Fish and Wildlife Service (USFWS). The Draft Amended EA will also be used in support of consultation with NMFS Greater Atlantic Regional Fisheries Office for Essential Fish Habitat (EFH) under the Magnuson-Stevens Act. Alternatives addressed in this Draft Amended EA consist of a corresponding program at a different time with issuance of an associated IHA and the no action alternative, with no IHA and no seismic survey. This document tiers to the Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey (June 2011) and Record of Decision (June 2012), referred to herein as PEIS. It also tiers to the Final EA for the proposed survey off New Jersey dated 1 July 2014. The proposed survey area off the coast of New Jersey is near one of the detailed

analysis areas (DAAs) in the PEIS; however, this Draft Amended EA and the 2014 Final EA were prepared because a different energy source level and configuration would be used for the proposed survey, and the proposed survey covers only shelf waters whereas the DAA was on the shelf and slope. Additionally, this Draft Amended EA addresses the differences from and updates to the Final EA for the 2014 survey.

Numerous species of marine mammals inhabit the proposed survey area off the coast of New Jersey. Several of these species are listed as ***endangered*** under the U.S. Endangered Species Act (ESA): the sperm, North Atlantic right, humpback, sei, fin, and blue whales. Other ESA-listed species that could occur in the area are the ***endangered*** leatherback, hawksbill, green, and Kemp's ridley turtles and roseate tern, and the ***threatened*** loggerhead turtle and piping plover. The ***endangered*** Atlantic sturgeon and shortnose sturgeon could also occur in or near the study area. ESA-listed ***candidate species*** that could occur in the area are the cusk, dusky shark, and great hammerhead shark.

Potential impacts of the seismic survey on the environment would be primarily a result of the operation of the airgun array. A multibeam echosounder and sub-bottom profiler would also be operated. Impacts would be associated with underwater noise, which could result in avoidance behavior by marine mammals, sea turtles, seabirds, and fish, and other forms of disturbance. An integral part of the planned survey is a monitoring and mitigation program designed to minimize potential impacts of the proposed activities on marine animals present during the proposed research, and to document as much as possible the nature and extent of any effects. Injurious impacts to marine mammals, sea turtles, and seabirds have not been proven to occur near airgun arrays, and are not likely to be caused by the other types of sound sources to be used. However, despite the relatively low levels of sound emitted by the subarray of airguns, a precautionary approach would still be taken. The planned monitoring and mitigation measures would reduce the possibility of any effects.

As was the case with the approved 2014 survey, protection measures designed to mitigate the potential environmental impacts to marine mammals and sea turtles would include the following: ramp ups; typically two, but a minimum of one dedicated observer maintaining a visual watch during all daytime airgun operations; two observers 30 min before and during ramp ups during the day and at night; no start ups during poor visibility or at night unless at least one airgun has been operating; passive acoustic monitoring (PAM) via towed hydrophones during both day and night to complement visual monitoring (unless operational issues prevent it or the system and back-up system are both damaged during operations); and power downs (or if necessary shut downs) when marine mammals or sea turtles are detected in or about to enter designated exclusion zones. L-DEO and its contractors are committed to applying these measures in order to minimize potential effects on marine mammals and sea turtles and other environmental impacts.

With the planned monitoring and mitigation measures, unavoidable impacts to each species of marine mammal and sea turtle that could be encountered would be expected to be limited to short-term, localized changes in behavior and distribution near the seismic vessel. At most, effects on marine mammals may be interpreted as falling within the U.S. Marine Mammal Protection Act (MMPA) definition of "Level B Harassment" for those species managed by NMFS. No long-term or significant effects would be expected on individual marine mammals, sea turtles, seabirds, fish, the populations to which they belong, or their habitats.

LIST OF ACRONYMS

~	approximately
ADCP	Acoustic Doppler current profiler
ALWTRP	Atlantic Large Whale Take Reduction Plan
AMVER	Automated Mutual-Assistance Vessel Rescue
BOEM	Bureau of Ocean Energy Management
CETAP	Cetacean and Turtle Assessment Program
CITES	Convention on International Trade in Endangered Species
CZMA	Coastal Zone Management Act
DAA	Detailed Analysis Area
dB	decibel
DoN	Department of the Navy
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ESA	(U.S.) Endangered Species Act
EZ	Exclusion Zone
FAO	Food and Agriculture Organization of the United Nations
FM	Frequency Modulated
GIS	Geographic Information System
h	hour
hp	horsepower
HRTRP	Harbor Porpoise Take Reduction Plan
Hz	Hertz
IHA	Incidental Harassment Authorization (under MMPA)
in	inch
IOC	Intergovernmental Oceanographic Commission of UNESCO
IODP	Integrated Ocean Drilling Program
IUCN	International Union for the Conservation of Nature
kHz	kilohertz
km	kilometer
kt	knot
L-DEO	Lamont-Doherty Earth Observatory
LFA	Low-frequency Active (sonar)
m	meter
min	minute
MBES	Multibeam Echosounder
MFA	Mid-frequency Active (sonar)
MMPA	(U.S.) Marine Mammal Protection Act
ms	millisecond
NEPA	(U.S.) National Environmental Policy Act
NJ	New Jersey
NEFSC	Northeast Fisheries Science Center
NMFS	(U.S.) National Marine Fisheries Service
NRC	(U.S.) National Research Council

NSF	National Science Foundation
OBIS	Ocean Biogeographic Information System
OCS	Outer Continental Shelf
OEIS	Overseas Environmental Impact Statement
OAWRS	Ocean Acoustic Waveguide Remote Sensing
p or pk	peak
PEIS	Programmatic Environmental Impact Statement
PI	Principal Investigator
PTS	Permanent Threshold Shift
PSO	Protected Species Observer
PSVO	Protected Species Visual Observer
RL	Received level
rms	root-mean-square
R/V	research vessel
s	second
SAR	U.S. Marine Mammal Stock Assessment Report
SBP	Sub-bottom Profiler
SCUBA	Self contained underwater breathing apparatus
SEFSC	Southeast Fisheries Science Center
TTS	Temporary Threshold Shift
SEL	Sound Exposure Level
SPL	Sound Pressure Level
UNEP	United Nations Environment Programme
U.S.	United States of America
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
USN	U.S. Navy
μPa	microPascal
vs.	versus
WCMC	World Conservation Monitoring Centre

I. PURPOSE AND NEED

The purpose of this Draft Amended EA is to provide the information needed to assess the potential environmental impacts associated with the use of a 4-airgun subarray during the proposed seismic survey off the coast of New Jersey. The survey was originally proposed for implementation in 2014. NSF environmental compliance, including all federal legal and regulatory obligations, was completed for the project on 1 July 2014, and the survey commenced. Because of mechanical issues with the vessel, the survey was unable to be completed during the effective periods of the Incidental Harassment Authorization (IHA) and Incidental Take Statement (ITS) issued for the survey. According to NMFS, a new IHA Application is required to reschedule the survey in 2015.

This Draft Amended EA was prepared pursuant to the National Environmental Policy Act (NEPA), and tiers to the Programmatic Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) for Marine Seismic Research funded by the National Science Foundation or Conducted by the U.S. Geological Survey (NSF and USGS 2011) and Record of Decision (NSF 2012), referred to herein as the PEIS. It also tiers to the Final EA for the proposed survey off New Jersey dated 1 July 2014. The proposed survey area off the coast of New Jersey is near one of the detailed analysis areas (DAAs) presented in the PEIS; however, a different energy source level and configuration would be used for the proposed survey, and the proposed survey covers only shelf waters whereas the DAA was on the shelf and slope. This Draft Amended EA was prepared to consider the survey proposed for 2015, provide updates, and address differences in the analysis prepared for the 2014 survey and the PEIS DAA. The Draft Amended EA provides details of the proposed action at the site-specific level and addresses potential impacts of the proposed seismic survey on marine mammals, as well as other species of concern in the area, including sea turtles, seabirds, fish, and invertebrates. The Draft Amended EA will be used in support of an application for an Incidental Harassment Authorization (IHA) from the National Marine Fisheries Service (NMFS), and re-initiation of Section 7 consultations under the Endangered Species Act (ESA). The IHA would allow for non-intentional, non-injurious "take by harassment" of small numbers of marine mammals during the proposed seismic survey directed by Rutgers in the Atlantic Ocean off New Jersey. The Draft Amended EA will also be used in support of consultation with NMFS Greater Atlantic Regional Fisheries Office for Essential Fish Habitat (EFH) under the Magnuson-Stevens Act.

To be eligible for an IHA under the U.S. Marine Mammal Protection Act (MMPA), the proposed "taking" (with mitigation measures in place) must not cause serious physical injury or death of marine mammals, must have negligible impacts on the species and stocks, must "take" no more than small numbers of those species or stocks, and must not have an unmitigable adverse impact on the availability of the species or stocks for legitimate subsistence uses.

Mission of NSF

NSF was established by Congress under the National Science Foundation Act of 1950 (Public Law 810507, as amended) and is the only federal agency dedicated to the support of fundamental research and education in all scientific and engineering disciplines. Further details on the mission of NSF are described in § 1.2 of the PEIS.

Purpose of and Need for the Proposed Action

As noted in the PEIS, § 1.3, NSF has a continuing need to fund seismic surveys that enable scientists to collect data essential to understanding complex Earth processes recorded in sediments on and beneath the ocean floor. The purpose of the proposed action is to collect data across existing Integrated Ocean Drilling Program (IODP) Expedition 313 drill sites on the inner-middle shelf of the New Jersey continental margin

to reveal the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to the present. Features such as river valleys cut into coastal plain sediments, now buried under a km of younger sediment and flooded by today's ocean, cannot be identified and traced with existing 2-D seismic data, despite their existence being clearly indicated in sediment cores recovered during IODP Expedition 313. These and other erosional and depositional features would be imaged using 3-D seismic data and would enable follow-on studies to identify the magnitude, time, and impact of major changes in sea level. The proposed seismic survey would collect data in support of a research proposal that has been reviewed under the NSF merit review process and identified as an NSF program priority to meet NSF's critical need to foster an understanding of Earth processes.

Background of NSF-funded Marine Seismic Research

The background of NSF-funded marine seismic research is described in § 1.5 of the PEIS.

Statutory and Regulatory Setting

The statutory and regulatory setting of this Draft Amended EA is described in § 1.8 of the PEIS, including the

- National Environmental Protection Act (NEPA);
- Marine Mammal Protection Act (MMPA);
- Endangered Species Act (ESA);
- Magnuson-Stevens Act for Essential Fish Habitat (EFH); and
- Coastal Zone Management Act (CZMA).

II. Alternatives Including Proposed Action

In this Draft Amended EA, three alternatives are evaluated: (1) the proposed seismic survey and issuance of an associated IHA, (2) a corresponding seismic survey at an alternative time, along with issuance of an associated IHA, and (3) no action alternative. Additionally, two alternatives were considered but were eliminated from further analysis. A summary table of the proposed action, alternatives, and alternatives eliminated from further analysis is provided at the end of this section.

Proposed Action

The project objectives and context, activities, and mitigation measures for Rutger's planned seismic survey are described in the following subsections. The proposed action remains the same as described for the 2014 survey, except where noted.

(1) Project Objectives and Context

Rutgers plans to conduct a 3-D seismic survey using the L-DEO operated R/V *Marcus G. Langseth* (*Langseth*) on the inner-middle shelf of the New Jersey continental margin (Fig. 1). As noted previously, the goal of the proposed research is to collect and analyze data on the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to present. Despite their existence being clearly indicated in sediment cores recovered during IODP Expedition 313, features such as river valleys cut into coastal plain sediments, now buried under a km of younger sediment and flooded by today's ocean, cannot be resolved in existing 2-D seismic data to the degree required to map shifting shallow-water depositional settings in the vicinity of clinoform rollovers. To achieve the project's goals, the lead Principal Investigator (PI), Dr. G. Mountain (Rutgers University), and collaborating PIs Drs. J.

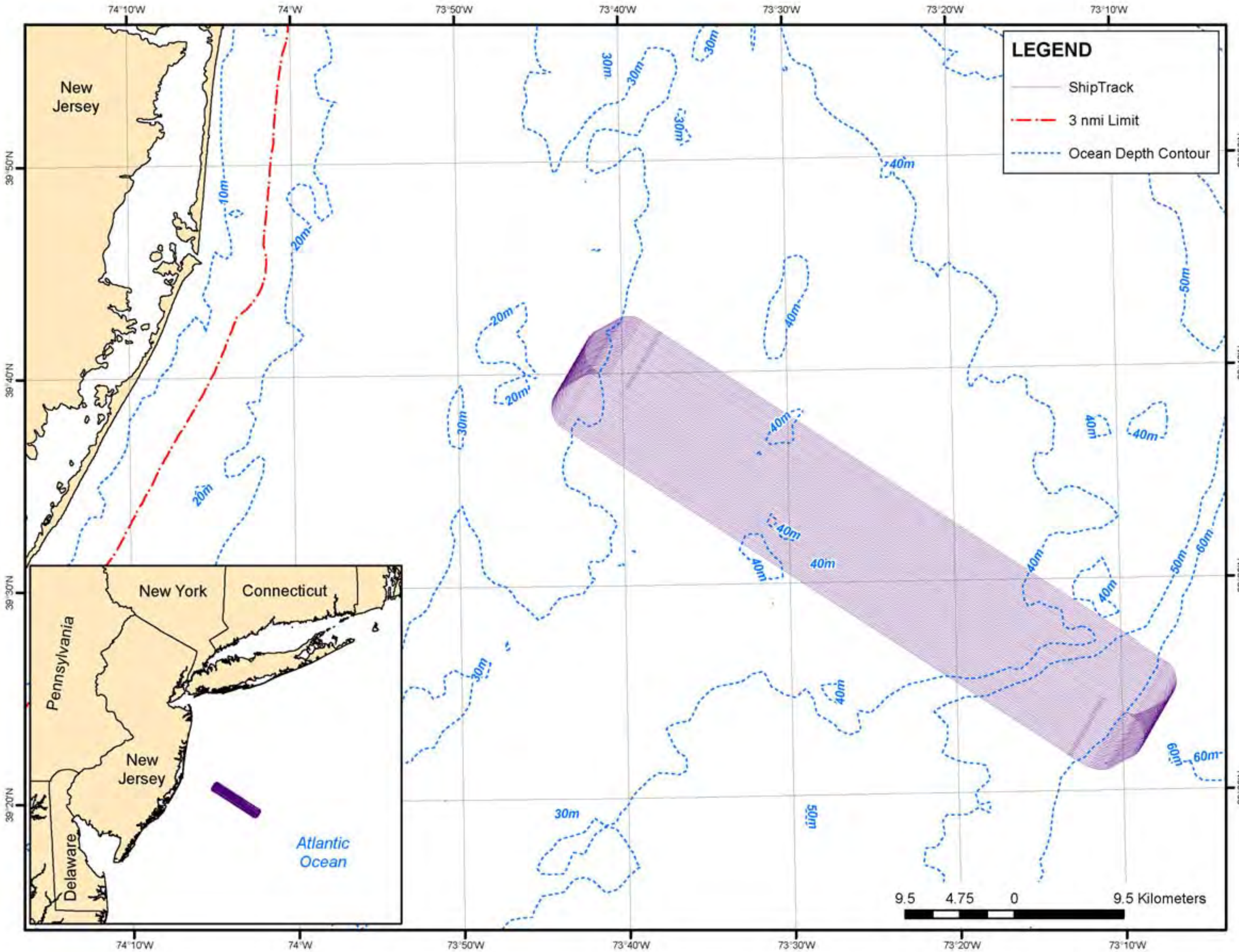

Figure 1. Location of the proposed seismic survey in the Atlantic Ocean off the coast of New Jersey.

Austin, C. Fulthorpe, and M. Nedimović (University of Texas at Austin), propose to use a 3-D seismic reflection survey to map sequences around existing IODP Expedition 313 drill sites and analyze their spatial/temporal evolution. Objectives that would then be met include establishing the impact of known Ice House base-level changes on the stratigraphic record; providing greater understanding of the response of nearshore environments to changes in elevation of global sea level; and determining the amplitudes and timing of global sea-level changes during the mid-Cenozoic. The project objectives remain the same as those described for the 2014 survey.

(2) Proposed Activities

(a) Location of the Activities

The proposed full-fold 3-D box/survey area is located in the Atlantic Ocean, ~25–85 km off the coast of New Jersey (Fig. 1). This area is defined by the coordinates at the four corners (including turns and run-in and run-out of each line): 39:38:00°N, 73:44:36°W; 39:43:12°N, 73:41:00°W; 39:25:30°N, 73:06:12°W; and 39:20:06°N, 73:10:06°W.

Water depths across the survey area are ~20–75 m. The seismic survey would be conducted outside of state waters and within the U.S. EEZ, and is scheduled to occur for ~30 days during June–August 2015. Although the proposed survey area is near the NW Atlantic DAA described in the PEIS, it does not include intermediate- and deep-water depths. The survey location would be the same as that for the 2014 survey.

(b) Description of the Activities

The procedures to be used for the survey would be the same as those proposed for the 2014 survey and similar to those used during previous NSF-funded seismic surveys and would use conventional seismic methodology. The survey would involve one source vessel, the *Langseth,* which is owned by NSF and operated on its behalf by Columbia University's L-DEO through a Cooperative Agreement entered into in 2012, and one support vessel. The *Langseth* would deploy two pairs of subarrays of 4 airguns as an energy source; the subarrays would fire alternately, with a total volume of ~700 in^3. The receiving system would be a passive component of the proposed activity and would consist of a system of hydrophones: four 3000-m hydrophone streamers at 75-m spacing, or preferentially, a combination of two 3000-m hydrophone streamers and a Geometrics P-Cable system. As the airgun array is towed along the survey lines, the hydrophone streamers would receive the returning acoustic signals and transfer the data to the on-board processing system.

A total of ~4900 km of 3-D survey lines, including turns, would be shot in an area 12 x 50 km with a line spacing of 150 m in two 6-m wide race-track patterns (Fig. 1). There would be additional seismic operations in the survey area associated with airgun testing and repeat coverage of any areas where initial data quality is sub-standard. In our calculations [see § IV(3)], 25% has been added for those additional operations. The survey parameters noted here support the proposed research goals and therefore differ from the NW Atlantic DAA survey parameters presented in the PEIS. The same transect lengths and area of survey proposed for 2015 was analyzed for the 2014 survey. Because of mechanical/equipment issues on the survey vessel along with weather issues (including Hurricane Arthur), the full 3-D array of equipment could not be deployed. Given equipment limitations, only ~61 h of seismic survey data were collected in 2014, with only ~43 h at full power (700 in^3) on survey tracklines. Of the 43 h of data collected, ~22 h were of substandard data quality because of equipment damage from rough seas. However, the existing data did allow confirmation that the smaller 700-in^3 source array was suitable for the project, thus eliminating potential use of the larger 1400-in^3 array originally proposed in 2014.

In addition to the operations of the airgun array, a multibeam echosounder (MBES) and a sub-bottom profiler (SBP) would be operated from the *Langseth* continuously throughout the survey, but not during transits. All planned geophysical data acquisition activities would be conducted with on-board assistance by

the scientists who have proposed the study. The vessel would be self-contained, and the crew would live aboard the vessel with some personnel transfer on/off the *Langseth* by a small vessel.

(c) Schedule

The *Langseth* would depart from New York, NY, and spend ~8 h in transit to the proposed survey area. Setup, deployment, and streamer ballasting would take ~3 days. The seismic survey would take 30 days plus 2 contingency days, and the *Langseth* would spend one day for gear retrieval and transit back to New York. The survey would be conducted during summer (June–August) 2015. Operations could be delayed or interrupted because of a variety of factors including equipment malfunctions and weather-related issues, but use of the airguns would not occur outside of the effective IHA period.

(d) Vessel Specifications

The *Langseth* is described in § 2.2.2.1 of the PEIS. The vessel speed during seismic operations would be ~4.5 kt (~8.3 km/h).

The support vessel would be a multi-purpose offshore utility vessel similar to the *Northstar Commander*, which is 28 m long with a beam of 8 m and a draft of 2.6 m. It is powered by a twin-screw Volvo D125-E, with 450 hp for each screw.

(e) Airgun Description

During the survey, the airgun array to be used would be the full 4-string array with most of the airguns turned off (see § II 3(a) for an explanation of the source level selection). The active airguns would be 4 airguns in one string on the port side forming Source 1, and 4 airguns in one string on the starboard side forming Source 2. These identical port and starboard sources would be operated in "flip-flop" mode, firing alternately as the ship progresses along the track, as is common for 3-D seismic data acquisition. Thus, the source volume would not exceed 700 in^3 at any time. Whereas the full array is described and illustrated in § 2.2.3.1 of the PEIS, the smaller subarrays proposed for this survey are described further in Appendix A. The subarrays would be towed at a depth of 4.5 or 6 m. The shot interval would be ~5-6 s (~12.5 m). Because the choice of the precise tow depth would not be made until the survey because of sea and weather conditions, we have assumed the use of 6 m for the impacts analysis and take estimate calculations, as that results in the farthest sound propagation. Mitigation zones have been calculated for the source level and tow depths, (see below and Appendix A, Table A2), and during operations the relevant mitigation zone would be applied.

During the attempted survey in 2014, the 700-in^3 airgun array was determined to be sufficient to image the geological targets of research interest. Thus, the 1400-in^3 array proposed as an operational possibility in the 1 July 2014 Final EA has been eliminated from the analysis in this Draft Amended EA.

(f) Additional Acoustical Data Acquisition Systems

Along with the airgun operations, two additional acoustical data acquisition systems would be operated during the survey, but not during transits: a multibeam echosounder (MBES) and sub-bottom profiler (SBP). The ocean floor would be mapped with the Kongsberg EM 122 MBES and a Knudsen Chirp 3260 SBP. These sources are described in § 2.2.3.1 of the PEIS.

(3) Monitoring and Mitigation Measures

Standard monitoring and mitigation measures for seismic surveys are described in § 2.4.4.1 of the PEIS and are described to occur in two phases: pre-cruise planning and during operations. The following sections describe the efforts during both stages for the proposed actions.

(a) Planning Phase

As discussed in § 2.4.1.1 of the PEIS, mitigation of potential impacts from the proposed activities begins during the planning phase of the proposed activities. Several factors were considered during the planning phase of the proposed activities, including

1. Energy Source—Part of the considerations for the proposed survey was to evaluate whether the research objectives could be met with a smaller energy source than the full, 36-airgun, 6600-in^3 *Langseth* array, and it was decided that the scientific objectives could be met using an energy source comprising 4 airguns (total volume 700 in^3 volume) towed at a depth of ~4.5 or 6 m. Two such subarrays of 4 airguns would be used alternately (flip-flop mode); one would be towed on the port side, the other one on the starboard side. Thus, the source volume would not exceed 700 in^3 at any time. We have assumed in the impacts analysis and take estimate calculations the use of the 4-airgun array towed at 6 m as that would result in the farthest sound propagation. Based on the research goals and current knowledge of environmental conditions in the survey area based on 2014 activities, the 1400-in^3 source level proposed for possible use in 2014 is no longer viewed necessary and has not been included in this analysis. For the DAA off the coast of New Jersey included in the PEIS, the energy source level analyzed was a pair of 45/105-in^3 GI guns, however this source level was not viewed as adequate for meeting the research goals of the proposed survey.
2. Survey Timing—The PIs worked with L-DEO and NSF to identify potential times to carry out the survey taking into consideration key factors such as environmental conditions (i.e., the seasonal presence of marine mammals, sea turtles, and seabirds), weather conditions, equipment, and optimal timing for other proposed seismic surveys using the *Langseth*. Some marine mammal species are expected to occur in the area year-round, so altering the timing of the proposed project likely would result in no net benefits for those species. Some migratory species are expected to be farther north at the time of the survey, so the survey timing is beneficial for those species.
3. Mitigation Zones—During the planning phase, mitigation zones for the proposed survey were calculated based on modeling by L-DEO for both the exclusion zone (EZ) and the safety zone; these zones are given in Table 1 and Appendix Table A2. A more detailed description of the modeling process used to develop the mitigation zones can be found in Appendix A. Received sound levels in deep water have been predicted by L-DEO for the 4-airgun array and the single Bolt 1900LL 40-in^3 airgun that would be used during power downs. Scaling factors between those arrays and the 18-airgun, 3300-in^3 array, taking into account tow depth differences, were developed and applied to empirical data for the 18-airgun array in shallow water in the Gulf of Mexico from Diebold et al. (2010). The use of the 4-airgun array towed at 6 m is assumed in the impacts and take estimate analysis as that would result in the farthest sound propagation. During actual operations, however, the corresponding mitigation zone would be applied for the selected source level. The 1 July 2014 Final EA included mitigation zones and take calculations for a 1400-in^3 array, however, that source level has been determined to be unnecessary and is not included in this analysis.

   Table 1 shows the 180-dB EZ and 160-dB "Safety Zone" (distances at which the rms sound levels are expected to be received) for the mitigation airgun and the 4-airgun subarray. The 160 and 180-dB re 1 μPa_{rms} distances are the criteria currently specified by NMFS (2000) for cetaceans. The 180-dB distance has also been used as the EZ for sea turtles, as required by NMFS in most other recent seismic projects per the IHAs. Per the Biological Opinion issued in 2014 (Appendix C of the 1 July 2014 Final EA), a 166-dB distance would be used for Level B takes for sea turtles. Per the IHA for this survey issued in 2014 (Appendix D of the 1 July

TABLE 1. Predicted distances to which sound levels ≥180 and 160 dB re 1 μPa$_{rms}$ would be received during the proposed 3-D survey off New Jersey, using a 4-airgun, 700-in^3 subset of 1 string at 4.5- or 6-m tow depth and the 40-in^3 airgun. Radii are based on scaling described in the text of Appendix A and Figures A2 to A6, and the assumption that received levels on an rms basis are, numerically, 10 dB higher than the SEL values.[1]

Source and Volume	Water Depth	Predicted RMS Radii (m)	
		180 dB	160 dB
4-airgun subarray (700 in^3) @ 4.5 m	<100 m	378	5240
4-airgun subarray (700 in^3) @ 6 m	<100 m	439	6100
Single Bolt airgun (40 in^3) @ 6 m	<100 m	73	995

2014 Final EA), the Exclusion Zone was increased by 3 dB (thus operational mitigation would be at the 177-dB isopleth), which adds ~50% to the power-down/shut-down radius. NSF does not view this overly precautionary approach appropriate, and it is not included here. A recent retrospective analysis of acoustic propagation of *Langseth* sources in a coastal/shelf environment from the Cascadia Margin off Washington suggests that predicted radii (using an approach similar to that used here) for *Langseth* sources were 2–3 times larger than measured in shallow water, so in fact were very conservative (Crone et al. 2014).

Southall et al. (2007) made detailed recommendations for new science-based noise exposure criteria. In December 2013, NOAA published draft guidance for assessing the effects of anthropogenic sound on marine mammals (NOAA 2013a), although at the time of preparation of this Draft Amended EA, the date of release of the final guidelines and how they would be implemented are unknown. As such, this Draft Amended EA has been prepared in accordance with the current NOAA acoustic practices, and the procedures are based on best practices noted by Pierson et al. (1998), Weir and Dolman (2007), Nowacek et al. (2013), and Wright (2014).

Enforcement of mitigation zones via power and shut downs would be implemented in the Operational Phase, as noted below unless otherwise prescribed by the IHA.

(b) Operational Phase

Marine species, including marine mammals and sea turtles, are known to occur in the proposed survey area. However, the number of individual animals expected to be approached closely during the proposed activities would be relatively small in relation to regional population sizes. To minimize the likelihood that potential impacts could occur to the species and stocks, monitoring and mitigation measures proposed during the operational phase of the proposed activities, which are consistent with the PEIS and past IHA requirements, include

1. monitoring by protected species visual observers (PSVOs) for marine mammals, sea turtles, and seabirds;

[1] Sound sources are primarily described in sound pressure level (SPL) units. SPL is often referred to as rms or "root mean square" pressure, averaged over the pulse duration. Sound exposure level (SEL) is a measure of the received energy in a pulse and represents the SPL that would be measured if the pulse energy were spread evenly over a 1-s period.

2. passive acoustic monitoring (PAM);
3. PSVO data and documentation;
4. mitigation during operations (speed or course alteration; power-down, shut-down, and ramp-up procedures; and special mitigation measures for rare species, species concentrations, and sensitive habitats).

The proposed operational mitigation measures are standard for all high energy seismic cruises, per the PEIS, and therefore are not discussed further here. Special mitigation measures were considered for this cruise. Although it is very unlikely that a North Atlantic right whale would be encountered, the airgun array would be shut down if one is sighted at any distance from the vessel because of the species' rarity and conservation status. It is also unlikely that concentrations of large whales of any species would be encountered, but if so, they would be avoided.

With the proposed monitoring and mitigation provisions, potential effects on most if not all individuals would be expected to be limited to minor behavioral disturbances. Those potential effects would be expected to have negligible impacts both on individual marine mammals and on the associated species and stocks. Ultimately, survey operations would be conducted in accordance with all applicable U.S. federal regulations and IHA requirements.

Alternative 1: Alternative Survey Timing

An alternative to issuing the IHA for the period requested and to conducting the project then would be to conduct the project at an alternative time, such as late spring or early fall (avoiding the North Atlantic right whale migration season) implementing the same monitoring and mitigation measures as under the Proposed Action, and requesting an IHA to be issued for that alternative time. An evaluation of the effects of this Alternative Action is given in § IV.

Alternative 2: No Action Alternative

An alternative to conducting the proposed activities is the "No Action" alternative, i.e., do not issue an IHA and do not conduct the research operations. If the research is not conducted, the "No Action" alternative would result in no disturbance to marine mammals because of the absence of the proposed activities. Although the No-Action Alternative is not considered a reasonable alternative because it does not meet the purpose and need for the Proposed Action, per CEQ regulations it is included and carried forward for analysis in § IV.

Alternatives Considered but Eliminated from Further Analysis

(1) Alternative E1: Alternative Location

The New Jersey (NJ) continental margin has for decades been recognized as among the best siliciclastic passive margins for elucidating the timing and amplitude of eustatic change during the "Ice House" period of Earth history, when glacioeustatic changes shaped continental margin sediment sections around the world. There is a fundamental need to constrain the complex forcing functions tying evolution and preservation of the margin stratigraphic record to base-level changes. This could be accomplished by following the transect strategy adopted by the international scientific ocean drilling community. This strategy involves integration of drilling results with seismic imaging. In keeping with this strategy, the proposed seismic survey would acquire a 3-D seismic volume encompassing the three existing IODP Expedition 313 (Exp313) drill sites on the inner-middle shelf of the NJ margin. Exp313, the latest chapter in the multi-decade Mid-Atlantic Transect, represents the scientific community's best opportunity to link excellently sampled and logged late Paleogene-Neogene prograding clinoforms to state-of-the-art

3-D images. Exp313 borehole data would provide lithostratigraphy, geochronology, and paleobathymetry. 3-D seismic imaging would put these sampled records in a spatially accurate, stratigraphically meaningful context. Such imagery would allow researchers to map sequences around Exp313 sites with a resolution and confidence previously unattainable, and to analyze their spatio-temporal evolution.

No other scientific ocean drilling boreholes are available on the NJ shelf or elsewhere that provide such high sediment recoveries and high-quality well logs as those of Exp313. The need to tie the proposed 3-D survey to Exp313 drill sites means that it is not possible to conduct the survey in a different area. Also, positioning a 3-D volume requires broad coverage by pre-existing 2-D seismic data. Such data, collected over more than two decades, are readily available on the NJ shelf. Furthermore, the proposed research underwent the NSF merit review process, and the science, including the site location, was determined to be meritorious.

(2) Alternative E2: Use of Alternative Technologies

As described in § 2.6 of the PEIS, alternative technologies to the use of airguns were investigated to conduct high-energy seismic surveys. At the present time, these technologies are still not feasible, commercially viable, or appropriate to meet the Purpose and Need. Additional details about these technologies are given in the Final USGS EA (RPS 2014).

Table 2 provides a summary of the proposed action, alternatives, and alternatives eliminated from further analysis.

III. AFFECTED ENVIRONMENT

As described in the PEIS, Chapter 3, the description of the affected environment focuses only on those resources potentially subject to impacts. Accordingly, the discussion of the affected environment (and associated analyses) has focused mainly on those related to marine biological resources, as the proposed short-term activities have the potential to impact marine biological resources within the proposed Project area. These resources are identified in Section III, and the potential impacts to these resources are discussed in Section IV. Initial review and analysis of the proposed Project activities determined that the following resource areas did not require further analysis in this Draft Amended EA:

- *Air Quality/Greenhouse Gases*—Project vessel emissions would result from the proposed activities; however, these short-term emissions would not result in any exceedance of federal Clean Air standards. Emissions would be expected to have a negligible impact on the air quality within the survey area;
- *Land Use*—All proposed activities would be in the marine environment. Therefore, no changes to current land uses or activities in the Project area would result from the proposed Project;
- *Safety and Hazardous Materials and Management*—No hazardous materials would be generated or used during proposed activities. All Project-related wastes would be disposed of in accordance with federal and international requirements;
- *Geological Resources (Topography, Geology and Soil)*—The proposed Project would result in no displacement of soil and seafloor sediments. Proposed activities would not adversely affect geologic resources as no impacts would occur;
- *Water Resources*—No discharges to the marine environment are proposed within the Project area that would adversely affect marine water quality. Therefore, there would be no impacts to water resources resulting from the proposed Project activities;
- *Terrestrial Biological Resources*—All proposed Project activities would occur in the marine environment and would not impact terrestrial biological resources;

Table 2. Summary of Proposed Action, Alternatives Considered, and Alternatives Eliminated

Proposed Action	Description
Proposed Action: Conduct a marine geophysical survey and associated activities in the Atlantic Ocean off New Jersey	Under the Proposed Action, a 3-D seismic reflection survey would take place in the Atlantic Ocean off New Jersey during the summer of 2015. When considering transit; equipment deployment, maintenance, and retrieval; weather; marine mammal activity; and other contingencies, the proposed activities would be expected to be completed in ~34 days. The standard monitoring and mitigation measures identified in the NSF PEIS would apply and are described in further detail in this document (§ II [3]), along with any additional requirements identified by regulating agencies. All necessary permits and authorizations, including an IHA, were requested and received from regulatory bodies in 2014 and would be requested again for 2015.
Alternatives	Description
Alternative 1: Alternative Survey Timing	Under this Alternative, the survey operations would be conducted at a different time of the year, such as late spring or early fall. The standard monitoring and mitigation measures identified in the NSF PEIS would apply. These measures are described in further detail in this document (§ II [3]) and would apply to survey activities conducted during an alternative survey time period, along with any additional requirements identified by regulating agencies as a result of the change. All necessary permits and authorizations, including an IHA, would be requested from regulatory bodies.
Alternative 2: No Action	Under this Alternative, no proposed activities would be conducted and seismic data would not be collected. No permits and authorizations, including an IHA, would be requested from regulatory bodies, as the Proposed Action would not be conducted.
Alternatives Eliminated from Further Analysis	Description
Alternative E1: Alternative Location	The survey location has been specifically identified because of the data available for that location, including borehole data from three IODP Expedition 313 drill sites that would provide lithostratigraphy, geochronology, and paleobathymetry, and broad coverage by pre-existing 2-D seismic data. The proposed 3-D seismic imaging would put these sampled records in a spatially accurate, stratigraphically meaningful context. Such imagery would allow researchers to map sequences around the drill sites with a resolution and confidence previously unattainable, and to analyze their spatio-temporal evolution. Furthermore, the proposed science underwent the NSF merit review process, and the science, including the site location, was determined to be meritorious. Thus, conducting the proposed survey at a different location was eliminated from further consideration.
Alternative E2: Alternative Survey Techniques	Under this alternative, alternative survey techniques would be used, such as marine vibroseis, which could potentially reduce impacts on the marine environment. Alternative technologies were evaluated in the PEIS, § 2.6. At the present time, however, these technologies are still not feasible, commercially viable, or appropriate to meet the Purpose and Need. NSF currently owns the *Langseth*, and its primary capability is to conduct seismic surveys; no other viable technologies are available to NSF. Thus, this Alternative was eliminated from further consideration.

- *Socioeconomic and Environmental Justice*—Implementation of the proposed Project would not affect, beneficially or adversely, socioeconomic resources, environmental justice, or the protection of children. No changes in the population or additional need for housing or schools would occur. Because of the location of the proposed activity and distance from shore, human activities in the area around the survey vessel would be limited to SCUBA diving, commercial and recreational fishing activities and other vessel traffic. Fishing, SCUBA diving, vessel traffic, and potential impacts are described in further detail in §§ III and IV. Additionally, there is a marine mammal watching industry in New Jersey. Because of the distance from shore to the proposed survey site, it would be unlikely that marine mammal watching boat tours would coincide with the proposed survey site or be impacted by

the proposed activities. Most activities are conducted within ~20 km of the coast, with the majority occurring closer inshore. Some boat tours occur well south (~100 km) of the proposed survey area around Cape May and in Delaware Bay. Some dolphin watching cruises take place off Atlantic City fairly close to shore. Tours typically are ~1.5–3 h long. Although marine mammals around the seismic survey may avoid the vessel during operations, this behavior would be of short duration and temporary. Given the distance from shore to the proposed activities, the likely distance from any of the few marine mammal watching activities, and the short and temporary duration of any potential impacts to marine mammals, it would be unlikely that the marine mammal watching industry would be affected by the proposed activities and, therefore, this issue is not analyzed further in this assessment. Furthermore, no whale watching vessels were encountered by the *Langseth* during the ~13 days the vessel was in the survey area in 2014. No other socioeconomic impacts would be anticipated as a result of the proposed activities;

- *Visual Resources*—No visual resources would be anticipated to be negatively impacted as the area of operation is significantly outside of the land and coastal view shed; and
- *Cultural Resources*—With the following possible exceptions, there are no known cultural resources in the proposed Project area. One shipwreck, a known dive site, is in or near the survey area (see Fig. 2 in § III): the *Lillian* (Galiano 2009; Fisherman's Headquarters 2014; NOAA 2014a). Shipwrecks are discussed further in § IV. Airgun sounds would have no effects on solid structures; no significant impacts on shipwrecks would be anticipated (§ IV). No impacts to cultural resources would be anticipated.

Physical Environment and Oceanography

The water off the U.S. east coast consists of three water masses: coastal or shelf waters, slope waters, and the Gulf Stream. Coastal waters off Canada, which originate mostly in the Labrador Sea, move southward over the continental shelf until they reach Cape Hatteras, NC, where they are entrained between the Gulf Stream and slope waters. North of Cape Hatteras, an elongated cyclonic gyre of slope water that forms because of the southwest flow of coastal water and the northward flowing Gulf Stream is present most of the year and shifts seasonally relative to the position of the north edge of the Gulf Stream. Slope water eventually merges with the Gulf Stream water. The Gulf Stream flows through the Straits of Florida and then parallel to the continental margin, becoming stronger as it moves northward. It turns seaward near Cape Hatteras and moves northeast into the open ocean.

The shelf waters off New Jersey are part of the Mid-Atlantic Bight, which includes shelf waters from Cape Hatteras, NC, to southern Cape Cod. The shelf is dominated by a sandy to muddy-sandy bottom (Steimle and Zetlin 2000; USGS 2000 *in* DoN 2005). The shelf off New Jersey slopes gently and uniformly seaward to the shelf-slope transition 120–150 km offshore in water depths 120–160 m (Carey et al. 1998 *in* GMI 2010). The shelf edge off New Jersey is incised by the Hudson Canyon to the north and the Wilmington Canyon to the south. Several smaller canyons also occur along the shelf edge. The Hudson Canyon is the largest canyon off the east coast of the U.S. The proposed survey area is entirely on the shelf.

The shelf waters off New Jersey become stratified in the spring as the water warms, and are fully stratified throughout the summer, i.e., warmer, fresher water accumulates at the surface and denser, colder, more saline waters occur near the seafloor. The stratification breaks down in fall because of mixing by wind and surface cooling (Castelao et al. 2008). Summer upwelling occurs off New Jersey, where nutrient-rich cold water is brought closer to the surface and stimulates primary production (Glenn et al. 2004; NEFSC 2013a). The primary production of the northeast U.S. continental shelf is

1536 mg C/m^2/day (Sea Around Us 2013). The salinity of shelf water usually increases with depth and is generally lower than the salinity of water masses farther offshore primarily because of the low-salinity input from rivers and estuaries.

There are numerous artificial reefs in shelf waters off New Jersey, including materials such as decommissioned ships, barges, and reef balls or hollow concrete domes (Steimle and Zetlin 2000; Figley 2005); these reefs can provide nursery habitat, protection, and foraging sites to marine organisms. Since 1984, more than 3500 of these artificial patch reefs have been constructed off New Jersey (Figley 2005).

Protected Areas

Several federal Marine Protected Areas (MPAs) or sanctuaries have been established ~500 km north of the proposed survey area, primarily with the intention of preserving cetacean habitat (Hoyt 2005; CetaceanHabitat 2013). These include the Cape Cod Bay Northern Right Whale Critical Habitat Area, the Great South Channel Northern Right Whale Critical Habitat Area east of Cape Cod, the Gerry E Studds Stellwagen Bank National Marine Sanctuary in the Gulf of Maine, and Jeffrey's Ledge, a proposed extension to the Stellwagen Bank National Marine Sanctuary. The Monitor National Marine Sanctuary is located to the southeast of Cape Hatteras, North Carolina. There are also five state Ocean Sanctuaries in Massachusetts waters including Cape Cod, Cape Cod Bay, Cape and Islands, North Shore, and South Essex Ocean Sanctuaries (Mass.Gov 2013). These sanctuaries include most Massachusetts state waters except for the area east of Boston. In addition, three Canadian protected areas also occur in the Northwest Atlantic for cetacean habitat protection, including the Bay of Fundy Right Whale Conservation Area, Roseway Basin Right Whale Conservation Area, and Gully Marine Protected Area off the Scotian Shelf. The proposed survey is not located within or near any federal, state, or international MPA or sanctuary.

The Harbor Porpoise Take Reduction Plan (HPTRP) is intended to reduce the interactions between harbor porpoises and commercial gillnets in four management areas: waters off New Jersey, Mudhole North, Mudhole South, and Southern Mid Atlantic (NOAA 2010b). The HPTRP is not relevant to this EA because harbor porpoises are not expected to occur in the survey area.

Marine Mammals

Thirty-one cetacean species (6 mysticetes and 25 odontocetes) could occur near the proposed survey site (Table 3). Six of the 31 species are listed under the U.S. Endangered Species Act (ESA) as ***Endangered***: the North Atlantic right, humpback, blue, fin, sei, and sperm whales. In fact, only five species were observed during the 13-day cruise in 2014, including one humpback whale, plus one unidentified baleen whale and one unidentified dolphin (Ingram et al. 2014). An additional four cetacean species, although present in the wider western North Atlantic Ocean, likely would not be found near the proposed survey area between ~39–40°N because their ranges generally do not extend as far north (Clymene dolphin, *Stenella clymene*; Fraser's dolphin, *Lagenodelphis hosei*; melon-headed whale, *Peponocephala electra*; and Bryde's whale, *Balaenoptera brydei*). Although the secondary range of the beluga whale (*Delphinapterus leucas*) may range as far south as New Jersey (Jefferson et al. 2008), and there have been at least two sightings off the coast of New Jersey (IOC 2013), this species is not included here as it is unlikely to be encountered during the proposed survey. Similarly, no pinnipeds are included; harp seals (*Pagophilus groenlandicus*) and hooded seals (*Cystophora cristata*) are rare in the proposed survey area, and gray (*Halichoerus grypus*) and harbor seals (*Phoca vitulina*) have a more northerly distribution during the summer (DoN 2005) and are therefore not expected to occur there during the survey. No pinnipeds were observed during the 13-day cruise in 2014. Information on grey, harbor, and harp seals is included in the 2014 NMFS EA for this project, and is incorporated into this Draft Amended EA by reference as if fully set forth herein (Appendix E of the 1 July 2014 Final EA).

TABLE 3. The habitat, occurrence, regional population sizes, and conservation status of marine mammals that could occur in or near the proposed survey area in the Northwest Atlantic Ocean off New Jersey.

Species	Habitat	Occurrence in survey area in summer	Regional/SAR abundance estimates[1]	ESA[2]	IUCN[3]	CITES[4]
Mysticetes						
North Atlantic right whale	Coastal and shelf	Rare	455 / 455[5]	EN	EN	I
Humpback whale	Mainly coastal, banks	Common	11,600[6] / 823[7]	EN	LC	I
Minke whale	Mainly coastal	Rare	138,000[8] / 20,741[9]	NL	LC	I
Sei whale	Mainly offshore	Uncommon	10,300[10] / 357[11]	EN	EN	I
Fin whale	Slope, pelagic	Uncommon	26,500[12] / 3522[5]	EN	EN	I
Blue whale	Coastal, shelf, pelagic	Rare	855[13] / 440[5]	EN	EN	I
Odontocetes						
Sperm whale	Pelagic	Common	13,190[14] / 2288[15]	EN	VU	I
Pygmy sperm whale	Off shelf	Uncommon	N.A. / 3785[16]	NL	DD	II
Dwarf sperm whale	Off shelf	Uncommon	N.A. / 3785[16]	NL	DD	II
Cuvier's beaked whale	Pelagic	Uncommon	N.A. / 6532[17]	NL	LC	II
Northern bottlenose whale	Pelagic	Rare	N.A. / N.A.	NL	DD	II
True's beaked whale	Pelagic	Rare	N.A. / 7092[18]	NL	DD	II
Gervais' beaked whale	Pelagic	Rare	N.A. / 7092[18]	NL	DD	II
Sowerby's beaked whale	Pelagic	Rare	N.A / 7092[18]	NL	DD	II
Blainville's beaked whale	Pelagic	Rare	N.A. / 7092[18]	NL	DD	II
Rough-toothed dolphin	Mainly pelagic	Rare	N.A. / 271[5]	NL	LC	II
Bottlenose dolphin	Coastal, offshore	Common	N.A / 89,080[19]	NL^	LC	II
Pantropical spotted dolphin	Mainly pelagic	Rare	N.A. / 3333[5]	NL	LC	II
Atlantic spotted dolphin	Mainly coastal	Common	N.A. / 44,715[5]	NL	DD	II
Spinner dolphin	Coastal, pelagic	Rare	N.A. / N.A.	NL	DD	II
Striped dolphin	Off shelf	Uncommon	N.A. / 54,807[5]	NL	LC	II
Short-beaked common dolphin	Shelf, pelagic	Common	N.A. / 173,486[5]	NL	LC	II
White-beaked dolphin	Shelf <200 m	Rare	10s–100s of 1000s[20] / 2003[5]	NL	LC	II
Atlantic white-sided dolphin	Shelf and slope	Uncommon	10s–100s of 1000s[21] / 48,819[5]	NL	LC	II
Risso's dolphin	Mainly shelf, slope	Common	N.A. /18,250[5]	NL	LC	II
False killer whale	Pelagic	Extralimital	N.A. / N.A.	NL	DD	II
Pygmy killer whale	Mainly pelagic	Rare	N.A. / N.A.	NL	DD	II
Killer whale	Coastal	Rare	N.A. / N.A.	NL*	DD	II
Long-finned pilot whale	Mainly pelagic	Uncommon	780K[22] / 26,535[5]	NL[†]	DD	II
Short-finned pilot whale	Mainly pelagic	Uncommon	780K[22] / 21,515[5]	NL	DD	II
Harbor porpoise	Coastal	Rare	~500K[23] / 79,883[24]	NL	LC	II

N.A. = Data not available or species status was not assessed.

[1] SAR (stock assessment report) abundance estimates are from the 2013 U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments (Waring et al. 2014) as noted, and regional abundance estimates are for the North Atlantic regions as noted.

[2] U.S. Endangered Species Act; EN = Endangered, NL = Not listed

[3] Codes for IUCN classifications from IUCN Red List of Threatened Species (IUCN 2013): EN = Endangered; VU = Vulnerable; LC = Least Concern; DD = Data Deficient

[4] Convention on International Trade in Endangered Species of Wild Fauna and Flora (UNEP-WCMC 2013): Appendix I = Threatened with extinction; Appendix II = not necessarily now threatened with extinction but may become so unless trade is closely controlled

[5] Estimate for the Western North Atlantic Stock (Waring et al. 2014)

[6] Best estimate for the western North Atlantic in 1992–1993 (IWC 2013)

[7] Minimum estimate for the Gulf of Maine stock (Waring et al. 2014)

[8] Best estimate for the North Atlantic in 2002–2007 (IWC 2013)

[9] Estimate for the Canadian East Coast Stock (Waring et al. 2014)
[10] Estimate for the Northeast Atlantic in 1989 (Cattanach et al. 1993)
[11] Estimate for the Nova Scotia Stock (Waring et al. 2014)
[12] Best estimate for the North Atlantic in 2007 (IWC 2013)
[13] Estimate for the central and northeast Atlantic in 2001 (Pike et al. 2009)
[14] Estimate for the North Atlantic (Whitehead 2002)
[15] Estimate for the North Atlantic Stock (Waring et al. 2014)
[16] Combined estimate for pygmy and dwarf sperm whales, Western North Atlantic Stock (Waring et al. 2014)
[17] Estimate for the Western North Atlantic Stock (Waring et al. 2014)
[18] Combined estimate for *Mesoplodon* spp. Western North Atlantic stocks (Waring et al. 2014)
[19] Combined estimate for the Western North Atlantic Offshore Stock and the Northern Migratory Coastal Stock (Waring et al. 2014)
[20] High tens to low hundreds of thousands in the North Atlantic (Reeves et al. 1999a)
[21] Tens to low hundreds of thousands in the North Atlantic (Reeves et al. 1999b)
[22] Estimate for both long- and short-finned pilot whales in the central and eastern North Atlantic in 1989 (IWC 2013)
[23] Estimate for the North Atlantic (Jefferson et al. 2008)
[24] Estimate for the Gulf of Maine/Bay of Fundy Stock (Waring et al. 2014)
* Killer whales in the eastern Pacific Ocean, near Washington state, are listed as endangered under the U.S. ESA but not in the Atlantic Ocean.
^ The Western North Atlantic Coastal Morphotype stocks, ranging from NJ to FL, are listed as depleted under the U.S. Marine Mammal Protection Act, as are some other stocks to the south of the proposed survey area.
[†] Considered a strategic stock.

General information on the taxonomy, ecology, distribution and movements, and acoustic capabilities of marine mammals are given in § 3.6.1 and § 3.7.1 of the PEIS. The proposed survey area off New Jersey is near one of the DAAs in the PEIS. The general distributions of mysticetes and odontocetes in this region of the Atlantic Ocean are discussed in § 3.6.2.1 and § 3.7.2.1 of the PEIS, respectively. Additionally, information on marine mammals in this region is included in § 4.2.2.1 of the Bureau of Ocean Energy Management (BOEM) Final PEIS for Atlantic OCS Proposed Geological and Geophysical Activities, Mid-Atlantic and South Atlantic Planning Areas (BOEM 2014). The rest of this section deals with more specific species distribution off the coast of New Jersey. For the sake of completeness, an additional six odontocetes that are expected to be rare or extralimital in the proposed survey area were included here, but were not included in the PEIS.

The main sources of information used here are the 2010 and 2013 U.S. Atlantic and Gulf of Mexico marine mammal stock assessment reports (SARs: Waring et al. 2010, 2014), the Ocean Biogeographic Information System (OBIS: IOC 2013), and the Cetacean and Turtle Assessment Program (CETAP 1982). The SARs include maps of sightings for most species from NMFS' Northeast and Southeast Fisheries Science Centers (NEFSC and SEFSC) surveys in summer 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010, and 2011. OBIS is a global database of marine species sightings. CETAP covered 424,320 km of trackline on the U.S. outer continental shelf from Cape Hatteras to Nova Scotia. Aerial and shipboard surveys were conducted over a 39-month period from 1 November 1978 to 28 January 1982. The mid-Atlantic area referred to in the following species accounts included waters south of Georges Bank down to Cape Hatteras, and from the coast out to ~1830 m depth.

(1) Mysticetes

North Atlantic Right Whale (*Eubalaena glacialis*)

The North Atlantic right whale is known to occur primarily in the continental shelf waters off the eastern U.S. and Canada, from Florida to Nova Scotia (Winn et al. 1986; Jefferson et al. 2008). There are five well-known habitats in the northwest Atlantic used annually by right whales (Winn et al. 1986; NMFS 2005). These include the winter calving grounds in coastal waters of the southeastern U.S. (Florida/Georgia); spring feeding grounds in the Great South Channel (east of Cape Cod); late winter/spring feeding grounds and nursery grounds in Massachusetts Bay and Cape Cod Bay; summer/fall feeding and nursery grounds in the Bay of Fundy; and summer/fall feeding grounds on the Nova Scotian

Shelf. In addition, Jeffreys Ledge, off the coast of northern Massachusetts, New Hampshire, and Maine, could be an important fall feeding area for right whales and an important nursery area during summer, especially in July and August (Weinrich et al. 2000). The first three habitats were designated as Critical Habitat Areas by NMFS (1994).

There is a general seasonal north-south migration of the North Atlantic population between feeding and calving areas, but right whales could be seen anywhere off the Atlantic U.S. throughout the year (Gaskin 1982). The seasonal occurrence of right whales in mid Atlantic waters is mostly between November and April, with peaks in December and April (Winn et al. 1986) when whales transit through the area on their migrations to and from breeding grounds or feeding grounds. The migration route between the Cape Cod summer feeding grounds and the Georgia/Florida winter calving grounds, known as the mid-Atlantic corridor, has not been considered to include "high use" areas, yet the whales clearly move through these waters regularly in all seasons (Reeves and Mitchell 1986; Winn et al. 1986; Kenney et al. 2001; Reeves 2001; Knowlton et al. 2002; Whitt et al. 2013).

North Atlantic right whales are found commonly on the northern feeding grounds off the north-eastern U.S. during early spring and summer. The highest abundance in Cape Cod Bay is in February and April (Winn et al. 1986; Hamilton and Mayo 1990) and from April to June in the Great South Channel east of Cape Cod (Winn et al. 1986; Kenney et al. 1995). Throughout the remainder of summer and into fall (June–November), they are most commonly seen farther north on feeding grounds in Canadian waters, with peak abundance during August, September, and early October (Gaskin 1987). Morano et al. (2012) and Mussoline et al. (2012) indicated that right whales are present in the southern Gulf of Maine year-round and that they occur there over longer periods than previously thought.

Some whales, including mothers and calves, remain on the feeding grounds through the fall and winter. However, the majority of the right whale population leaves the feeding grounds for unknown wintering habitats and returns when the cow-calf pairs return. The majority of the right whale population is unaccounted for on the southeastern U.S. winter calving ground, and not all reproductively-active females return to the area each year (Kraus et al. 1986; Winn et al. 1986; Kenney et al. 2001). Other wintering areas have been suggested, based upon sparse data or historical whaling logbooks; these include the Gulf of St. Lawrence, Newfoundland and Labrador, coastal waters of New York and between New Jersey and North Carolina, Bermuda, and Mexico (Payne and McVay 1971; Aguilar 1986; Mead 1986; Lien et al. 1989; Knowlton et al. 1992; Cole et al. 2009; Patrician et al. 2009).

Knowlton et al. (2002) provided an extensive and detailed analysis of survey data, satellite tag data, whale strandings, and opportunistic sightings along State waters of the mid-Atlantic migratory corridor[2], from the border of Georgia/South Carolina to south of New England, including waters in the proposed seismic survey area, spanning the period from 1974 to 2002. The majority of sightings (94%) along the migration corridor were within 56 km of shore, and more than half (64%) were within 18.5 km of shore (Knowlton et al. 2002). Water depth preference was for shallow waters; 80% of all sightings were in depths <27 m, and 93% were in depths <45 m (Knowlton et al. 2002). Most sightings >56 km from shore occurred at the northern end of the corridor, off New York and south of New England. North of Cape Hatteras, most sightings were reported for March–April. Sighting data analyzed by Winn et al. (1986) dating back to 1965 showed that the occurrence of right whales in the mid Atlantic, including the

[2] Multi-year datasets for the analysis were provided by the New England Aquarium, North Atlantic Right Whale Consortium, Oregon State University, Coastwise Consulting Inc., Georgia Department of Natural Resources, University of North Carolina Wilmington, Continental Shelf Associates, CETAP, NOAA, and University of Rhode Island.

proposed survey area, peaked in April and December (Winn et al. 1986). A review of the mid-Atlantic whale sighting and tracking data archive from 1974 to 2002 showed right whale sightings off the coast of New Jersey throughout the year, except during May–June, August, and November (Beaudin Ring 2002).

The Interactive North Atlantic Right Whale Sighting Map showed 32 sightings in the shelf waters off New Jersey between 2006 and 2012 (NEFSC 2013b). Two of these sightings occurred just to the north of the proposed survey site. Three sightings were made in June, and none were made in July. However, two sightings were made during July to the far east of the proposed survey area (NEFSC 2013b). There are also at least eight sightings of right whales off New Jersey in the Ocean Biogeographic Information System (OBIS; IOC 2013), which were made during the 1978–1982 Cetacean and Turtle Assessment Program (CETAP) surveys (CETAP 1982).

Palka (2006) reviewed North Atlantic right whale density in the U.S. Navy NE Operating Area based on summer abundance surveys conducted during 1998–2004. One of the lowest whale densities (including right whales) was found in the mid-Atlantic stratum, which includes the proposed survey area. However, survey effort for this stratum was also the lowest; only two surveys were conducted. No right whales were sighted.

Whitt et al. (2013) surveyed for right whales off the coast of New Jersey using acoustic and visual techniques from January 2008 to December 2009. Whale calls were detected off New Jersey year-round and four sightings were made: one in November, one in December, one in January just to the west of the survey area, and one cow-calf pair in May. In light of these findings, Whitt et al. (2013) suggested expanding the existing critical habitat to include waters of the mid-Atlantic. NMFS (2010) previously noted that such a revision could be warranted, but no revisions have been made to the critical habitat yet.

Federal and Other Action.—In 2002, NMFS received a petition to revise and expand the designation of critical habitat for the North Atlantic right whale. The revision was declined and the critical habitat designated in 1994 remained in place (NMFS 2005). Another petition for a revision to the critical habitat was received in 2009 that sought to expand the currently designated critical feeding and calving habitat areas and include a migratory corridor as critical habitat (NMFS 2010). NMFS noted that the requested revision may be warranted, but no revisions have been made as of June 2014. The designation of critical habitat does not restrict activities within the area or mandate any specific management action. However, actions authorized, funded, or carried out by federal agencies that may have an impact on critical habitat must be consulted upon in accordance with Section 7 of the ESA, regardless of the presence of right whales at the time of impacts. Impacts on these areas that could affect primary constituent elements such as prey availability and the quality of nursery areas must be considered when analyzing whether habitat may be adversely modified.

A number of other actions have been taken to protect North Atlantic right whales, including establishing the Right Whale Sighting Advisory System designed to reduce collisions between ships and right whales by alerting mariners to the presence of the whales (see NEFSC 2012); a Mandatory Ship Reporting System implemented by the U.S. Coast Guard in the right whale nursery and feeding areas (USCG 1999, 2001; Ward-Geiger et al. 2005); recommended shipping routes in key right whale aggregation areas (NOAA 2006, 2007, 2013b); regulations to implement seasonal mandatory vessel speed restrictions in specific locations (Seasonal Management Areas or SMAs) during times when whales are likely present, including ~37 km around points near the Ports of New York/New Jersey (40.495ºN, 73.933ºW) and Philadelphia and Wilmington (38.874ºN, 75.026ºW) during 1 November–30 April (NMFS 2008); temporary Dynamic Management Areas (DMAs) in response to actual whale sightings, requiring gear modifications to traps/pots and gillnets in areas north of 40°N with unexpected right whale aggregations (NOAA 2012a); and a voluntary seasonal (April 1 to July 31) Area to be Avoided in the

Great South Channel off Massachusetts (NOAA 2013b). Furthermore, in its Final PEIS (BOEM 2014), BOEM proposed that no seismic surveys would be authorized within right whale critical habitat from 15 November to April 15, nor within the Mid-Atlantic and Southeast U.S. SMAs from 1 November to 30 April 30. Additionally, G&G seismic surveys would not be allowed in active DMAs. The proposed survey area is not in any of these areas.

North Atlantic right whales likely would not be encountered during the proposed survey.

Humpback Whale (*Megaptera novaeangliae*)

In the North Atlantic, a Gulf of Maine stock of the humpback whale is recognized off the northeastern U.S. coast as a distinct feeding stock (Palsbøll et al. 2001; Vigness-Raposa et al. 2010). Whales from this stock feed during spring, summer, and fall in areas ranging from Cape Cod to Newfoundland. In the spring, greatest concentrations of humpback whales occur in the western and southern edges of the Gulf of Maine. During summer, the greatest concentrations are found throughout the Gulf of Maine, east of Cape Cod, and near the coast from Long Island to northern Virginia. Similar distribution patterns are seen in the fall, although sightings south of Cape Cod Bay are less frequent than those near the Gulf of Maine. From December to March, there are few occurrences of humpback whales over the continental shelf of the Gulf of Maine, and in Cape Cod and Massachusetts Bay (Clapham et al. 1993; Fig. B-5a *in* DoN 2005).

GMI (2010) reported 17 sightings of humpback whales during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with sightings during every season (including 1 in spring and 4 in summer[3]). There are >40 OBIS sighting records of humpback whales for the continental shelf off New Jersey, including sightings near the proposed survey area (IOC 2013). There was one sighting of a humpback whale during the 13-day cruise in 2014.

Common Minke Whale (*Balaenoptera acutorostrata*)

Four populations of the minke whale are recognized in the North Atlantic, including the Canadian East Coast stock that ranges from the eastern U.S. coast to Davis Strait (Waring et al. 2013). Minke whales are common off the U.S. east coast over continental shelf waters, especially off New England during spring and summer (CETAP 1982). Seasonal movements in the Northwest Atlantic are apparent, with animals moving south and offshore from New England waters during the winter (Fig. B-11a *in* DoN 2005; Waring et al. 2013). There are approximately 30 OBIS sightings of minke whales off New Jersey (IOC 2013), most of which were observed in the spring and summer during CETAP surveys (CETAP 1982).

GMI (2010) reported four sightings of minke whales during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009: two during winter and two during spring. Two sightings were also reported during summer NEFSC and SEFSC surveys between 1998 and 2011 on the shelf break off New Jersey (Waring et al. 2013). Minke whales likely would not be encountered during the proposed survey.

Sei Whale (*Balaenoptera borealis*)

Two stocks of the sei whale are recognized in the North Atlantic: the Labrador Sea Stock and the Nova Scotia Stock; the latter has a distribution that includes continental shelf waters from the northeastern U.S. to areas south of Newfoundland (Waring et al. 2013). The southern portion of the Nova Scotia stock's range includes the Gulf of Maine and Georges Bank during spring and summer (Waring et

[3] GMI defined spring as 11 April–21 June and summer as 22 June–27 September.

al. 2013). Peak sightings occur in spring and are concentrated along the eastern edge of Georges Bank into the Northeast Channel and the southwestern edge of Georges Bank (Fig. B-6a *in* DoN 2005; Waring et al. 2013). Mitchell and Chapman (1977) suggested that this stock moves from spring feeding grounds on or near Georges Bank to the Scotian Shelf in June and July, eastward to Newfoundland and the Grand Banks in late summer, back to the Scotian Shelf in fall, and offshore and south in winter. During summer and fall, most sei whale sightings occur in feeding grounds in the Bay of Fundy and on the Scotian Shelf; sightings south of Cape Cod are rare (Fig. B-6a *in* DoN 2005).

There are at least three OBIS sightings of sei whales off New Jersey, and several more sightings to the south of the proposed survey area (IOC 2013). Palka (2012) reported one sighting on the shelf break off New Jersey in water depths ranging from 100–2000 m during June–August 2011 surveys. There were no sightings of sei whales during the CETAP surveys (CETAP 1982).

Fin Whale (*Balaenoptera physalus*)

Fin whales are present in U.S. shelf waters during winter, and are sighted more frequently than any other large whale at this time (DoN 2005). They occur year-round in shelf waters of New England and New Jersey (CETAP 1982; Fig. B-8a *in* DoN 2005). Winter sightings are most concentrated around Georges Bank and in Cape Cod Bay. During spring and summer, most fin whale sightings are north of 40ºN, with smaller numbers on the shelf south of there, including off New Jersey (Fig. B-8a *in* DoN 2005). During fall, almost all fin whales move out of U.S. waters to feeding grounds in the Bay of Fundy and on the Scotian Shelf, remain at Stellwagen Bank and Murray Basin (Fig. B-8a *in* DoN 2005), or begin a southward migration (Clark 1995).

GMI (2010) reported 37 sightings of fin whales during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with sightings during every season (including 11 in spring and 4 in summer). Acoustic detections were also made during all seasons (GMI 2010). Numerous sightings were also made off New Jersey during NEFSC and SEFSC summer surveys between 1995 and 2011, with two sightings on the shelf and other sightings on the shelf break and beyond (Waring et al. 2013). There are 170 OBIS sightings of fin whales off New Jersey (IOC 2013), most of which were made during the CETAP surveys (CETAP 1982).

Blue Whale (*Balaenoptera musculus*)

In the western North Atlantic, the distribution of the blue whale extends as far north as Davis Strait and Baffin Bay (Sears and Perrin 2009). Little is known about the movements and wintering grounds of the stocks (Mizroch et al. 1984). Acoustic detection of blue whales using the U.S. Navy's Sound Surveillance System (SOSUS) program has tracked blue whales throughout most of the North Atlantic, including deep waters east of the U.S. Atlantic EEZ and subtropical waters north of the West Indies (Clark 1995).

Wenzel et al. (1988) reported the occurrence of three blue whales in the Gulf of Maine in 1986 and 1987, which were the only reports of blue whales in shelf waters from Cape Hatteras to Nova Scotia. Several other sightings for the waters off the east coast of the U.S. were reported by DoN (2005). Wenzel et al. (1988) suggested that it is unlikely that blue whales occur regularly in the shelf waters off the U.S. east coast. Similarly, Waring et al. (2010) suggested that the blue whale is, at best, an occasional visitor in the U.S. Atlantic EEZ.

During CETAP surveys, the only two sightings of blue whales were made south of Nova Scotia (CETAP 1982). There are two offshore sightings of blue whales in the OBIS database to the southeast of New Jersey and several sightings to the north off New England and in the Gulf of Maine (IOC 2013). Blue whales likely would not be encountered during the proposed survey.

(2) Odontocetes

Sperm Whale (*Physeter macrocephalus*)

In the northwest Atlantic, the sperm whale generally occurs in deep water along the continental shelf break from Virginia to Georges Bank, and along the northern edge of the Gulf Stream (Waring et al. 2001). Shelf edge, oceanic waters, seamounts, and canyon shelf edges are also predicted habitats of sperm whales in the Northwest Atlantic (Waring et al. 2001). Off the eastern U.S. coast, they are also known to concentrate in regions with well-developed temperature gradients, such as along the edges of the Gulf Stream and warm core rings, which may aggregate their primary prey, squid (Jaquet 1996).

Sperm whales appear to have a well-defined seasonal cycle in the Northwest Atlantic. In winter, most historical records are in waters east and northeast of Cape Hatteras, with few animals north of 40ºN; in spring, they shift the center of their distribution northward to areas east of Delaware and Virginia, but they are widespread throughout the central area of the Mid-Atlantic Bight and southern tip of Georges Bank (Fig. B-10a in DoN 2005; Waring et al. 2013). During summer, they expand their spring distribution to include areas east and north of Georges Bank, the Northeast Channel, and the continental shelf south of New England (inshore of 100 m deep). By fall, sperm whales are most common south of New England on the continental shelf but also along the shelf edge in the Mid-Atlantic Bight (Fig. B-10a in DoN 2005; Waring et al. 2013).

There are several hundred OBIS records of sperm whales in deep waters off New Jersey and New England (IOC 2013), and numerous sightings were reported on and seaward of the shelf break during CETAP surveys (CETAP 1982) and during summer NEFSC and SEFSC surveys between 1998 and 2011 (Waring et al. 2013).

Pygmy and Dwarf Sperm Whales (*Kogia breviceps* and *K. sima*)

In the northwest Atlantic, both pygmy and dwarf sperm whales are thought to occur as far north as the Canadian east coast, with the pygmy sperm whale ranging as far as southern Labrador; both species prefer deep, offshore waters (Jefferson et al. 2008). Between 2006 and 2010, 127 pygmy and 32 dwarf sperm whale strandings were recorded from Maine to Puerto Rico, mostly off the southeastern U.S. coast; five strandings of pygmy sperm whales were reported for New Jersey (Waring et al. 2013).

There are 14 OBIS sightings of pygmy or dwarf sperm whales in offshore waters off New Jersey (IOC 2013). Several sightings of *Kogia* sp. (pygmy or dwarf sperm whales) for shelf-break waters off New Jersey were also reported during summer NEFSC and SEFSC surveys between 1995 and 2011 (Waring et al. 2013).

Cuvier's Beaked Whale (*Ziphius cavirostris*)

In the northwest Atlantic, Cuvier's beaked whale has stranded and been sighted as far north as the Nova Scotian shelf, and occurs most commonly from Massachusetts to Florida (MacLeod et al. 2006). Most sightings in the northwest Atlantic occur in late spring or summer, particularly along the continental shelf edge in the mid-Atlantic region (CETAP 1982; Waring et al. 2001, 2013). Mapping of combined beaked whale sightings in the northwest Atlantic suggests that beaked whales are rare in winter and fall, uncommon in spring, and abundant in summer in waters north of Virginia, off the shelf break and over the continental slope and areas of high relief, including the waters off New Jersey (Fig. B-13a *in* DoN 2005).

DoN mapped several sightings of Cuvier's beaked whales during the summer along the shelf break off New Jersey (Fig. B-13a *in* DoN 2005). One sighting was made off New Jersey during the CETAP surveys (CETAP 1982). Palka (2012) reported one sighting on the shelf break off New Jersey in water depths 100–2000 m during June–August 2011 surveys. There are eight OBIS sighting records of Cuvier's beaked whale in offshore waters off New Jersey (IOC 2013).

Northern Bottlenose Whale (*Hyperoodon ampullatus*)

Northern bottlenose whales are considered extremely uncommon or rare within waters of the U.S. Atlantic EEZ (Reeves et al. 1993; Waring et al. 2010), but there are known sightings off New England and New Jersey (CETAP 1982; McLeod et al. 2006; Waring et al. 2010). Two sightings of three individuals were made during the CETAP surveys; one sighting was made during May to the east of Cape Cod and the second sighting was made on 12 June along the shelf edge east of Cape May, New Jersey (CETAP 1982). Three sightings were made during summer surveys along the southern edge of Georges Bank in 1993 and 1996, and another three sightings were made in water depths 1000–4000 m at ~38–40ºN during NEFSC and SEFSC surveys between 1998 and 2006 (Waring et al. 2010). In addition, there is one OBIS sighting off New England in 2005 made by the Canadian Department of Fisheries and Oceans (IOC 2013). DoN (2005) also reported northern bottlenose whale sightings beyond the shelf break off New Jersey during spring and summer. Northern bottlenose whales likely would not be encountered during the proposed survey.

True's Beaked Whale (*Mesoplodon mirus*)

In the Northwest Atlantic, True's beaked whale occurs from Nova Scotia to Florida and the Bahamas (Rice 1998). Carwardine (1995) suggested that this species could be associated with the Gulf Stream. DoN did not report any sightings of True's beaked whale off New Jersey (Fig. B-13a *in* DoN 2005); however, several sightings of undifferentiated beaked whales were reported for shelf break waters off New Jersey during summer NEFSC and SEFSC surveys between 1995 and 2011 (Waring et al. 2013). There are no OBIS sightings of True's beaked whale off New Jersey, but there is one stranding record off North Carolina and one record off New England (IOC 2013). There are numerous other stranding records for the east coast of the U.S. (Macleod et al. 2006). True's beaked whales likely would not be encountered during the proposed survey.

Gervais' Beaked Whale (*Mesoplodon europaeus*)

Based on stranding records, Gervais' beaked whale appears to be more common in the western Atlantic than in the eastern Atlantic (Macleod et al. 2006; Jefferson et al. 2008). Off the U.S. east coast, it occurs from Cape Cod Bay, Massachusetts (Moore et al. 2004) to Florida, with a few records in the Gulf of Mexico (Mead 1989). DoN mapped two sightings of Gervais' beaked whale during summer to the south of the proposed survey area and numerous other sightings along the shelf break off the northeast coast of the U.S. (Fig. B-13a *in* DoN 2005). Palka (2012) reported three sightings in deep offshore waters during June–August 2011 surveys off the northeastern coast of the U.S. There are four OBIS stranding records of Gervais' beaked whale for Virginia, but no records for New Jersey (IOC 2013). Gervais' beaked whales likely would not be encountered during the proposed survey.

Sowerby's Beaked Whale (*Mesoplodon bidens*)

Sowerby's beaked whale occurs in cold temperate waters of the North Atlantic (Mead 1989). In the western North Atlantic, it is found from at least Massachusetts to the Labrador Sea (Mead et al. 2006; Jefferson et al. 2008). Palka (2012) reported one sighting on the shelf break off New Jersey during June–August 2011 surveys. There are also at least five OBIS sighting records in deep waters off New Jersey (IOC 2013). DoN mapped one stranding in New Jersey in fall and one in Delaware in spring, but no sightings off New Jersey (Fig. B-13a *in* DoN 2005). Sowerby's beaked whales likely would not be encountered during the proposed survey.

Blainville's Beaked Whale (*Mesoplodon densirostris*)

In the western North Atlantic, Blainville's beaked whale is found from Nova Scotia to Florida, the Bahamas, and the Gulf of Mexico (Würsig et al. 2000). There are numerous strandings records along the east coast of the U.S. (Macleod et al. 2006). DoN mapped several sightings of Blainville's beaked whale during summer along the shelf break off the northeastern coast of the U.S. (Fig. B-13a *in* DoN 2005). There is one OBIS sighting record in offshore waters to the southeast of New Jersey and one in offshore waters off New England (IOC 2013). Blainville's beaked whales likely would not be encountered during the proposed survey.

Rough-toothed Dolphin (*Steno bredanensis*)

The rough-toothed dolphin is distributed worldwide in tropical, subtropical, and warm temperate waters (Miyazaki and Perrin 1994). They are generally seen in deep, oceanic water, although they can occur in shallow coastal waters in some locations (Jefferson et al. 2008). The rough-toothed dolphin rarely ranges north of 40°N (Jefferson et al. 2008).

One sighting of 45 individuals was made south of Georges Bank seaward of the shelf edge during the CETAP surveys (CETAP 1982), and another sighting was made in the same areas during 1986 (Waring et al. 2010). In addition, two sightings were made off New Jersey to the southeast of the proposed survey area during 1979 and 1998 (Waring et al. 2010; IOC 2013). Palka (2012) reported a sighting in deep offshore waters off New Jersey during June–August 2011 surveys. Rough-toothed dolphins likely would not be encountered during the proposed survey.

Common Bottlenose Dolphin (*Tursiops truncatus*)

In the northwest Atlantic, the common bottlenose dolphin occurs from Nova Scotia to Florida, the Gulf of Mexico and the Caribbean, and south to Brazil (Würsig et al. 2000). There are regional and seasonal differences in the distribution of the offshore and coastal forms of bottlenose dolphins off the U.S. east coast. Although strandings of bottlenose dolphins are a regular occurrence along the U.S. east coast, since July 2013, an unusually high number of dead or dying bottlenose dolphins (971 as of 8 December 2013; 1175 as of 16 March 2014; 1283 as of 18 May 2014; and 1546 as of 19 October 2014) have washed up on the mid-Atlantic coast from New York to Florida (NOAA 2014b). NOAA declared an unusual mortality event (UME), the tentative cause of which is thought to be cetacean morbillivirus. As of 20 October 2014, 266 of 280 dolphins tested were confirmed positive or suspect positive for morbillivirus. NOAA personnel observed that the affected dolphins occur in nearshore waters, whereas dolphins in offshore waters >50 m deep did not appear to be affected (Environment News Service 2013), but have stated that it is uncertain exactly what populations have been affected (NOAA 2014b). In addition to morbillivirus, the bacteria *Brucella* was confirmed in 30 of 95 dolphins tested as of 20 October 2014 (NOAA 2014b). The NOAA web site is updated frequently, and it is apparent that the strandings initially had been moving south; in the 4 November update, dolphins had been reported washing up only as far south as South Carolina, and in the 8 December update, strandings were also reported in Georgia and Florida. Recently, the numbers of strandings appear to be decreasing, especially in the northern states; between 17 August and 19 October, there were 2, 3, 4, and 0 strandings in NY, NJ, DE, and MD, respectively.

Evidence of year-round or seasonal residents and migratory groups exist for the coastal form of bottlenose dolphins, with the so-called "northern migratory management unit" occurring north of Cape Hatteras to New Jersey, but only during summer and in waters <25 m deep (Waring et al. 2010). The offshore form appears to be most abundant along the shelf break and is differentiated from the coastal form by occurring in waters typically >40 m deep (Waring et al. 2010). Bottlenose dolphin records in the Northwest Atlantic suggest that they generally can occur year-round from the continental shelf to deeper waters over the abyssal plain, from the Scotian Shelf to North Carolina (Fig. B-14a *in* DoN 2005).

GMI (2010) reported 319 sightings of bottlenose dolphins during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with most sightings made during spring and summer. Palka (2012) also reported numerous sightings on the shelf break off New Jersey in water depths ranging from 100–2000 m during June–August 2011 surveys. There are also several hundred OBIS records off New Jersey, including sightings near the proposed survey area on the shelf and along the shelf edge (IOC 2013). There was one sighting of 10 bottlenose dolphins during the 13-day cruise in 2014.

Pantropical Spotted Dolphin (*Stenella attenuata*)

Pantropical spotted dolphins generally occur in deep offshore waters between 40°N and 40°S (Jefferson et al. 2008). There have been a few sightings at the southern edge of Georges Bank (Waring et al. 2010). In addition, there are at least 10 OBIS sighting records for waters off New Jersey that were made during surveys by the Canadian Wildlife Service between 1965 and 1992 (IOC 2013). Pantropical spotted dolphins likely would not be encountered during the proposed survey.

Atlantic Spotted Dolphin (*Stenella frontalis*)

In the western Atlantic, the distribution of the Atlantic spotted dolphin extends from southern New England, south to the Gulf of Mexico, the Caribbean Sea, Venezuela, and Brazil (Leatherwood et al. 1976; Perrin et al. 1994; Rice 1998). During summer, Atlantic spotted dolphins are sighted in shelf waters south of Chesapeake Bay, and near the continental shelf edge, on the slope, and offshore north of there, including the waters of New Jersey (Fig. B-15a *in* DoN 2005; Waring et al. 2014). Several sightings were also reported during summer NEFSC and SEFSC surveys between 1998 and 2011 on the shelf break off New Jersey (Waring et al. 2014). There are two OBIS sighting records northeast of the survey area and at least eight records to the southeast of the survey area (IOC 2013). There was one sighting of 12 Atlantic spotted dolphins during the 13-day cruise in 2014.

Spinner dolphin (*Stenella longirostris*)

The spinner dolphin is pantropical in distribution, with a range nearly identical to that of the pantropical spotted dolphin, including oceanic tropical and sub-tropical waters between 40ºN and 40ºS (Jefferson et al. 2008). The distribution of spinner dolphins in the Atlantic is poorly known, but they are thought to occur in deep waters along most of the U.S. coast; sightings off the northeast U.S. coast have occurred exclusively in offshore waters >2000 m (Waring et al. 2010). Several sightings were mapped by DoN (Fig. B-16 *in* DoN 2005) for offshore waters to the far east of New Jersey. There are also seven OBIS sighting records off the eastern U.S. but no records near the proposed survey area or in shallow water (IOC 2013). Spinner dolphins likely would not be encountered during the proposed survey.

Striped Dolphin (*Stenella coeruleoalba*)

In the western North Atlantic, the striped dolphin occurs from Nova Scotia to the Gulf of Mexico and south to Brazil (Würsig et al. 2000). Off the northeastern U.S. coast, striped dolphins occur along the continental shelf edge and over the continental slope from Cape Hatteras to the southern edge of Georges Bank (Waring et al. 2014). In all seasons, striped dolphin sightings have been centered along the 1000-m depth contour, and sightings have been associated with the north edge of the Gulf Stream and warm core rings (Waring et al. 2014). Their occurrence off the northeastern U.S. coast seems to be highest in the summer and lowest during the fall (Fig. B-17a *in* DoN 2005).

There are approximately 100 OBIS sighting records of striped dolphins for the waters off New Jersey to the east of the proposed survey area, mainly along the shelf break (IOC 2013). Numerous

sightings were also reported during summer NEFSC and SEFSC surveys between 1998 and 2011 off the shelf break (Waring et al. 2014).

Short-beaked Common Dolphin (*Delphinus delphis*)

The short-beaked common dolphin occurs from Cape Hatteras to Georges Bank during mid January–May, moves onto Georges Bank and the Scotian Shelf during mid summer and fall, and has been observed in large aggregations on Georges Bank in fall (Selzer and Payne 1988; Waring et al. 2014). Sightings off New Jersey have been made during all seasons (Fig. B-19a *in* DoN 2055). GMI (2010) reported 32 sightings of short-beaked common dolphins during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with sightings during fall and winter. There are over 100 OBIS sighting records near the proposed survey area off New Jersey, with most sightings near the shelf edge, but there are also several sightings in shelf waters (IOC 2013). There were 4 sightings of a total of 45 short-beaked common dolphins during the 13-day cruise in 2014.

White-beaked Dolphin (*Lagenorhynchus albirostris*)

The white-beaked dolphin is widely distributed in cold temperature and subarctic North Atlantic waters (Reeves et al. 1999a), and mainly occurs over the continental shelf, especially along the shelf edge (Carwardine 1995). It occurs in immediate offshore waters of the east coast of the North America, from Labrador to Massachusetts (Rice 1998). Off the northeastern U.S. coast, white-beaked dolphins are mainly found in the western Gulf of Maine and around Cape Cod (CETAP 1982; Fig. B-20a *in* DoN 2005; Waring et al. 2010). There are two OBIS sighting records to the east of the proposed survey area off New Jersey, and one to the south off North Carolina (IOC 2013). White-beaked dolphins likely would not be encountered during the proposed survey.

Atlantic White-sided Dolphin (*Lagenorhynchus acutus*)

The Atlantic white-sided dolphin occurs in cold temperate to subpolar waters of the North Atlantic in deep continental shelf and slope waters (Jefferson et al. 2008). In the western North Atlantic, it ranges from Labrador and southern Greenland to ~38ºN (Jefferson et al. 2008). There are seasonal shifts in Atlantic white-sided dolphin distribution off the northeastern U.S. coast, with low numbers in winter from Georges Basin to Jeffrey's Ledge and very high numbers in spring in the Gulf of Maine. In summer, Atlantic white-sided dolphins are mainly distributed northward from south of Cape Cod with the highest numbers from Cape Cod north to the lower Bay of Fundy; sightings off New Jersey appear to be sparse (Fig. B-21a *in* DoN 2005). There are over 20 OBIS sighting records in the shelf waters off New Jersey, including near the proposed survey area (IOC 2013).

Risso's Dolphin (*Grampus griseus*)

The highest densities of Risso's dolphin occur in mid latitudes ranging from 30° to 45°, and primarily in outer continental shelf and slope waters (Jefferson et al. 2013). Off the northeast U.S. coast during spring, summer, and autumn, Risso's dolphins are distributed along the continental shelf edge from Cape Hatteras to Georges Bank, but they range into oceanic waters during the winter (Waring et al. 2014). Mapping of Risso's dolphin sightings off the U.S. east coast suggests that they could occur year-round from the Scotian Shelf to the coast of the southeastern U.S. in waters extending from the continental shelf to the continental rise (DoN 2005). Off New Jersey, the greatest number of sightings occurs near the continental slope during summer (Fig. B-22a *in* DoN 2005).

There are at least 170 OBIS records near the proposed survey area off New Jersey, including shelf waters and at the shelf edge (IOC 2013). Numerous sightings were also reported during summer NEFSC

and SEFSC surveys between 1998 and 2011 for the shelf break off New Jersey (Waring et al. 2014). There was one sighting of a Risso's dolphin during the 13-day cruise in 2014.

Pygmy Killer Whale (*Feresa attenuata*)

The pygmy killer whale is pantropical/subtropical, generally occurring between 40ºN and 35ºS (Jefferson et al. 2008). There is no abundance estimate for the pygmy killer whale off the U.S. east coast because it is rarely sighted during surveys (Waring et al. 2010). One group of six pygmy killer whales was sighted off Cape Hatteras in waters >1500 m deep during a NMFS vessel survey in 1992 (Hansen et al. 1994 *in* Waring et al. 2010). There are an additional three OBIS sighting records to the southeast of the proposed survey area (Palka et al. 1991 *in* IOC 2013). Pygmy killer whales likely would not be encountered during the proposed survey.

False Killer Whale (*Pseudorca crassidens*)

The false killer whale is found worldwide in tropical and temperate waters generally between 50ºN and 50ºS (Odell and McClune 1999). It is widely distributed, but not abundant anywhere (Carwardine 1995). In the western Atlantic, it occurs from Maryland to Argentina (Rice 1998). Very few false killer whales were sighted off the U.S. northeast coast in the numerous surveys mapped by DoN (2005). There are 13 OBIS sighting records for the waters off the eastern U.S., but none are near the proposed survey area (IOC 2013). False killer whales likely would not be encountered during the proposed survey.

Killer Whale (*Orcinus orca*)

In the western North Atlantic, killer whales occur from the polar ice pack to Florida and the Gulf of Mexico (Würsig et al. 2000). Based on historical sightings and whaling records, killer whales apparently were most often found along the shelf break and offshore in the northwest Atlantic (Katona et al. 1988). They are considered uncommon or rare in waters of the U.S. Atlantic EEZ (Katona et al. 1988). Killer whales represented <0.1 % of all cetacean sightings (12 of 11,156 sightings) in CETAP surveys during 1978–1981 (CETAP 1982). Four of the 12 sightings made during the CETAP surveys were made offshore from New Jersey. Off New England, killer whales are more common in summer than in any other season, occurring nearshore and off the shelf break (Fig. B-24 *in* DoN 2005). There are 39 OBIS sighting records for the waters off the eastern U.S., but none off New Jersey (IOC 2013). Killer whales likely would not be encountered during the proposed survey.

Long- and Short-finned Pilot Whales (*Globicephala melas* and *G. macrorhynchus*)

There are two species of pilot whale, both of which could occur in the survey area. The long-finned pilot whale (*G. melas*) is distributed antitropically, whereas the short-finned pilot whale (*G. macrorhynchus*) is found in tropical, subtropical, and warm temperate waters (Olson 2009). In the northwest Atlantic, pilot whales often occupy areas of high relief or submerged banks and associated with the Gulf Stream edge or thermal fronts along the continental shelf edge (Waring et al. 1992). The ranges of the two species overlap in the shelf/shelf-edge and slope waters of the northeastern U.S. between New Jersey and Cape Hatteras, with long-finned pilot whales occurring to the north (Bernard and Reilly 1999). During winter and early spring, long-finned pilot whales are distributed along the continental shelf edge off the northeast U.S. coast and in Cape Cod Bay, and in summer and fall they also occur on Georges Bank, in the Gulf of Maine, and north into Canadian waters (Fig. B-25a *in* DoN 2005).

There are at least 200 OBIS sighting records for pilot whales for the waters off New Jersey, including sightings over the shelf; these sightings include *Globicephala* sp. and *G. melas* (IOC 2013). Numerous sightings were also reported during summer NEFSC and SEFSC surveys between 1998 and 2007 for the shelf break off New Jersey (Waring et al. 2014).

Harbor Porpoise (*Phocoena phocoena*)

The harbor porpoise inhabits cool temperate to subarctic waters of the Northern Hemisphere (Jefferson et al. 2008). There are likely four populations in the western North Atlantic: Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, Newfoundland, and Greenland (Gaskin 1984, 1992). Individuals found off the eastern U.S. coast likely would be almost exclusively from the Gulf of Maine/Bay of Fundy stock.

Harbor porpoises concentrate in the northern Gulf of Maine and southern Bay of Fundy during July–September, with a few sightings ranging as far south as Georges Bank and one off Virginia (Waring et al. 2014). In summer, sightings mapped from numerous sources extended only as far south as off northern Long Island, New York (Fig. B-26a *in* DoN 2005). During October–December and April–June, harbor porpoises are dispersed and range from New Jersey to Maine, although there are lower densities at the northern and southern extremes (DoN 2005; Waring et al. 2014). Most would be found over the continental shelf, but some are also encountered over deep waters (Westgate et al. 1998). During January–March, harbor porpoises concentrate farther south, from New Jersey to North Carolina, with lower densities occurring from New York to New Brunswick (DoN 2005; Waring et al. 2014).

GMI (2010) reported 51 sightings of harbor porpoise during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with sightings during fall and winter. There are 10 OBIS sighting records for the waters off New Jersey during March–June, most of which are from the CETAP surveys (CETAP 1982; IOC 2013). Harbor porpoises likely would not be encountered during the proposed survey.

Sea Turtles

Two species of sea turtle, the leatherback and loggerhead turtles, are common off the U.S. east coast. Kemp’s ridley and green turtles also occur in this area at much lower densities. A fifth species, the hawksbill turtle, is considered very rare in the northwest Atlantic Ocean. In fact, only one species was observed and identified during the 13-day cruise in 2014, the loggerhead turtle. Thirteen additional shelled sea turtles were also sighted, but were not identified. General information on the taxonomy, ecology, distribution and movements, and acoustic capabilities of sea turtles are given in § 3.4.1 of the PEIS. The general distribution of sea turtles in the northwest Atlantic is also discussed in § 3.4.2.1 of the PEIS and § 4.2.3.1 of the BOEM Final PEIS (BOEM 2014). The rest of this section deals specifically with their distribution off the northeastern coast of the U.S., particularly off New Jersey.

(1) Leatherback Turtle (*Dermochelys coriacea*)

Leatherback turtles commonly occur along the eastern U.S. coast and as far north as New England (Eckert 1995a), although important nesting areas occur only as far north as Florida (NMFS and USFWS 2013a). Leatherback occurrence in New England waters has been documented for many years, with most historic records during March–August focused around the Gulf of Maine and Georges and Browns Banks; in fall, they were focused more southerly in New England bays and sounds (Lazell 1980). Leatherbacks tagged off Cape Breton and mainland Nova Scotia during summer remained off eastern Canada and the northeastern U.S. coast before most began migrating south in October (James et al. 2005); foraging adults off Nova Scotia mainly originate from Trinidad (NMFS and USFWS 2013a). Some of these tags remained attached long enough to observe northward migrations, with animals leaving nesting grounds during February–March and typically arriving north of 38ºN during June, usually in areas within several hundred km of where they were observed in the previous year. Virtually all of the leatherbacks in sighting records off the northeastern U.S. occurred in summer off southern New Jersey, the southeastern tip of Long Island, and southern Nova Scotia (Fig. C-2a *in* DoN 2005).

GMI (2010) reported 12 sightings of leatherback sea turtles on the continental shelf off New Jersey during surveys conducted in January 2008–December 2009, with all sightings occurring during summer. There are over 200 OBIS sighting records for the waters off New Jersey (IOC 2013). Palka (2012) also reported several sightings off northern New Jersey south of Long Island during June–August 2011 surveys.

(2) Green Turtle (*Chelonia mydas*)

Important feeding areas for green turtles in U.S. waters are primarily located in Florida and southern Texas, but Long Island Sound and inshore waters of North Carolina appear to be important to juveniles during summer months (NMFS and USFWS 2007). Small numbers of juvenile green turtles have occurred historically in Long Island and Nantucket Sounds in New England (Lazell 1980). There are few sighting records, but DoN (Fig. C-5 *in* DoN 2005) suggested that small numbers can be found from spring to fall as far north as Cape Cod Bay, including off New Jersey. There are seven OBIS sightings of green turtles off the coast of New Jersey (IOC 2013). Palka (2012) also reported several sightings off northern New Jersey south of Long Island during June–August 2011 surveys.

(3) Loggerhead Turtle (*Caretta caretta*)

Major nesting areas for loggerheads in the western North Atlantic are located in the southeastern U.S., principally southern Florida, but also as far north as the Carolinas and occasionally Virginia; the nesting season is from May to August (Spotila 2004). Most females tagged on North Carolina nesting beaches traveled north to forage at higher latitudes (primarily off New Jersey, Maryland, and Delaware) during summer, and south to wintering grounds off the southeastern U.S. in the fall (Hawkes et al. 2007).

Some juveniles make seasonal foraging migrations into temperate latitudes as far north as Long Island, New York (Shoop and Kenney 1992 *in* Musick and Limpus 1997). Lazell (1980) reported that loggerheads were historically common in New England waters and the Gulf of Maine. Sighting records of loggerheads off the northeastern U.S. were in all seasons in continental shelf and slope waters from Cape Cod to southern Florida, with greatest concentrations in mid-continental shelf waters off New Jersey during the summer (Fig. C-3a *in* DoN 2005). There are increased stranding records of loggerheads from Cape Cod Bay and Long Island Sound in the fall (DoN 2005); loggerheads may be unable to exit these inshore habitats, which can result in hypothermia as temperatures drop in late fall (Burke et al. 1991 *in* DoN 2005).

GMI (2010) reported 69 sightings of loggerhead turtles on the continental shelf off New Jersey during surveys conducted in January 2008–December 2009; sightings occurred from spring through fall, with most sightings during summer. There are over 1000 OBIS sighting records off the coast of New Jersey, including within the proposed project area (IOC 2013). Palka (2012) also reported several sightings off northern New Jersey south of Long Island during June–August 2011 surveys. There were 16 sightings of a single loggerhead turtle during the 13-day cruise in 2014.

(4) Hawksbill Turtle (*Eretmochelys imbricata*)

The hawksbill is the most tropical of all sea turtles, generally occurring between ~30ºN and ~30ºS (Eckert 1995b). In the Atlantic Ocean, most nesting beaches are in the Caribbean Sea as far north as Cuba and the Bahamas (NMFS and USFWS 2013b). It is considered very rare and possibly extralimital in the northwest Atlantic (Lazell 1980; Eckert 1995b). Nonetheless, DoN (Fig. C-6 *in* DoN 2005) mapped two hawksbill turtle sightings off New Jersey (one during spring and one during fall) and several south of New Jersey. In addition, there is one OBIS sighting record offshore New Jersey, east of the proposed survey area (SEFSC 1992 *in* IOC 2013).

(5) Kemp's Ridley Turtle (*Lepidochelys kempii*)

Kemp's ridley turtle has a more restricted distribution than other sea turtles, with adults primarily located in the Gulf of Mexico; some juveniles also feed along the U.S. east coast, including Chesapeake Bay, Delaware Bay, Long Island Sound, and waters off Cape Cod (Spotila 2004). Nesting occurs primarily along the central and southern Gulf of Mexico coast during May–late July (Morreale et al. 2007). There have also been some rare records of females nesting on Atlantic beaches of Florida, North Carolina, and South Carolina (Plotkin 2003). After nesting, female Kemp's ridley turtles travel to foraging areas along the coast of the Gulf of Mexico, typically in waters <50 m deep from Mexico's Yucatan Peninsula to southern Florida; males tend to stay near nesting beaches in the central Gulf of Mexico year-round (Morreale et al. 2007). Only juvenile and immature Kemp's ridley turtles appear to move beyond the Gulf of Mexico into more northerly waters along the U.S. east coast.

Hatchlings are carried by the prevalent currents off the nesting beaches and do not reappear in the neritic zone until they are about two years old (Musick and Limpus 1997). Those juvenile and immature Kemp's ridley turtles that migrate northward past Cape Hatteras probably do so in April and return southward in November (Musick et al. 1994). North of Cape Hatteras, juvenile and immature Kemp's ridleys prefer shallow-water areas, particularly along North Carolina and in Chesapeake Bay, Long Island Sound, and Cape Cod Bay (Musick et al. 1994; Morreale et al. 1989; Danton and Prescott 1988; Frazier et al. 2007). There are historical summer sightings and strandings of Kemp's ridley turtles from Massachusetts into the Gulf of Maine (Lazell 1980). Occasionally, individuals can be carried by the Gulf Stream as far as northern Europe, although those individuals are considered lost to the breeding population. Virtually all sighting records of Kemp's ridley turtles off the northeastern U.S. were in summer off the coast of New Jersey (Fig. C-4a *in* DoN 2005). There are 60 OBIS sighting records off the coast of New Jersey, some within the proposed survey area (SEFSC 1992 *in* IOC 2013).

Seabirds

Two ESA-listed seabird species could occur in or near the Project area: the ***Threatened*** piping plover and the ***Endangered*** roseate tern. Neither species was observed during the 13-day cruise in 2014. General information on the taxonomy, ecology, distribution and movements, and acoustic capabilities of seabird families are given in § 3.5.1 of the PEIS.

(1) Piping Plover (*Charadrius melodus*)

The Atlantic Coast Population of the piping plover is listed as ***Threatened*** under the U.S. ESA, and the species is listed as ***Near Threatened*** on the IUCN Red List of Threatened Species (IUCN 2013). It breeds on coastal beaches from Newfoundland to North Carolina during March–August and it winters along the Atlantic Coast from North Carolina south, along the Gulf Coast, and in the Caribbean (USFWS 1996). Its marine nesting habitat consists of sandy beaches, sandflats, and barrier islands (Birdlife International 2013). Feeding areas include intertidal portions of ocean beaches, mudflats, sandflats, and shorelines of coastal ponds, lagoons, or salt marshes (USFWS 1996). Wintering plovers are generally found on barrier islands, along sandy peninsulas, and near coastal inlets (USFWS 1996).

Because it is strictly coastal, the piping plover likely would not be encountered at the proposed survey site.

(2) Roseate Tern (*Sterna dougallii*)

The Northeast Population of the roseate tern is listed as ***Endangered*** under the U.S. ESA, and the species is listed as ***Near Threatened*** on the IUCN Red List of Threatened Species (IUCN 2013). It breeds on islands along the northeast coast of the U.S from New York to Maine and north into Canada,

and historically as far south as Virginia (USFWS 1998, 2010). It is thought to migrate beginning in mid September through the eastern Caribbean and along the north coast of South America, and to winter mainly on the east coast of Brazil (USFWS 2010). During the breeding season, roseate terns forage over shallow coastal waters, especially in water depths <5 m, sometimes near the colony and at other times at distances of over 30 km. They usually forage over shallow bays, tidal inlets and channels, tide rips, and sandbars (USFWS 2010).

Because of its distribution during the breeding season, the roseate tern likely would not be encountered at the proposed survey site.

Fish, Essential Fish Habitat, and Habitat Areas of Particular Concern

(1) ESA-Listed Fish and Invertebrate Species

There are two fish species listed under the ESA as ***Endangered*** that could occur in the study area: the New York Bight distinct population segment (DPS) of the Atlantic sturgeon, and the shortnose sturgeon. There are two species that are candidates for ESA listing: the cusk and the Northwest Atlantic and Gulf of Mexico DPS of the dusky shark. There are no listed or candidate invertebrate species.

Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*)

Five DPSs of the Atlantic sturgeon are listed under the U.S. ESA, one as ***Threatened*** and four as ***Endangered***, including the New York Bight DPS, and the species is listed as ***Near Threatened*** on the IUCN Red List of Threatened Species (IUCN 2014). It is a long-lived, late maturing (11–21 years in the Hudson River), anadromous fish. Spawning adults migrate upriver in spring, beginning in April–May in the mid Atlantic. The New York Bight DPS primarily uses the Delaware and Hudson rivers for spawning. Following spawning, males can remain in the river or lower estuary until fall, and females usually exit the rivers within 4–6 weeks. Juveniles move downstream and inhabit brackish waters for a few months before moving into nearshore coastal waters (NOAA 2012b).

Shortnose Sturgeon (*Acipenser brevirostrum*)

The shortnose sturgeon is listed as ***Endangered*** throughout its range under the U.S. ESA and ***Vulnerable*** on the IUCN Red List of Threatened Species (IUCN 2014). It is an anadromous species that spawns in coastal rivers along the east coast of North America from Canada to Florida. The shortnose sturgeon prefers the nearshore marine, estuarine, and riverine habitats of large river systems, and apparently does not make long-distance offshore migrations (NOAA 2013c).

Cusk (*Brosme brosme*)

The cusk is an ESA ***Candidate Species*** throughout its range, and has not been assessed for the IUCN Red List. In the Northwest Atlantic, it occurs from New Jersey north to the Strait of Belle Isle and the Grand Banks of Newfoundland and rarely to southern Greenland. It is a solitary, benthic species found in rocky, hard bottom areas to a depth of 100 m. In U.S waters, it occurs primarily in deep water of the central Gulf of Maine (NOAA 2013d).

Dusky Shark (*Carcharhinus obscurus*)

The Northwest Atlantic and Gulf of Mexico DPS of the dusky shark is an ESA ***Candidate Species***, and the species is listed as ***Vulnerable*** on the IUCN Red List of Threatened Species (IUCN 2014). It is a coastal-pelagic species that inhabits warm temperate and tropical waters throughout the world. In the Northwest Atlantic, it is found from southern Massachusetts and Georges Bank to Florida and the northern Gulf of Mexico. The dusky shark occurs in both inshore and offshore waters, although it avoids

areas of low salinity from the surface to depths of 575 m. Along U.S. coasts, it undertakes long temperature-related migrations, moving north in summer and south in fall (NMFS 2013b).

(2) Essential Fish Habitat (EFH)

EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity". "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish. "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities (NMFS 2013c). The entire eastern sea-board from the coast to the limits of the EEZ is EFH for one or more species or life stage for which EFH has been designated.

Two fishery management councils, created by the 1976 Magnuson Fisheries Conservation and Management Act (renamed Magnuson Stevens Fisheries Conservation and Management Act in 1996) are responsible for the management of fishery resources, including designation of EFH, in federal waters of the survey area: the Mid-Atlantic Fishery Management Council (MAFMC) and the New England Fishery Management Council (NEFMC). The Highly Migratory Division of the National Marine Fisheries Service in Silver Spring, MD, manages highly migratory species (sharks, swordfish, billfish, and tunas).

The life stages and associated habitats for those species with EFH in the survey area are described in Table 4.

Two EFH areas located ~150 km northeast of the proposed survey area, the Lydonia and Oceanographer canyons, were previously protected from fishing. Bottom trawling was prohibited in these areas because of the presence of *Loligo* squid eggs, under the Fisheries Management Plan for Atlantic mackerel, butterfish, and *Illex* and *Loligo* squid. This protection was valid as of 31 July 2008 for up to three years, after which it was to be subject to review for the possibility of extension (NOAA 2008).

(3) Habitat Areas of Particular Concern

Habitat Areas of Particular Concern (HAPC) are subsets of EFH that provide important ecological functions and/or are especially vulnerable to degradation, and are designated by Fishery Management Councils. All four life stages of summer flounder have EFH within the proposed survey area, whereas HAPC have only been designated for the juvenile and adult EFH: demersal waters over the continental shelf, from the coast to the limits of the EEZ, from the Gulf of Maine to Cape Hatteras, North Carolina (NOAA 2012c). Specifically, the HAPC include "all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile EFH. If native species of submerged aquatic vegetation are eliminated then exotic species should be protected because of functional value, however, all efforts should be made to restore native species" (NOAA 2012c). No other HAPC have been designated for those species with EFH within the proposed survey area.

Fisheries

Commercial and recreational fisheries data are collected by NMFS, including species, gear type and landings mass and value, all of which are reported by state of landing (NOAA 2013e). Fisheries data from 2008 to 2013 were used in the analysis of New Jersey's commercial and recreational fisheries near the proposed study area.

(1) Commercial Fisheries

The average annual catch weights and values, fishing season, and gear types for major commercial species are summarized in Table 5. In the waters off New Jersey, commercial fishery catches are dominated by menhaden, various shellfish, and squid. Menhaden accounted for 33% of the catch weight, followed by

Table 4. Marine species with Essential Fish Habitat (EFH) overlapping the proposed survey area.

	Life stage[1] and habitat[2]				
Species	E	L/N	J	A	SA
Atlantic cod *Gadus morhua*				B	B
Atlantic haddock *Melanogrammus aeglefinus*		P	B		
Pollock *Pollachius virens*				B	
Black sea bass *Centropristis striata*	P	P	D	D	D
Bluefish *Pomatomus saltatrix*	P	P	P	P	P
Butterfish *Peprilus triacanthus*	P	P	P	P	P
Atlantic herring *Clupea harengus*			P	P	B
Atlantic mackerel *Scomber scombrus*	P	P	P	P	P
Red hake *Urophycis chuss*	P	P	B		
Silver hake *Merluccius bilinearis*	P	P	B		
Scup *Stenotomus chrysops*			D	D	
Monkfish *Lophius americanus*	P	P	B	B	B
Ocean pout *Macrozoarces americanus*	B	B	B	B	B
Summer flounder *Paralichthys dentatus*	P	P	B	B	B
Windowpane flounder *Scophthalmus acquosus*	P	P		B	B
Winter flounder *Pleuronectes americanus*	B	D/P	B	B	B
Witch flounder *Glyptocephalus cynoglossus*	P	P			B
Yellowtail flounder *Limanda ferruginea*	P				
Albacore tuna *Thunnus alalunga*			P		
Bigeye tuna *Thunnus obesus*				P	
Bluefin tuna *Thunnus thynnus*			P		
Skipjack tuna *Katsuwonus pelamis*				P	
Yellowfin tuna *Thunnus albacres*			P		
Swordfish *Xiphias gladius*			P		
Little skate *Leucoraja erinacea*			B	B	
Winter skate *Leucoraja ocellata*			B		
Basking shark *Cetorhinus maximus*			P	P	
Blue shark *Prionace glauca*		P	P	P	
Dusky shark *Carcharhinus obscurus*		P	P	P	
Common thresher shark *Alopias vulpinus*		P	P	P	
Porbeagle shark *Lamna nasus*				P	
Sandbar shark *Carcharhinus plumbeus*		B	B	B	
Scalloped hammerhead shark *Sphyrna lewini*			P	P	
Shortfin mako shark *Isurus oxyrinchus*		P	P	P	
Smooth (spiny) dogfish *Squalus acanthias*		P	P	P	
Sand tiger shark *Carcharias taurus*		P	P		
Tiger shark *Galeocerdo cuvier*			P	P	
White shark *Carcharodon carcharias*		P	P	P	
Atlantic sea scallop *Placopecten magellanicus*	B	P	B	B	B
Atlantic surfclam *Spisula solidissima*	P	P	B	B	B
Ocean quahog *Arctica islandica*	P	P	B	B	B
Northern shortfin squid *Illex illecebrosus*	P	P	D/P	D/P	D/P
Longfin inshore squid *Loligo pealeii*	B	P	D/P	D/P	D/P

Source: NOAA 2012c

[1] E = eggs; L/N = larvae for bony fish and invertebrates, neonate for sharks; J = juvenile; A = adult; SA = spawning adult

[2] P = pelagic; D = demersal; B = benthic

Table 5. Commercial fishery catches for major marine species for New Jersey waters by weight, value, season, and gear type, averaged from 2008 to 2013.

Species	Average annual landings (mt)	% total	Average annual landings (1000$)	% total	Fishing season (peak season)	Gear Type: Fixed	Gear Type: Mobile
Menhaden	24,056	34	5,328	3	Year-round (May–Oct)	Gill nets, pots, traps, pound nets	Dip nets, trawls, dredge, purse seines, tongs, grabs
Atlantic surf clam	12,324	18	16,745	10	Year-round	N/A	Dredge, tongs, grabs
Ocean quahog	6,697	10	9,245	6	Year-round (spring–fall)	N/A	Dredge
Sea scallop	5,524	8	101,497	63	Year-round (Mar–Oct)	Gill nets, long lines, pots, traps, pound nets	Dredge, trawls
Northern shortfin squid	4,593	7	3,424	2	Year-round (Jun–Oct)	N/A	Dredge, trawls
Shellfish	3,607	5	1,464	1	Year-round (May–Oct)	Gill nets, long lines, pots, traps, pound nets, weirs	Trawls, cast nets, dip nets, diving, dredge, fyke net, hand lines, Scottish seine
Blue crab	2,768	4	7,718	5	Year-round (May–Oct)	Lines trot with bait, pots, traps	Dredge, hand lines, trawls
Atlantic herring	2,284	3	574	<1	Year-round (Jan–Feb)	Gill nets, pound nets	Trawls, fyke net
Atlantic mackerel	2,007	3	769	<1	Fall–spring (Jan–Apr)	Gill nets, pound nets	Dredge, trawls
Longfin squid	1,533	2	3,278	2	Year-round (Jan–Mar; Jul–Nov)	Gill nets, pound nets	Dredge, trawls
Monkfish (Goosefish)	1,144	2	3,199	2	Year-round (Oct–Mar; May–Jun)	Gill nets, long lines, pots, traps, pound nets	Dredge, trawls
Skate	1,036	1	667	<1	Year-round (Nov–Jan; May–Jun)	Gill nets, pots, traps, pound nets	Dredge, trawls
Summer flounder	953	1	4,527	3	Year-round	Gill nets, pots, traps, pound nets	Dredge, hand lines, trawls, rod and reel
Scup	669	1	831	1	Year-round (Jan–Apr)	Gill nets, pots, traps, pound nets	Dredge, trawls, hand lines
Spiny dogfish shark	554	1	247	<1	Fall–spring (Nov–Jan; May)	Gill nets, long lines, pots, traps, pound nets	Dredge, trawls, hand lines
Bluefish	422	1	452	<1	Year-round (Apr–Nov)	Gill nets, pots, traps, pound nets	Dredge, hand lines, trawls
Total	70,172	100	159,964	100			

Source: NOAA 2013g

Atlantic surf clam (17%), ocean quahog (9%), sea scallop (7%), northern shortfin squid (6%), shellfish (5%), and blue crab (4%). Numerous other fish and invertebrate species accounted for the remaining proportion of catch weight. In 2010 (the only such dataset available in NOAA 2013g), most finfish by weight (68.8%) were caught within 5.6 km from shore; that catch was almost all (98.1%) accounted for by menhaden. Fish dominating the offshore (5.6–370 km from shore) finfish catch by weight were American mackerel (20.1% of total finfish weight), American herring (17.7%), skates (12.8%), and summer flounder (8.8%). Most finfish by value (73.3%) were caught between 5.6 and 370 km from shore; dominant fish by value were summer flounder (25.7% of total finfish value), goosefish/anglerfish (15.2%), yellowfin tuna (6.8%), and bigeye tuna (6.4%). Most shellfish and squid were captured between 5.6 and 370 km from shore, both by weight (73.6% of total shellfish and squid catch) and value (89.1%).

During 2002–2006 (the last year reported), commercial catch in the EEZ along the U.S east coast has only been landed by U.S. and Canadian vessels, with the vast majority of the catch (>99%) taken by U.S. vessels (Sea Around Us Project 2011). Typical commercial fishing vessels in the New Jersey area include trawlers, gill netters, lobster/crab boats, dredgers, longliners, and purse seiners.

(2) Recreational Fisheries

In 2013, marine recreational fishers caught over 5 million fish for harvest or bait, and >17.8 million fish in catch and release programs in New Jersey waters. These catches were taken by over 900,000 recreational fishers during more than 4 million trips. The majority of the trips (87%) occurred within 5.6 km from shore. The periods with the most boat-based trips (including charter, party, and private/rental boats) were July–August (1.03 million trips or 44% of total), followed by 1.03 million trips or 44%), and September–October (445,923 or 19%). Most shore-based trips (from beaches, marshes, docks, and/or piers; DoN 2005) occurred in July–August (600,400 or 32%), then September–October (442,464 or 23%), and May–June (370,832 or 20%).

In 2004, there were eight recreational fishing tournaments around New Jersey between May and November, all of which were within 150 km (~80 nm) from shore (DoN 2005). Of the 'hotspots' (popular fishing sites commonly visited by recreational anglers) mapped by DoN (2005), most are to the north or south of the proposed survey area; however, there are several hotspots located within or very near the northwestern corner of the survey area. As of April 2014, 11 tournaments were scheduled in 2014 for central New Jersey ports of call (Table 6). No detailed information about locations is given in the sources cited. As of 10 October 2014, lists of 2015 tournaments were not available (D. Kaldunski, AmericanFishingContests.com, pers. comm.). As of 13 November 2014, one tournament is scheduled for 15–21 August 2015 out of Cape May, New Jersey (InTheBite 2014).

In 2013, at least 75 species of fish were targeted by recreational fishers off New Jersey. Species with 2013 recreational catch numbers exceeding one million include summer flounder (33% of total catch), black sea bass (12%), Atlantic croaker (7%), bluefish (7%), striped searobin (7%), striped bass (6%), and spot (5%). Other notable species or species groups representing at least 1% each of the total catch included unidentified sea robin, tautog, smooth dogfish, Atlantic menhaden, little skate, spiny dogfish, clearnose skate, tilefish, scup, cunner, red hake, unidentified skate, northern searobin, and weakfish. Most of these species/species groups were predominantly caught within 5.6 km from shore (on average 90% of total catch); summer flounder, skates/rays, and cunner were caught roughly equally within and beyond 5.6 km from shore, and red hake were mainly taken beyond 5.6 km from shore (80%).

Recreational SCUBA Diving

Wreck diving is a popular form of recreation in the waters off New Jersey. A search for shipwrecks in New Jersey waters was made using NOAA's automated wreck and obstruction information system (NOAA 2014a). Results of the search are plotted in Figure 2 together with the survey lines. There are over 900 shipwrecks/obstructions in New Jersey waters, most (58%) of which are listed by NOAA (2014b) as unidentified. Only one shipwreck, a known dive site, is in or near the survey area (Fig. 2): the *Lillian* (Galiano 2009; Fisherman's Headquarters 2014; NOAA 2014a).

Table 6. Fishing tournaments off New Jersey, June–mid August 2014.

Dates	Tournament name	Port/ waters	Marine species/groups targeted	Source
1 Feb–14 Dec	Kayak Wars	Statewide/ all legal	Barred sand/calico/spotted bay/white sea bass; bonefish; bonito; cabezon; California barracuda; coho/king/pink salmon; corvina; dorado (mahi mahi); greenling; halibut; leopard/mako/ sevengill/thresher shark; lingcod; opaleye; rock sole; rockfish; saltwater perch; sanddab; sculpin; sheepshead; spiny dogfish; starry flounder; sturgeon; cutthroat trout; whitefish; yellowtail	1
1 Apr–30 Nov	Jersey Shore Beach N Boat Fishing Tournament	Beach Haven/out to 37 km	Black drum; bluefish; fluke; northern kingfish; sea/striped bass; tog; weakfish	1
1 May–30 Nov	Manasquan River MTC Monthly and Mako Tournament	Brielle/N/A	White/blue marlin; pelagic sharks; bigeye/albacore/yellowfin tuna	2
Spring–Fall	Annual Striper Derby – Spring Lake Live Liners Fishing Club	Spring Lake/ any NJ waters	Striped bass	1
6 Jun–27 Jul	Manasquan River Marlin & Tuna Club Bluefin Tournament	Manasquan/ Atlantic Ocean	Bluefin tuna	1
27 Jun–6 Jul	Manasquan River Marlin & Tuna Club Jack Meyer Trolling Tournament	Manasquan/ Atlantic Ocean	Unlisted	1
3–7 Jul	Manasquan River MTC Jack Meyer Memorial Tournament	Brielle/ N/A	White/blue marlin; bigeye/ albacore/yellowfin tuna	2
4 Jul	World Cup Blue Marlin Championship	Statewide/ offshore	Blue marlin	1
12–13 Jul	Manasquan River Marlin & Tuna Club Ladies & Juniors	Manasquan/ Atlantic Ocean	Mako shark	1
23–26 Jul	Beach Haven Marlin & Tuna Club White Marlin Invitational	Beach Haven/ offshore	White marlin	1, 3
31 Jul–3 Aug	Manasquan River Marlin & Tuna Club Fluke Tournament	Manasquan/ Atlantic Ocean	Mako shark	1

Sources: 1: American Fishing Contests (2014); 2: NOAA (2014c); 3: InTheBite (2014)

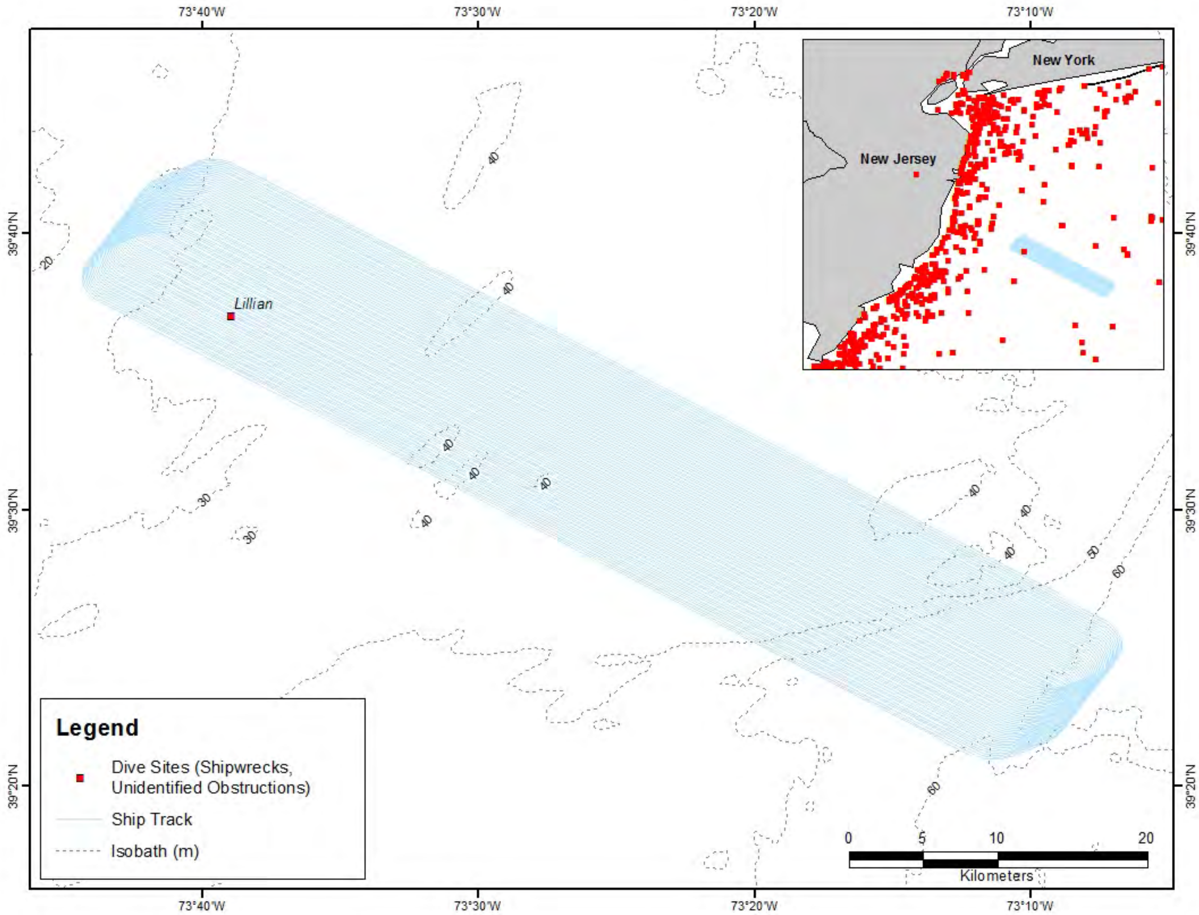

Figure 2. Potential dive sites (shipwrecks or unidentified obstructions) in New Jersey waters. Source: NOAA (2014b).

IV. Environmental Consequences

Proposed Action

The PEIS presented analyses of potential impacts from acoustic sources in general terms and for specific analysis areas. The proposed survey and effects analysis differ from those in the NW Atlantic DAA presented in the PEIS in that different sources were used, the survey areas covered a different range of depths, and different modeling methods were used. The following section includes site-specific details of the proposed survey, summary effects information from the PEIS, and updates to the effects information from recent literature. Analysis conducted for the proposed 2015 survey remains the same as described in the 2014 NSF Final EA for the 2014 survey, except for the smaller size of the airgun array. Seismic effects literature is updated in this Draft Amended EA, and additional effects literature given in the 2014 NMFS EA (Appendix E of the 1 July 2014 Final EA) is incorporated into this Draft Amended EA by reference as if fully set forth herein. In the conclusions of this section, we also refer to conclusions of the Final EA, FONSI, IHA, and Biological Opinion issued by NMFS for the New Jersey survey in 2014, and to observations made during the brief survey conducted in 2014. The effects are fully consistent with those set forth in the 2014 NSF Final EA and FONSI, and 2014 NMFS Final EA, FONSI,

IHA, and Biological Opinion, and EFH concurrence letter, and which are incorporated herein by reference.

(1) Direct Effects on Marine Mammals and Sea Turtles and Their Significance

The material in this section includes a brief summary of the anticipated potential effects (or lack thereof) of airgun sounds on marine mammals and sea turtles, and reference to recent literature that has become available since the PEIS was released in 2011. A more comprehensive review of the relevant background information, as well as information on the hearing abilities of marine mammals and sea turtles, appears in § 3.4.4.3, § 3.6.4.3, § 3.7.4.3, and Appendix E of the PEIS.

Estimates of the numbers of marine mammals that could be affected by the proposed seismic survey scheduled to occur during June–August 2015 are provided in (e) below, along with a description of the rationale for NSF's estimates of the numbers of individuals exposed to received sound levels ≥160 dB re 1 μPa_{rms}. Although the PEIS included modeling for the NW Atlantic DAA, it was done for a different energy source level and survey parameters (e.g., survey water depths and source tow depth), and modeling methods were different from those used by L-DEO (see PEIS, Appendix B, for further modeling details regarding the NW Atlantic DAA). Acoustic modeling for the proposed action was conducted by L-DEO, consistent with past EAs and determined to be acceptable by NMFS to use in the calculation of estimated takes under the MMPA (e.g., NMFS 2013d,e), including for the 2014 survey.

(a) Summary of Potential Effects of Airgun Sounds

As noted in the PEIS (§ 3.4.4.3, § 3.6.4.3, and § 3.7.4.3), the effects of sounds from airguns could include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, and at least in theory, temporary or permanent hearing impairment, or non-auditory physical or physiological effects (Richardson et al. 1995; Gordon et al. 2004; Nowacek et al. 2007; Southall et al. 2007). Permanent hearing impairment (PTS), in the unlikely event that it occurred, would constitute injury, but temporary threshold shift (TTS) is not considered an injury (Southall et al. 2007; Le Prell 2012). Rather, the onset of TTS has been considered an indicator that, if the animal is exposed to higher levels of that sound, physical damage is ultimately a possibility. Recent research has shown that sound exposure can cause cochlear neural degeneration, even when threshold shifts and hair cell damage are reversible (Liberman 2013). These findings have raised some doubts as to whether TTS should continue to be considered a non-injurious effect. Although the possibility cannot be entirely excluded, it is unlikely that the project would result in any cases of temporary or permanent hearing impairment, or any significant non-auditory physical or physiological effects. If marine mammals encounter the survey while it is underway, some behavioral disturbance could result, but this would be localized and short-term.

***Tolerance*.—**Numerous studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers (e.g., Nieukirk et al. 2012). Several studies have shown that marine mammals at distances more than a few kilometers from operating seismic vessels often show no apparent response. That is often true even in cases when the pulsed sounds must be readily audible to the animals based on measured received levels and the hearing sensitivity of that mammal group. Although various baleen whales and toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to airgun pulses under some conditions, at other times mammals of all three types have shown no overt reactions. The relative responsiveness of baleen and toothed whales are quite variable.

***Masking*.—**Masking effects of pulsed sounds (even from large arrays of airguns) on marine mammal calls and other natural sounds are expected to be limited, although there are very few specific data on this. Because of the intermittent nature and low duty cycle of seismic pulses, animals can emit and receive

sounds in the relatively quiet intervals between pulses. However, in exceptional situations, reverberation occurs for much or all of the interval between pulses (e.g., Simard et al. 2005; Clark and Gagnon 2006), which could mask calls. Situations with prolonged strong reverberation are infrequent. However, it is common for reverberation to cause some lesser degree of elevation of the background level between airgun pulses (e.g., Gedamke 2011; Guerra et al. 2011, 2013), and this weaker reverberation presumably reduces the detection range of calls and other natural sounds to some degree. Guerra et al. (2013) reported that ambient noise levels between seismic pulses were elevated because of reverberation at ranges of 50 km from the seismic source. Based on measurements in deep water of the Southern Ocean, Gedamke (2011) estimated that the slight elevation of background levels during intervals between pulses reduced blue and fin whale communication space by as much as 36–51% when a seismic survey was operating 450–2800 km away. Based on preliminary modeling, Wittekind et al. (2013) reported that airgun sounds could reduce the communication range of blue and fin whales 2000 km from the seismic source. Klinck et al. (2012) also found reverberation effects between airgun pulses. Nieukirk et al. (2012) and Blackwell et al. (2013) noted the potential for masking effects from seismic surveys on large whales.

Some baleen and toothed whales are known to continue calling in the presence of seismic pulses, and their calls usually can be heard between the seismic pulses (e.g., Nieukirk et al. 2012). Cerchio et al. (2014) suggested that the breeding display of humpback whales off Angola could be disrupted by seismic sounds, as singing activity declined with increasing received levels. In addition, some cetaceans are known to change their calling rates, shift their peak frequencies, or otherwise modify their vocal behavior in response to airgun sounds (e.g., Di Iorio and Clark 2010; Castellote et al. 2012; Blackwell et al. 2013). The hearing systems of baleen whales are undoubtedly more sensitive to low-frequency sounds than are the ears of the small odontocetes that have been studied directly (e.g., MacGillivray et al. 2014). The sounds important to small odontocetes are predominantly at much higher frequencies than are the dominant components of airgun sounds, thus limiting the potential for masking. In general, masking effects of seismic pulses are expected to be minor, given the normally intermittent nature of seismic pulses. We are not aware of any information concerning masking of hearing in sea turtles.

***Disturbance Reactions*.—**Disturbance includes a variety of effects, including subtle to conspicuous changes in behavior, movement, and displacement. Based on NMFS (2001, p. 9293), NRC (2005), and Southall et al. (2007), we believe that simple exposure to sound, or brief reactions that do not disrupt behavioral patterns in a potentially significant manner, do not constitute harassment or "taking". By potentially significant, we mean, 'in a manner that might have deleterious effects to the well-being of individual marine mammals or their populations'.

Reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, and many other factors (Richardson et al. 1995; Wartzok et al. 2004; Southall et al. 2007; Weilgart 2007; Ellison et al. 2012). If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or population (e.g., New et al. 2013). However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and populations could be significant (e.g., Lusseau and Bejder 2007; Weilgart 2007). Given the many uncertainties in predicting the quantity and types of impacts of noise on marine mammals, it is common practice to estimate how many marine mammals would be present within a particular distance of industrial activities and/or exposed to a particular level of industrial sound. In most cases, this approach likely overestimates the numbers of marine mammals that would be affected in some biologically important manner.

The sound criteria used to estimate how many marine mammals could be disturbed to some biologically important degree by a seismic program are based primarily on behavioral observations of a few species. Detailed studies have been done on humpbacks, gray whales, bowheads, and sperm whales. Less detailed data are available for some other species of baleen whales and small toothed whales, but for many species, there are no data on responses to marine seismic surveys.

Baleen Whales

Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable. Whales are often reported to show no overt reactions to pulses from large arrays of airguns at distances beyond a few kilometers, even though the airgun pulses remain well above ambient noise levels out to much longer distances. However, baleen whales exposed to strong noise pulses from airguns often react by deviating from their normal migration route and/or interrupting their feeding and moving away. In the cases of migrating gray and bowhead whales, the observed changes in behavior appeared to be of little or no biological consequence to the animals. They simply avoided the sound source by displacing their migration route to varying degrees, but within the natural boundaries of the migration corridors (Malme et al. 1984; Malme and Miles 1985; Richardson et al. 1995).

Responses of *humpback whales* to seismic surveys have been studied during migration, on summer feeding grounds, and on Angolan winter breeding grounds; there has also been discussion of effects on the Brazilian wintering grounds. Off Western Australia, avoidance reactions began at 5–8 km from the array, and those reactions kept most pods ~3–4 km from the operating seismic boat; there was localized displacement during migration of 4–5 km by traveling pods and 7–12 km by more sensitive resting pods of cow-calf pairs (McCauley et al. 1998, 2000). However, some individual humpback whales, especially males, approached within distances of 100–400 m. Studies examining the behavioral responses of humpback whales to airguns are currently underway off eastern Australia (Cato et al. 2011, 2012, 2013).

In the Northwest Atlantic, sighting rates were significantly greater during non-seismic periods compared with periods when a full array was operating, and humpback whales were more likely to swim away and less likely to swim towards a vessel during seismic vs. non-seismic periods (Moulton and Holst 2010). On their summer feeding grounds in southeast Alaska, there was no clear evidence of avoidance, despite the possibility of subtle effects, at received levels up to 172 re 1 μPa on an approximate rms basis (Malme et al. 1985). It has been suggested that South Atlantic humpback whales wintering off Brazil may be displaced or even strand upon exposure to seismic surveys (Engel et al. 2004), but data from subsequent years, indicated that there was no observable direct correlation between strandings and seismic surveys (IWC 2007).

There are no data on reactions of *right whales* to seismic surveys. However, Rolland et al. (2012) suggested that ship noise causes increased stress in right whales; they showed that baseline levels of stress-related fecal hormone metabolites decreased in North Atlantic right whales with a 6-dB decrease in underwater noise from vessels. Wright et al. (2011) also reported that sound could be a potential source of stress for marine mammals.

Results from *bowhead whales* show that their responsiveness can be quite variable depending on their activity (migrating vs. feeding). Bowhead whales migrating west across the Alaskan Beaufort Sea in autumn, in particular, are unusually responsive, with substantial avoidance occurring out to distances of 20–30 km from a medium-sized airgun source (Miller et al. 1999; Richardson et al. 1999). However, more recent research on bowhead whales corroborates earlier evidence that, during the summer feeding season, bowheads are not as sensitive to seismic sources (e.g., Miller et al. 2005). Nonetheless, Robertson et al. (2013) showed that bowheads on their summer feeding grounds showed subtle but statis-

tically significant changes in surfacing–respiration–dive cycles during exposure to seismic sounds, including shorter surfacing intervals, shorter dives, and decreased number of blows per surface interval.

Bowhead whale calls detected in the presence and absence of airgun sounds have been studied extensively in the Beaufort Sea. Bowheads continue to produce calls of the usual types when exposed to airgun sounds on their summering grounds, although numbers of calls detected are significantly lower in the presence than in the absence of airgun pulses; Blackwell et al. (2013) reported that calling rates in 2007 declined significantly where received SPLs from airgun sounds were 116–129 dB re 1 µPa. Thus, bowhead whales in the Beaufort Sea apparently decrease their calling rates in response to seismic operations, although movement out of the area could also contribute to the lower call detection rate (Blackwell et al. 2013).

A multivariate analysis of factors affecting the distribution of calling bowhead whales during their fall migration in 2009 noted that the southern edge of the distribution of calling whales was significantly closer to shore with increasing levels of airgun sound from a seismic survey a few hundred kilometers to the east of the study area (i.e., behind the westward-migrating whales; McDonald et al. 2010, 2011). It was not known whether this statistical effect represented a stronger tendency for quieting of the whales farther offshore in deeper water upon exposure to airgun sound, or an actual inshore displacement of whales.

Reactions of migrating and feeding (but not wintering) *gray whales* to seismic surveys have been studied. Off St. Lawrence Island in the northern Bering Sea, it was estimated, based on small sample sizes, that 50% of feeding gray whales stopped feeding at an average received pressure level of 173 dB re 1 µPa on an (approximate) rms basis, and that 10% of feeding whales interrupted feeding at received levels of 163 dB re 1 μPa_{rms} (Malme et al. 1986, 1988). Those findings were generally consistent with the results of experiments conducted on larger numbers of gray whales that were migrating along the California coast (Malme et al. 1984; Malme and Miles 1985), and western Pacific gray whales feeding off Sakhalin Island, Russia (e.g., Gailey et al. 2007; Johnson et al. 2007; Yazvenko et al. 2007a,b).

Various species of *Balaenoptera* (blue, sei, fin, and minke whales) have occasionally been seen in areas ensonified by airgun pulses; sightings by observers on seismic vessels off the U.K. from 1997 to 2000 suggest that, during times of good sightability, sighting rates for mysticetes (mainly fin and sei whales) were similar when large arrays of airguns were shooting vs. silent, although there was localized avoidance (Stone and Tasker 2006). Singing fin whales in the Mediterranean moved away from an operating airgun array, and their song notes had lower bandwidths during periods with versus without airgun sounds (Castellote et al. 2012).

During seismic surveys in the Northwest Atlantic, baleen whales as a group showed localized avoidance of the operating array (Moulton and Holst 2010). Sighting rates were significantly lower during seismic operations compared with non-seismic periods. Baleen whales were seen on average 200 m farther from the vessel during airgun activities vs. non-seismic periods, and these whales more often swam away from the vessel when seismic operations were underway compared with periods when no airguns were operating (Moulton and Holst 2010). Blue whales were seen significantly farther from the vessel during single airgun operations, ramp up, and all other airgun operations compared with non-seismic periods (Moulton and Holst 2010). Similarly, fin whales were seen at significantly farther distances during ramp up than during periods without airgun operations; there was also a trend for fin whales to be sighted farther from the vessel during other airgun operations, but the difference was not significant (Moulton and Holst 2010). Minke whales were seen significantly farther from the vessel during periods with than without seismic operations (Moulton and Holst 2010). Minke whales were also

more likely to swim away and less likely to approach during seismic operations compared to periods when airguns were not operating (Moulton and Holst 2010).

Data on short-term reactions by cetaceans to impulsive noises are not necessarily indicative of long-term or biologically significant effects. It is not known whether impulsive sounds affect reproductive rate or distribution and habitat use in subsequent days or years. However, gray whales have continued to migrate annually along the west coast of North America with substantial increases in the population over recent years, despite intermittent seismic exploration (and much ship traffic) in that area for decades. The western Pacific gray whale population did not seem affected by a seismic survey in its feeding ground during a previous year, and bowhead whales have continued to travel to the eastern Beaufort Sea each summer, and their numbers have increased notably, despite seismic exploration in their summer and autumn range for many years.

Toothed Whales

Little systematic information is available about reactions of toothed whales to sound pulses. However, there are recent systematic studies on sperm whales, and there is an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies. Seismic operators and marine mammal observers on seismic vessels regularly see dolphins and other small toothed whales near operating airgun arrays, but in general there is a tendency for most delphinids to show some avoidance of operating seismic vessels (e.g., Stone and Tasker 2006; Moulton and Holst 2010; Barry et al. 2012). In most cases, the avoidance radii for delphinids appear to be small, on the order of 1 km or less, and some individuals show no apparent avoidance.

During seismic surveys in the Northwest Atlantic, delphinids as a group showed some localized avoidance of the operating array (Moulton and Holst 2010). The mean initial detection distance was significantly farther (by ~200 m) during seismic operations compared with periods when the seismic source was not active; however, there was no significant difference between sighting rates (Moulton and Holst 2010). The same results were evident when only long-finned pilot whales were considered.

Preliminary findings of a monitoring study of *narwhals* (*Monodon monoceros*) in Melville Bay, Greenland (summer and fall 2012) showed no short-term effects of seismic survey activity on narwhal distribution, abundance, migration timing, and feeding habits (Heide-Jørgensen et al. 2013a). In addition, there were no reported effects on narwhal hunting. These findings do not seemingly support a suggestion by Heide-Jørgensen et al. (2013b) that seismic surveys in Baffin Bay may have delayed the migration timing of narwhals, thereby increasing the risk of narwhals to ice entrapment.

The *beluga*, however, is a species that (at least at times) shows long-distance (10s of km) avoidance of seismic vessels (e.g., Miller et al. 2005). Captive bottlenose dolphins and beluga whales exhibited changes in behavior when exposed to strong pulsed sounds similar in duration to those typically used in seismic surveys, but the animals tolerated high received levels of sound before exhibiting aversive behaviors (e.g., Finneran et al. 2000, 2002, 2005).

Most studies of *sperm whales* exposed to airgun sounds indicate that the sperm whale shows considerable tolerance of airgun pulses; in most cases the whales do not show strong avoidance (e.g., Stone and Tasker 2006; Moulton and Holst 2010), but foraging behavior can be altered upon exposure to airgun sound (e.g., Miller et al. 2009). There are almost no specific data on the behavioral reactions of *beaked whales* to seismic surveys. Most beaked whales tend to avoid approaching vessels of other types (e.g., Würsig et al. 1998) and/or change their behavior in response to sounds from vessels (e.g., Pirotta et al. 2012). However, some northern bottlenose whales remained in the general area and continued to produce high-frequency clicks when exposed to sound pulses from distant seismic surveys (e.g., Simard

et al. 2005). In any event, it is likely that most beaked whales would also show strong avoidance of an approaching seismic vessel, although this has not been documented explicitly.

The limited available data suggest that *harbor porpoises* show stronger avoidance of seismic operations than do Dall's porpoises. Thompson et al. (2013) reported decreased densities and reduced acoustic detections of harbor porpoise in response to a seismic survey in Moray Firth, Scotland, at ranges of 5–10 km (SPLs of 165–172 dB re 1 μPa, SELs of 145–151 dB $\mu Pa^2 \cdot s$); however, animals returned to the area within a few hours. The apparent tendency for greater responsiveness in the harbor porpoise is consistent with their relative responsiveness to boat traffic and some other acoustic sources (Richardson et al. 1995; Southall et al. 2007).

Odontocete reactions to large arrays of airguns are variable and, at least for delphinids, seem to be confined to a smaller radius than has been observed for the more responsive of the mysticetes and some other odontocetes. A ≥170 dB disturbance criterion (rather than ≥160 dB) is considered appropriate for delphinids, which tend to be less responsive than the more responsive cetaceans.

Sea Turtles

The limited available data indicate that sea turtles will hear airgun sounds and sometimes exhibit localized avoidance (see PEIS, § 3.4.4.3). Based on available data, it is likely that sea turtles will exhibit behavioral changes and/or avoidance within an area of unknown size near a seismic vessel. To the extent that there are any impacts on sea turtles, seismic operations in or near areas where turtles concentrate are likely to have the greatest impact. There are no specific data that demonstrate the consequences to sea turtles if seismic operations with large or small arrays of airguns occur in important areas at biologically important times of year.

Hearing Impairment and Other Physical Effects.**—**Temporary or permanent hearing impairment is a possibility when marine mammals are exposed to very strong sounds. TTS has been demonstrated and studied in certain captive odontocetes and pinnipeds exposed to strong sounds. However, there has been no specific documentation of TTS let alone permanent hearing damage, i.e., PTS, in free-ranging marine mammals exposed to sequences of airgun pulses during realistic field conditions.

Additional data are needed to determine the received sound levels at which small odontocetes would start to incur TTS upon exposure to repeated, low-frequency pulses of airgun sound with variable received levels. To determine how close an airgun array would need to approach in order to elicit TTS, one would (as a minimum) need to allow for the sequence of distances at which airgun pulses would occur, and for the dependence of received SEL on distance in the region of the seismic operation (e.g., Breitzke and Bohlen 2010; Laws 2012). At the present state of knowledge, it is also necessary to assume that the effect is directly related to total received energy, although there is recent evidence that auditory effects in a given animal are not a simple function of received acoustic energy. Frequency, duration of the exposure and occurrence of gaps within the exposure can also influence the auditory effect (Finneran and Schlundt 2010, 2011; Finneran et al. 2010a,b; Finneran 2012; Ketten 2012; Finneran and Schlundt 2011, 2013; Kastelein et al. 2013a).

The assumption that, in marine mammals, the occurrence and magnitude of TTS is a function of cumulative acoustic energy (SEL) is probably an oversimplification (Finneran 2012). Popov et al. (2011) examined the effects of fatiguing noise on the hearing threshold of Yangtze finless porpoises when exposed to frequencies of 32–128 kHz at 140–160 dB re 1 μPa for 1–30 min. They found that an exposure of higher level and shorter duration produced a higher TTS than an exposure of equal SEL but of lower level and longer duration. Kastelein et al. (2012a,b; 2013b) also reported that the equal-energy model is not valid for predicting TTS in harbor porpoises or harbor seals.

Recent data have shown that the SEL required for TTS onset to occur increases with intermittent exposures, with some auditory recovery during silent periods between signals (Finneran et al. 2010b; Finneran and Schlundt 2011). Schlundt et al. (2013) reported that the potential for seismic surveys using airguns to cause auditory effects on dolphins could be lower than previously thought. Based on behavioral tests, Finneran et al. (2011) and Schlundt et al. (2013) reported no measurable TTS in bottlenose dolphins after exposure to 10 impulses from a seismic airgun with a cumulative SEL of ~195 dB re 1 $\mu Pa^2 \cdot s$; results from auditory evoked potential measurements were more variable (Schlundt et al. 2013).

Recent studies have also shown that the SEL necessary to elicit TTS can depend substantially on frequency, with susceptibility to TTS increasing with increasing frequency above 3 kHz (Finneran and Schlundt 2010, 2011; Finneran 2012). When beluga whales were exposed to fatiguing noise with sound levels of 165 dB re 1 µPa for durations of 1–30 min at frequencies of 11.2–90 kHz, the highest TTS with the longest recovery time was produced by the lower frequencies (11.2 and 22.5 kHz); TTS effects also gradually increased with prolonged exposure time (Popov et al. 2013a). Popov et al. (2013b) also reported that TTS produced by exposure to a fatiguing noise was larger during the first session (or naïve subject state) with a beluga whale than TTS that resulted from the same sound in subsequent sessions (experienced subject state). Therefore, Supin et al. (2013) reported that SEL may not be a valid metric for examining fatiguing sounds on beluga whales. Similarly, Nachtigall and Supin (2013) reported that false killer whales are able to change their hearing sensation levels when exposed to loud sounds, such as warning signals or echolocation sounds.

It is inappropriate to assume that onset of TTS occurs at similar received levels in all cetaceans (*cf.* Southall et al. 2007). Some cetaceans could incur TTS at lower sound exposures than are necessary to elicit TTS in the beluga or bottlenose dolphin. Based on the best available information, Southall et al. (2007) recommended a TTS threshold for exposure to single or multiple pulses of 183 dB re 1 $\mu Pa^2 \cdot s$. Tougaard et al. (2013) proposed a TTS criterion of 165 dB re 1 $\mu Pa^2 \cdot s$ for porpoises based on data from two recent studies. Gedamke et al. (2011), based on preliminary simulation modeling that attempted to allow for various uncertainties in assumptions and variability around population means, suggested that some baleen whales whose closest point of approach to a seismic vessel is 1 km or more could experience TTS.

There is no specific evidence that exposure to pulses of airgun sound can cause PTS in any marine mammal, even with large arrays of airguns. However, given the likelihood that some mammals close to an airgun array might incur at least mild TTS, there has been further speculation about the possibility that some individuals occurring very close to airguns might incur PTS (e.g., Richardson et al. 1995, p. 372*ff*; Gedamke et al. 2011). In terrestrial animals, exposure to sounds sufficiently strong to elicit a large TTS induces physiological and structural changes in the inner ear, and at some high level of sound exposure, these phenomena become non-recoverable (Le Prell 2012). At this level of sound exposure, TTS grades into PTS. Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage, but repeated or (in some cases) single exposures to a level well above that causing TTS onset might elicit PTS (e.g., Kastak and Reichmuth 2007; Kastak et al. 2008).

Current NMFS policy regarding exposure of marine mammals to high-level sounds is that cetaceans and pinnipeds should not be exposed to impulsive sounds with received levels ≥180 dB and 190 dB re 1 μPa_{rms}, respectively (NMFS 2000). These criteria have been used in establishing the exclusion (shut-down) zones planned for the proposed seismic survey. However, those criteria were established before there was any information about minimum received levels of sounds necessary to cause auditory impairment in marine mammals.

Recommendations for science-based noise exposure criteria for marine mammals, frequency-weighting procedures, and related matters were published by Southall et al. (2007). Those recommendations were never formally adopted by NMFS for use in regulatory processes and during mitigation programs associated with seismic surveys, although some aspects of the recommendations have been taken into account in certain environmental impact statements and small-take authorizations. In December 2013, NOAA made available for public comment new draft guidance for assessing the effects of anthropogenic sound on marine mammals (NOAA 2013a), taking at least some of the Southall et al. recommendations into account. The new acoustic guidance and procedures could account for the now-available scientific data on marine mammal TTS, the expected offset between the TTS and PTS thresholds, differences in the acoustic frequencies to which different marine mammal groups are sensitive (e.g., M-weighting or generalized frequency weightings for various groups of marine mammals, allowing for their functional bandwidths), and other relevant factors. At the time of preparation of this Draft Amended EA, the date of release of the final guidelines and how they would be implemented are unknown.

Nowacek et al. (2013) concluded that current scientific data indicate that seismic airguns have a low probability of directly harming marine life, except at close range. Several aspects of the planned monitoring and mitigation measures for this project are designed to detect marine mammals occurring near the airgun array, and to avoid exposing them to sound pulses that might, at least in theory, cause hearing impairment (see § II and § IV[2], below). Also, many marine mammals and (to a limited degree) sea turtles show some avoidance of the area where received levels of airgun sound are high enough such that hearing impairment could potentially occur. In those cases, the avoidance responses of the animals themselves would reduce or (most likely) avoid any possibility of hearing impairment.

Non-auditory physical effects could also occur in marine mammals exposed to strong underwater pulsed sound. Possible types of non-auditory physiological effects or injuries that might (in theory) occur in mammals close to a strong sound source include stress, neurological effects, bubble formation, and other types of organ or tissue damage. It is possible that some marine mammal species (i.e., beaked whales) could be especially susceptible to injury and/or stranding when exposed to strong transient sounds.

There is no definitive evidence that any of these effects occur even for marine mammals in close proximity to large arrays of airguns. However, Gray and Van Waerebeek (2011) have suggested a cause-effect relationship between a seismic survey off Liberia in 2009 and the erratic movement, postural instability, and akinesia in a pantropical spotted dolphin based on spatially and temporally close association with the airgun array. Additionally, a few cases of strandings in the general area where a seismic survey was ongoing have led to speculation concerning a possible link between seismic surveys and strandings (e.g., Castellote and Llorens 2013).

Non-auditory effects, if they occur at all, would presumably be limited to short distances and to activities that extend over a prolonged period. Marine mammals that show behavioral avoidance of seismic vessels, including most baleen whales, some odontocetes, and some pinnipeds, are especially unlikely to incur non-auditory physical effects. The brief duration of exposure of any given mammal and the planned monitoring and mitigation measures would further reduce the probability of exposure of marine mammals to sounds strong enough to induce non-auditory physical effects.

Sea Turtles

There is substantial overlap in the frequencies that sea turtles detect vs. the frequencies in airgun pulses. We are not aware of measurements of the absolute hearing thresholds of any sea turtle to waterborne sounds similar to airgun pulses. In the absence of relevant absolute threshold data, we cannot estimate how far away an airgun array might be audible. Moein et al. (1994) and Lenhardt (2002) reported TTS for loggerhead turtles exposed to many airgun pulses (see PEIS). This suggests that sounds

from an airgun array might cause temporary hearing impairment in sea turtles if they do not avoid the (unknown) radius where TTS occurs. However, exposure duration during the proposed survey would be much less than during the aforementioned studies. Also, recent monitoring studies show that some sea turtles do show localized movement away from approaching airguns. At short distances from the source, received sound level diminishes rapidly with increasing distance. In that situation, even a small-scale avoidance response could result in a significant reduction in sound exposure.

The PSVOs stationed on the *Langseth* would also watch for sea turtles, and airgun operations would be shut down if a turtle enters the designated EZ.

(b) Possible Effects of Other Acoustic Sources

The Kongsberg EM 122 MBES, Knudsen Chirp 3260 SBP, and Teledyne OS75 75-kHz ADCP would be operated from the source vessel during the proposed survey, but not during transits. Information about this equipment was provided in § 2.2.3.1 of the PEIS (MBES, SBP) or § II of this Draft Amended EA (ADCP). A review of the anticipated potential effects (or lack thereof) of MBESs, SBPs, and pingers on marine mammals and sea turtles appears in § 3.4.4.3, § 3.6.4.3, § 3.7.4.3, and Appendix E of the PEIS.

There has been some recent attention given to the effects of MBES on marine mammals, as a result of a report issued in September 2013 by an IWC independent scientific review panel (ISRP) linking the operation of a MBES to a mass stranding of melon-headed whales (*Peponocephala electra*; Southall et al. 2013) off Madagascar. During May–June 2008, ~100 melon-headed whales entered and stranded in the Loza Lagoon system in northwest Madagascar at the same time that a 12-kHz MBES survey was being conducted ~65 km away off the coast. In conducting a retrospective review of available information on the event, an independent scientific review panel concluded that the Kongsberg EM 120 MBES was the most plausible behavioral trigger for the animals initially entering the lagoon system and eventually stranding. The independent scientific review panel, however, identified that an unequivocal conclusion on causality of the event was not possible because of the lack of information about the event and a number of potentially contributing factors. Additionally, the independent review panel report indicated that this incident was likely the result of a complicated confluence of environmental, social, and other factors that have a very low probability of occurring again in the future, but recommended that the potential be considered in environmental planning. The proposed survey design and environmental context of the proposed survey are quite different from the mass melon-headed whale stranding described by the ISRP. It should be noted that this event is the first known marine mammal mass stranding closely associated with the operation of a MBES. It is noted that leading scientific experts knowledgeable about MBES have expressed concerns about the independent scientific review panel analyses and findings (Bernstein 2013).

There is no available information on marine mammal behavioral response to MBES sounds (Southall et al. 2013) or sea turtle responses to MBES systems. Much of the literature on marine mammal response to sonars relates to the types of sonars used in naval operations, including Low-Frequency Active (LFA) sonars (e.g., Miller et al. 2012; Sivle et al. 2012) and Mid-Frequency Active (MFA) sonars (e.g., Tyack et al. 2011; Melcón et al. 2012; Miller et al. 2012; DeRuiter et al. 2013a,b; Goldbogen et al. 2013). However, the MBES sounds are quite different from naval sonars. Ping duration of the MBES is very short relative to naval sonars. Also, at any given location, an individual marine mammal would be in the beam of the MBES for much less time given the generally downward orientation of the beam and its narrow fore-aft beamwidth; naval sonars often use near-horizontally-directed sound. In addition, naval sonars have higher duty cycles. These factors would all reduce the sound energy received from the MBES relative to that from naval sonars.

Risch et al. (2012) found a reduction in humpback whale song in the Stellwagen Bank National Marine Sanctuary during Ocean Acoustic Waveguide Remote Sensing (OAWRS) activities that were carried out approximately 200 km away. The OAWRS used three frequency-modulated (FM) pulses centered at frequencies of 415, 734, and 949 Hz with received levels in the sanctuary 88–110 dB re 1 µPa. Deng et al (2014) measured the spectral properties of pulses transmitted by three 200-kHz echo sounders, and found that they generated weaker sounds at frequencies below the center frequency (90–130 kHz). These sounds are within the hearing range of some marine mammals, and the authors suggested that they could be strong enough to elicit behavioural responses within close proximity to the sources, although they would be well below potentially harmful levels.

Despite the aforementioned information that has recently become available, this Draft Amended EA is in agreement with the assessment presented in § 3.4.7, 3.6.7, and 3.7.7 of the PEIS that operation of MBESs, SBPs, and pingers is not likely to impact mysticetes or odontocetes, and is not expected to affect sea turtles, (1) given the lower acoustic exposures relative to airguns and (2) because the intermittent and/or narrow downward-directed nature of these sounds would result in no more than one or two brief ping exposures of any individual marine mammal or sea turtle given the movement and speed of the vessel. Also, for sea turtles, the associated frequency ranges are above their known hearing range.

(c) Other Possible Effects of Seismic Surveys

Other possible effects of seismic surveys on marine mammals and/or sea turtles include masking by vessel noise, disturbance by vessel presence or noise, and injury or mortality from collisions with vessels or entanglement in seismic gear.

Vessel noise from the *Langseth* could affect marine animals in the proposed survey area. Sounds produced by large vessels generally dominate ambient noise at frequencies from 20 to 300 Hz (Richardson et al. 1995). Ship noise, through masking, can reduce the effective communication distance of a marine mammal if the frequency of the sound source is close to that used by the animal, and if the sound is present for a significant fraction of time (e.g., Richardson et al. 1995; Clark et al. 2009; Jensen et al. 2009; Hatch et al. 2012). In order to compensate for increased ambient noise, some cetaceans are known to increase the source levels of their calls in the presence of elevated noise levels from shipping, shift their peak frequencies, or otherwise change their vocal behavior (e.g., Parks et al. 2011; 2012; Castellote et al. 2012; Melcón et al. 2012: Tyack and Janik 2013).

Baleen whales are thought to be more sensitive to sound at these low frequencies than are toothed whales (e.g., MacGillivray et al. 2014), possibly causing localized avoidance of the proposed survey area during seismic operations. Reactions of gray and humpback whales to vessels have been studied, and there is limited information available about the reactions of right whales and rorquals (fin, blue, and minke whales). Reactions of humpback whales to boats are variable, ranging from approach to avoidance (Payne 1978; Salden 1993). Baker et al. (1982, 1983) and Baker and Herman (1989) found humpbacks often move away when vessels are within several kilometers. Humpbacks seem less likely to react overtly when actively feeding than when resting or engaged in other activities (Krieger and Wing 1984, 1986).

Many odontocetes show considerable tolerance of vessel traffic, although they sometimes react at long distances if confined by ice or shallow water, if previously harassed by vessels, or have had little or no recent exposure to ships (Richardson et al. 1995). Dolphins of many species tolerate and sometimes approach vessels. Some dolphin species approach moving vessels to ride the bow or stern waves (Williams et al. 1992). There are few data on the behavioral reactions of beaked whales to vessel noise, though they seem to avoid approaching vessels (e.g., Würsig et al. 1998) or dive for an extended period when approached by a vessel (e.g., Kasuya 1986). Based on a single observation, Aguilar-Soto et al. (2006) suggest foraging efficiency of Cuvier's beaked whales may be reduced by close approach of vessels.

The PEIS concluded that project vessel sounds would not be at levels expected to cause anything more than possible localized and temporary behavioral changes in marine mammals or sea turtles, and would not be expected to result in significant negative effects on individuals or at the population level. In addition, in all oceans of the world, large vessel traffic is currently so prevalent that it is commonly considered a usual source of ambient sound.

Another concern with vessel traffic is the potential for striking marine mammals or sea turtles. Information on vessel strikes is reviewed in § 3.4.4.4 and § 3.6.4.4 of the PEIS. The PEIS concluded that the risk of collision of seismic vessels or towed/deployed equipment with marine mammals or sea turtles exists but is extremely unlikely, because of the relatively slow operating speed (typically 7–9 km/h) of the vessel during seismic operations, and the generally straight-line movement of the seismic vessel. There has been no history of marine mammal vessel strikes with the *Langseth*, or its predecessor, R/V *Maurice Ewing* over the last ~23 years, including those conducted off NJ.

Entanglement of sea turtles in seismic gear is also a concern. There have been reports of turtles being trapped and killed between the gaps in tail-buoys offshore from West Africa (Weir 2007); however, these tailbuoys are significantly different than those used on the *Langseth*. In April 2011, a dead olive ridley turtle was found in a deflector foil of the seismic gear on the *Langseth* during equipment recovery at the conclusion of a survey off Costa Rica, where sea turtles were numerous. Such incidents are possible, but this is the first case of sea turtle entanglement in seismic gear for the *Langseth*, which has been conducting seismic surveys since 2008, or for R/V *Maurice Ewing*, during 2003–2007. Towing the hydrophone streamer or other equipment during the proposed survey is not expected to significantly interfere with sea turtle movements, including migration. Although sea turtles were observed during the 2014 survey, no such effects were detected nor were strandings reported during survey activities.

(d) Mitigation Measures

Several mitigation measures are built into the proposed seismic survey as an integral part of the planned activities. These measures include the following: ramp ups; typically two, however a minimum of one dedicated observer maintaining a visual watch during all daytime airgun operations; two observers for 30 min before and during ramp ups; PAM during the day and night to complement visual monitoring (unless the system and back-up systems are damaged during operations); and power downs (or if necessary shut downs) when mammals or turtles are detected in or about to enter designated EZ. These mitigation measures are described in § 2.4.4.1 of the PEIS and summarized earlier in this document, in § II(3). The fact that the 4-airgun subarray, because of its design, would direct the majority of the energy downward, and less energy laterally, is also an inherent mitigation measure.

Previous and subsequent analysis of the potential impacts takes account of these planned mitigation measures. It would not be meaningful to analyze the effects of the planned activities without mitigation, as the mitigation (and associated monitoring) measures are a basic part of the activities, and would be implemented under the Proposed Action or Alternative Action. The same monitoring and mitigation measures proposed for the 2014 survey are proposed for the 2015 survey.

(e) Potential Numbers of Cetaceans Exposed to Received Sound Levels ≥160 dB

All anticipated takes would be "takes by harassment" as described in § I, involving temporary changes in behavior. The mitigation measures to be applied would minimize the possibility of injurious takes. (However, as noted earlier and in the PEIS, there is no specific information demonstrating that injurious "takes" would occur even in the absence of the planned mitigation measures.) In the sections below, we describe methods to estimate the number of potential exposures to sound levels >160 dB re 1 μPa_{rms}, and present estimates of the numbers of marine mammals that could be affected during the proposed seismic

program. The estimates are based on consideration of the number of marine mammals that could be disturbed appreciably by ~4900 km of seismic surveys off the coast of New Jersey. The main sources of distributional and numerical data used in deriving the estimates are described in the next subsection.

Basis for Estimating Exposure.—The estimates are based on a consideration of the number of marine mammals that could be within the area around the operating airgun array where the received levels (RLs) of sound >160 dB re 1 μPa_{rms} are predicted to occur (see Table 1). The estimated numbers are based on the densities (numbers per unit area) of marine mammals expected to occur in the area in the absence of a seismic survey. To the extent that marine mammals tend to move away from seismic sources before the sound level reaches the criterion level and tend not to approach an operating airgun array, these estimates are likely to overestimate the numbers actually exposed to the specified level of sounds. The overestimation is expected to be particularly large when dealing with the higher sound-level criteria, e.g., 180 dB re 1 μPa_{rms}, as animals are more likely to move away before RL reaches 180 dB than they are to move away before it reaches (for example) 160 dB re 1 μPa_{rms}. Likewise, they are less likely to approach within the ≥180 dB re 1 μPa_{rms} radius than they are to approach within the considerably larger ≥160 dB radius.

We used densities calculated from the U.S. Navy's "OPAREA Density Estimates" (NODE) database (DoN 2007). The cetacean density estimates are based on the NMFS-NEFSC aerial surveys conducted between 1998 and 2004; all surveys from New Jersey to Maine were conducted in summer (June–August). Density estimates were derived using density surface modeling of the existing line-transect data, which uses sea surface temperature, chlorophyll *a*, depth, longitude, and latitude to allow extrapolation to areas/seasons where survey data were not collected. For some species, there were not enough sightings to be able to produce a density surface, so densities were estimated using traditional line-transect analysis. The models and analyses have been incorporated into a web-based Geographic Information System (GIS) developed by Duke University's Department of Defense Strategic Environmental Research and Development Program (SERDP) team in close collaboration with the NMFS SERDP team (Read et al. 2009). We used the GIS to obtain densities in a polygon the size of the survey area for the 19 cetacean species in the model. The GIS provides minimum, mean, and maximum estimates for four seasons, and we have used the mean estimates for summer (June–August). Mean densities were used because the minimum and maximum estimates are for points within the polygon, whereas the mean estimate is for the entire polygon.

The estimated numbers of individuals potentially exposed presented below are based on the 160-dB re 1 μPa_{rms} criterion for all cetaceans. It is assumed that marine mammals exposed to airgun sounds that strong could change their behavior sufficiently to be considered "taken by harassment". Table 7 shows the density estimates calculated as described above and the estimates of the number of different individual marine mammals that potentially could be exposed to ≥160 dB re 1 μPa_{rms} during the seismic survey if no animals moved away from the survey vessel. The *Requested Take Authorization* is given in the far right column of Table 7. For species for which densities were not available but for which there were sighting records near the survey area, we have included a *Requested Take Authorization* for the mean group size for the species from Palka (2012).

It should be noted that the following estimates of exposures to various sound levels assume that the proposed survey would be completed; in fact, the ensonified areas calculated using the planned number of line-kilometers ***have been increased by 25%*** to accommodate lines that may need to be repeated, equipment testing, etc. As is typical during offshore ship surveys, inclement weather and equipment malfunctions are likely to cause delays and may limit the number of useful line-kilometers of seismic operations that can be undertaken. Also, any marine mammal sightings within or near the designated EZ would result in the shut down of seismic operations as a mitigation measure. Thus, the following estimates of the numbers of marine mammals potentially exposed to 160-dB re 1 μPa_{rms} sounds are precautionary and

TABLE 7. Densities and estimates of the possible numbers of individuals that could be exposed to ≥160 dB re 1 μPa_{rms} during the proposed seismic survey in the northwest Atlantic off New Jersey during June–August 2015. The proposed sound source consists of an 4-airgun subarray with a total discharge volume of ~700 in^3. Species in italics are listed under the ESA as endangered. The column of numbers in boldface shows the numbers of Level B "takes" for which authorization is requested.

Species	Reported Density (#/1000 km^2) Read et al. (2009)[1]	Correction Factor[2]	Estimated Density (#/1000 km^2)	Ensonified Area (km^2)	Calculated Take[3]	% of Regional Pop'n[4]	Requested Level B Take Authorization
Mysticetes							
North Atlantic right whale	*0*		*0*	*2037*	*0*	*0*	***0***
Humpback whale	*0*		*0*	*2037*	*0*	*0.01*	***1[5]***
Minke whale	0		0	2037	0	0	**0**
Sei whale	*0.161*		*0.161*	*2037*	*0*	*0.01*	***1[5]***
Fin whale	*0.002*		*0.002*	*2037*	*0*	*<0.01*	***1[5]***
Blue whale	*0*		*0*	*2037*	*0*	*0*	***0***
Odontocetes							
Sperm whale	*7.06*		*7.06*	*2037*	*14*	*0.11*	***14***
Pygmy/dwarf sperm whale	0.001		0.001	2037	0	0.05	**2[5]**
Beaked whales[6]	0.124		0.124	2037	0	0.02	**3[5]**
Rough-toothed dolphin	0		0	2037	0	0	**0**
Bottlenose dolphin	111.3		111.3	2037	227	0.26	**227**
Pantropical spotted dolphin	0		0	2037	0	0	**0**
Atlantic spotted dolphin	36.11		36.11	2037	74	0.16	**74**
Spinner dolphin[7]	0		0	2037	0	0	**0**
Striped dolphin	0		0	2037	0	0.08	**46[5]**
Short-beaked common dolphin	0		0	2037	0	0.01	**18[5]**
White-beaked dolphin[7]	0		0	2037	0	0	**0**
Atlantic white-sided dolphin	0		0	2037	0	0.03	**15[5]**
Risso's dolphin	13.60		13.60	2037	28	0.15	**28**
Pygmy killer whale[7]	0		0	2037	0	N/A	**0**
False killer whale[7]	0		0	2037	0	N/A	**0**
Killer whale [7]	0		0	2037	0	N/A	**0**
Pilot whale	0.184		0.184	2037	0	<0.01	**9[5]**
Harbor porpoise	0		0	2037	0	0	**0**

[1] Densities are the mean values for the survey area, calculated from the SERDP model of Read et al. (2009)
[2] No correction factors were applied for these calculations
[3] Calculated take is estimated density (reported density x correction factor) multiplied by the 160-dB ensonified area (including the 25% contingency)
[4] Requested takes expressed as percentages of the larger regional populations, where available, for species that are at least partly pelagic; where not available (most odontocetes–see Table 3), 2013 SAR population estimates were used; N/A means not available
[5] Requested take authorization was increased to group size from Palka (2012) for species for which densities were zero but that have been sighted near the proposed survey area
[6] May include Cuvier's, True's, Gervais', Sowerby's, or Blainville's beaked whales, or the northern bottlenose whale
[7] Atlantic waters not included in the SERDP model of Read et al. (2009)

probably overestimate the actual numbers of marine mammals that could be involved. These estimates assume that there would be no weather, equipment, or mitigation delays, which is highly unlikely. For the 2014 survey, NMFS added an additional 25% to the estimated take to account for the turnover of marine mammals in the survey area. NSF has traditionally not included this factor into take calculations and therefore has not included it here.

Consideration should be given to the hypothesis that delphinids are less responsive to airgun sounds than are mysticetes, as referenced in both the PEIS and "Summary of Potential Airgun Effects" of this document. The 160-dB (rms) criterion currently applied by NMFS, on which the following estimates are based, was developed based primarily on data from gray and bowhead whales. The estimates of "takes by harassment" of delphinids given below are thus considered precautionary. As noted previously, in December 2013, NOAA made available for public comment new draft guidance for assessing the effects of anthropogenic sound on marine mammals (NOAA 2013a), although at the time of preparation of this Draft Amended EA, the date of release of the final guidelines and how they would be implemented are unknown. Available data suggest that the current use of a 160-dB criterion may be improved upon, as behavioral response may not occur for some percentage of odontocetes and mysticetes exposed to received levels >160 dB, while other individuals or groups may respond in a manner considered as taken to sound levels <160 dB (NMFS 2013a). It has become evident that the context of an exposure of a marine mammal to sound can affect the animal's initial response to the sound (NMFS 2013a).

Potential Number of Marine Mammals Exposed.—The number of different individuals that could be exposed to airgun sounds with received levels ≥160 dB re 1 μPa_{rms} on one or more occasions can be estimated by considering the total marine area that would be within the 160-dB radius around the operating seismic source on at least one occasion, along with the expected density of animals in the area. The number of possible exposures (including repeated exposures of the same individuals) can be estimated by considering the total marine area that would be within the 160-dB radius around the operating airguns, including areas of overlap. During the proposed survey, the transect lines are closely spaced relative to the 160-dB distance. Thus, the area including overlap is 35.5 times the area excluding overlap, so a marine mammal that stayed in the survey area during the entire survey could be exposed ~36 times, on average. However, it is unlikely that a particular animal would stay in the area during the entire survey. The numbers of different individuals potentially exposed to ≥160 dB re 1 μPa_{rms} were calculated by multiplying the expected species density times the anticipated area to be ensonified to that level during airgun operations excluding overlap. The area expected to be ensonified was determined by entering the planned survey lines into a MapInfo GIS, using the GIS to identify the relevant areas by "drawing" the applicable 160-dB buffer (see Table 1) around each seismic line, and then calculating the total area within the buffers.

Applying the approach described above, ~1630 km^2 (~2037 km^2 including the 25% contingency) would be within the 160-dB isopleth on one or more occasions during the proposed survey. Because this approach does not allow for turnover in the mammal populations in the area during the course of the survey, the actual number of individuals exposed may be underestimated, although the conservative (i.e., probably overestimated) line-kilometer distances used to calculate the area may offset this. Also, the approach assumes that no cetaceans would move away or toward the trackline as the *Langseth* approaches in response to increasing sound levels before the levels reach 160 dB. Another way of interpreting the estimates that follow is that they represent the number of individuals that are expected (in the absence of a seismic program) to occur in the waters that would be exposed to ≥160 dB re 1 μPa_{rms}.

The estimate of the number of individual cetaceans that could be exposed to seismic sounds with received levels ≥160 dB re 1 μPa_{rms} during the proposed survey is 343 (Table 7). That total includes 14 cetaceans listed as ***Endangered*** under the ESA, all sperm whales (0.11% of the regional population). Most (96%) of the cetaceans potentially exposed are delphinids; the bottlenose dolphin, Atlantic spotted dolphin, and Risso's dolphin are estimated to be the most common delphinid species in the area, with estimates of 227 (0.26% of the regional population), 74 (0.16%), and 28 (0.15%) exposed to ≥160 dB re 1 μPa_{rms}, respectively.

As part of the IHA process in 2014, NMFS reviewed the take estimates presented in Table 7 of the July 2014 Final EA (Table 6 in the Draft EA), which were based on an 8-airgun subarray with a volume of ~1400 in^3. As part of NMFS's analyses process, however, they revised the take calculations for most species based upon the best available density information from SERDP SDSS and other sources and most recent population estimates from the 2013 SAR. These included some additional takes for blue, fin, humpback, minke, sei, and north Atlantic right whales; beaked whales; harbor porpoise; and gray, harbor, and harp seals, and other species. The IHA issued by NOAA on 1 July 2014 therefore included slightly different estimates of the possible numbers of marine mammals exposed to sound levels ≥160 dB re 1 mPa during the proposed seismic survey than those presented in Table 7. For all but two of the species for which take has been issued, the takes remain less than 1% of the species' regional population or stock. Additionally, in the 2014 Biological Opinion, a different methodology to analyze for multiple exposures of endangered species was presented. NMFS does not provide specific guidance or requirements for IHA Applicants or for Section 7 ESA consultation for the development of take estimates and multiple exposure analysis, therefore variation in methodologies and calculations are likely to occur. The analysis presented in this NSF Draft Amended EA and the Final EA dated 1 July 2014, however, is a methodology that has been used successfully for past NSF seismic surveys to generate take estimates and multiple exposures for the MMPA and ESA processes. Although NSF did not, and has not historically, estimated take for sea turtles, the Biological Opinion and ITS included analysis and take estimates for sea turtles (Appendix C of the 1 July 2014 Final EA). NSF and LDEO would adhere to the requirements of the Incidental Take Statement (ITS) and the IHA and associated take levels issued.

(f) Conclusions for Marine Mammals and Sea Turtles

The proposed seismic project would involve towing a 4-airgun subarray, with a total discharge volume of 700 in^3, that introduces pulsed sounds into the ocean. Routine vessel operations, other than the proposed seismic operations, are conventionally assumed not to affect marine mammals sufficiently to constitute "taking".

Cetaceans.—In § 3.6.7 and 3.7.7, the PEIS concluded that airgun operations with implementation of the proposed monitoring and mitigation measures could result in a small number of Level B behavioral effects in some mysticete and odontocete species in the NW Atlantic DAA; that Level A effects were highly unlikely; and that operations were unlikely to adversely affect ESA-listed species. The information from recent literature summarized in sections (a) to (c) above complements, and does not affect the outcome of the effects assessment as presented in the PEIS.

In this analysis, estimates of the numbers of marine mammals that could be exposed to airgun sounds during the proposed program have been presented, together with the requested "take authorization". The estimated numbers of animals potentially exposed to sound levels sufficient to cause appreciable disturbance are very low percentages of the regional population sizes (Table 7). The estimates are likely overestimates of the actual number of animals that would be exposed to and would react to the seismic sounds. The reasons for that conclusion are outlined above. The relatively short-term exposures are unlikely to result in any long-term negative consequences for the individuals or their populations. Therefore, no significant impacts on cetaceans would be anticipated from the proposed activities. In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, Protected Species Observers (PSOs) and other crew members have seen no seismic sound-related marine mammal injuries or mortality, including during 2014 survey activities. For the 2014 survey, NMFS issued a Final EA and a FONSI. NMFS also issued an IHA on 1 July 2014, therefore, the proposed activity meets the criteria that the proposed activities, "must not cause serious physical injury or death of marine mammals, must have negligible impacts on the species and stocks, must "take" no more than

small numbers of those species or stocks, and must not have an unmitigable adverse impact on the availability of the species or stocks for legitimate subsistence uses." In the Biological Opinion dated 1 July 2014, NMFS determined that the level of incidental take was not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat**.** The issuance of the Final EA, FONSI, IHA, and Biological Opinion by NMFS in July 2014 further verifies that significant impacts would not be anticipated from the proposed activities, especially given that the activities would be using the smaller 700-in^3 source, rather than the larger size source also analyzed and authorized by NMFS in 2014. Observations from the brief 2014 survey support this conclusion (Ingram et al. 2014).

Sea Turtles.—In § 3.4.7, the PEIS concluded that with implementation of the proposed monitoring and mitigation measures, no significant impacts of airgun operations are likely to sea turtle populations in any of the analysis areas, and that any effects are likely to be limited to short-term behavioral disturbance and short-term localized avoidance of an area of unknown size near the active airguns. Five species of sea turtle**—**the leatherback, loggerhead, green, hawksbill, and Kemp's ridley**—**could be encountered in the proposed survey area. Only foraging or migrating individuals would occur. Given the proposed activities, no significant impacts on sea turtles would be anticipated. In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, Protected Species Observers (PSOs) and other crew members have seen no seismic sound-related sea turtle injuries or mortality, including during 2014 survey activities. In their July 2014 Final EA, FONSI, and Biological Opinion, NMFS determined that the level of incidental take was not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat**.** The Biological Opinion further verifies that significant impacts would not be anticipated from the proposed activities. Observations from the brief 2014 survey support this conclusion (Ingram et al. 2014).

(2) Direct Effects on Invertebrates, Fish, Fisheries, and EFH and Their Significance

Effects of seismic sound on marine invertebrates (crustaceans and cephalopods), marine fish, and their fisheries are discussed in § 3.2.4 and § 3.3.4 and Appendix D of the PEIS. Relevant new studies on the effects of sound on marine invertebrates, fish, and fisheries that have been published since the release of the PEIS are summarized below.

(a) Effects of Sound on Fish and Invertebrates

Morley et al. (2013) considered invertebrates important when examining the impacts of anthropogenic noise. Although their review focused on terrestrial invertebrates, they noted that invertebrates, because of their short life cycle, can provide model systems for evaluating the effects of noise on individual fitness and physiology, thereby providing data that can be used to draw stronger, ecologically valid conclusions.

Solé et al. (2013) exposed four cephalopod species to low-frequency sound (50–400 Hz sweeps) with received levels of 157 ± 5 dB re 1 µPa, and peak levels up to 175 dB re 1 µPa. Besides exhibiting startle responses, all four species examined received damage to the statocyst, which is the organ responsible for equilibrium and movement. The animals showed stressed behavior, decreased activity, and loss of muscle tone. When the shore crab *Carcinus maenas* was initially exposed to ship-noise playbacks, it consumed more oxygen, indicating a higher metabolic rate and potentially more stress; however, there were no changes in physiological responses to repeated exposure (Wale et al. 2013). Heavier crabs were more responsive than lighter crab (Wale et al. 2013). Celi et al. (2013) exposed red swamp crayfish (*Procambarus clarkia*) to linear sweeps with a frequency range of 0.1 to 25 kHz and a

peak amplitude of 148 dB re 1 µPa rms at 12 kHz for 30 min. They found that the noise exposure caused changes in the haemato-immunological parameters (indicating stress) and reduced agonistic behaviors.

Fewtrell and McCauley (2012) exposed squid (*Sepioteuthis australis*), pink snapper (*Pagrus auratus*), and trevally (*Pseudocaranx dentex*) to pulses from a single airgun. The received sound levels ranged from 120 to 184 dB re 1 dB re 1 µPa^2 · s SEL. Increases in alarm responses were seen in the squid and fish at SELs >147–151 dB re 1 µPa^2 · s; the fish swam faster and formed more cohesive groups in response to the airgun sounds, and squid were seen to discharge ink or change their swimming pattern or vertical position in the water column.

Significant developmental delays and body abnormalities in scallop larvae exposed to seismic pulses were reported by de Soto et al. (2013). Their experiment used larvae enclosed in 60-ml flasks suspended in a 2-m diameter by 1.3-m water depth tank and exposed to a playback of seismic sound at a distance of 5–10 cm. Other studies conducted in the field have shown no effects on Dungeness crab larvae or snow crab embryos (Pearson et al. 1994; DFOC 2004 *in* NSF PEIS). Moreover, a major annual scallop-spawning period occurs in the Mid-Atlantic Bight during late summer to fall (August–October), although MacDonald and Thompson (1988 in NMFS 2004) reported scallop spawning off New Jersey during September–November. The timing of the proposed survey would not coincide with the time when scallops are spawning.

Bui et al. (2013) examined the behavioral responses of Atlantic salmon (*Salmo salar L*.) to light, sound, and surface disturbance events. They reported that the fish showed short-term avoidance responses to the three stimuli. Salmon that were exposed to 12 Hz sounds and/or surface disturbances increased their swimming speeds.

Peña et al. (2013) used an omnidirectional fisheries sonar to determine the effects of a 3D seismic survey off Vesterålen, northern Norway, on feeding herring (*Clupea harengus*). They reported that herring schools did not react to the seismic survey; no significant changes were detected in swimming speed, swim direction, or school size when the drifting seismic vessel approached the fish from a distance of 27 km to 2 km over a 6 h period. Peña et al. (2013) attributed the lack of response to strong motivation for feeding, the slow approach of the seismic vessel, and an increased tolerance to airgun sounds.

Miller and Cripps (2013) used underwater visual census to examine the effect of a seismic survey on a shallow-water coral reef fish community in Australia. The census took place at six sites on the reef prior to and after the survey. When the census data collected during the seismic program were combined with historical data, the analyses showed that the seismic survey had no significant effect on the overall abundance or species richness of reef fish. This was in part attributed to the design of the seismic survey, which reduced the impacts of seismic sounds on the fish communities by exposing them to relatively low SELs (<187 dB re 1 µPa^2 · s).

Hastings and Miksis-Olds (2012) measured the hearing sensitivity of caged reef fish following exposure to a seismic survey in Australia. When the auditory evoked potentials (AEP) were examined for fish that had been in cages as close as 45 m from the pass of the seismic vessel and at water depth of 5 m, there was no evidence of temporary threshold shift (TTS) in any of the fish examined, even though the cumulative SELs had reached 190 dB re 1 µPa^2 · s.

Two spawning stocks that migrate inshore/offshore off New Jersey are the summer flounder and black sea bass. Summer flounder normally inhabit shallow coastal and estuarine waters in summer and move offshore in 60–150 m depth in fall and winter. They spawn in fall and winter (September–December) (MAFMC 1988), after the proposed seismic survey period. Black sea bass normally inhabit shallow waters in summer and move offshore and south in 75–165 m depth in fall and winter (MAFMC 1996). Spawning in the Middle Atlantic Bight population occurs primarily on the inner continental shelf

from May to July during inshore migrations (NMFS 1999), largely before the survey's proposed timing. Therefore, spawning of at least two important species would not be affected to any great degree.

(b) Effects of Sound on Fisheries

Handegard et al. (2013) examined different exposure metrics to explain the disturbance of seismic surveys on fish. They applied metrics to two experiments in Norwegian waters, during which fish distribution and fisheries were affected by airguns. Even though the disturbance for one experiment was greater, the other appeared to have the stronger SEL, based on a relatively complex propagation model. Handegard et al. (2013) recommended that simple sound propagation models should be avoided and that the use of sound energy metrics like SEL to interpret disturbance effects should be done with caution. In this case, the simplest model (exposures per area) best explained the disturbance effect.

Hovem et al. (2012) used a model to predict the effects of airgun sounds on fish populations. Modeled SELs were compared with empirical data and were then compared with startle response levels for cod. Their preliminary analyses indicated that seismic surveys should occur at a distance of 5–10 km from fishing areas, in order to minimize potential effects on fishing.

In their introduction, Løkkeborg et al. (2012) described three studies in the 1990s that showed effects on fisheries. Results of their study off Norway in 2009 indicated that fishes reacted to airgun sound based on observed changes in catch rates during seismic shooting; gillnet catches increased during the seismic shooting, likely a result of increased fish activity, whereas longline catches decreased overall (Løkkeborg et al. 2012).

(c) Conclusions for Invertebrates, Fish, and Fisheries

This newly available information does not affect the outcome of the effects assessment as presented in the PEIS. The PEIS concluded that there could be changes in behavior and other non-lethal, short-term, temporary impacts, and injurious or mortal impacts on a small number of individuals within a few meters of a high-energy acoustic source, but that there would be no significant impacts of NSF-funded marine seismic research on populations and associated EFH. The PEIS also concluded that seismic surveys could cause temporary, localized reduced fish catch to some species, but that effects on commercial and recreation fisheries were not significant.

Most commercial fish catches by weight (almost all menhaden) and most recreational fishing trips off the coast of New Jersey (87% in 2013 occur in waters within 5.6 km from shore, although the highest-value fish (e.g., flounder and tuna) are caught farther offshore. The closest distance between the proposed survey and shore is >25 km, so interactions between the proposed survey and recreational and some commercial fisheries would be relatively limited. Also, most of the recreational fishery "hotspots" described in § III are to the north or south of the proposed survey area; however, there are several hotspots located within or very near the northwestern corner of the survey area. Two possible conflicts are the *Langseth*'s streamer entangling with fixed fishing gear and temporary displacement of fishers within the survey area, although the survey area is relatively small (12 x 50 km). Fishing activities could occur within the survey area; however, a safe distance would need to be kept from the *Langseth* and the towed seismic equipment. Conflicts would be avoided and, therefore, impacts would be negligible, through communication with the fishing community and publication of a Notice to Mariners about operations in the area. No fisheries activities except vessels in transit were observed in the survey area during the 13 days that the Langseth was there in July 2014.

Survey activities are proposed to take place ~25–85 km off the coast of New Jersey. The area of the proposed survey is relatively small, ~600 km^2. If we were to make a comparison of that survey area to blocks in New York City, it would essentially be equivalent to an area of 8 by 22 city blocks. The overall

area of NJ marine waters from shore to the EEZ encompasses ~210,768 km^2. Thus the proposed survey area represents less than one half percent (0.28%) of the area of waters from the NJ shore to the EEZ (600 km^2/210,768 km^2). The survey area plus the largest mitigation zone (8.15 km) would represent less than one percent (0.88%) of the area of waters from the NJ shore to the EEZ (1159 km^2/210,768 km^2). The seismic survey is proposed to take place for ~30 days within the June to August timeframe in 2015, not over the entire time that would be allowable under the IHA. As noted previously, fishing activities would not be precluded from operating in the proposed survey area. Any impacts to fish species would occur very close to the survey vessel and would be temporary. No fish kills or injuries were observed during 2014 survey activities (Ingram et al. 2014).

Given the proposed activities, no significant impacts on marine invertebrates, marine fish, their EFH, and their fisheries would be anticipated. In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, Protected Species Observers (PSOs) and other crew members have seen no seismic sound-related fish or invertebrate injuries or mortality. Furthermore, past seismic surveys in the proposed survey area (2002, 1998, 1995, 1990) did not result in noticeable effects on commercial or recreational fish catches, based on a review of multi-year NMFS fish catch data in the months when seismic surveys were undertaken. The issuance of the Final EA, FONSI, IHA, and Biological Opinion by NMFS in July 2014 further verifies that significant impacts would not be anticipated from the proposed activities. Observations from the brief 2014 survey support this conclusion (Ingram et al. 2014).

NSF consulted in 2014, and will do so again in 2015, with the NMFS Greater Atlantic Regional Fisheries Office under the Magnuson-Stevens Act for EFH (see below "Coordination with Other Agencies and Processes" for further details). The NMFS Greater Atlantic Regional Fisheries Office concluded that the proposed activities may at some level adversely affect EFH, however, no specific conservation measures were identified for the proposed activities.

(3) Direct Effects on Seabirds and Their Significance

Effects of seismic sound and other aspects of seismic operations (collisions, entanglement, and ingestion) on seabirds are discussed in § 3.5.4 of the PEIS. The PEIS concluded that there could be transitory disturbance, but that there would be no significant impacts of NSF-funded marine seismic research on seabirds or their populations. Given the proposed activities, no significant impacts on seabirds would be anticipated. In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, Protected Species Observers (PSOs) and other crew members have seen no seismic sound-related seabird injuries or mortality. Furthermore, NSF received concurrence from USFWS in 2014 (Appendix F of the 1 July 2014 Final EA), and will seek concurrence again in 2015, that the proposed activities "may affect" but "are not likely to adversely affect" species under their jurisdiction (Appendix F of the 1 July 2014 Final EA). Observations from the July 2014 survey support this conclusion (Ingram et al. 2014).

(4) Indirect Effects on Marine Mammals, Sea Turtles, and Their Significance

The proposed seismic operations would not result in any permanent impact on habitats used by marine mammals or sea turtles, or to the food sources they use. The main impact issue associated with the proposed activities would be temporarily elevated noise levels and the associated direct effects on marine mammals and sea turtles, as discussed above.

During the proposed seismic survey, only a small fraction of the available habitat would be ensonified at any given time. Disturbance to fish species and invertebrates would be short-term, and fish would return to their pre-disturbance behavior once the seismic activity ceased. Thus, the proposed

survey would have little impact on the abilities of marine mammals or sea turtles to feed in the area where seismic work is planned. No other indirect effects on other species would be anticipated.

(5) Direct Effects on Recreational SCUBA Divers and Dive Sites and Their Significance

No significant impacts on dive sites, including shipwrecks, would be anticipated. Airgun sounds would have no effects on solid structures. The only potential effects could be temporary displacement of fish and invertebrates from the structures.

Significant impacts on, or conflicts with, divers or diving activities would be avoided through communication with the diving community before and during the survey and publication of a Notice to Mariners about operations in the area. In particular, dive operators with dives scheduled on the shipwreck *Lillian* during the survey would be contacted directly. That dive site represents only a very small percentage of the recreational dive sites in New Jersey waters. No dive vessels were observed in the survey area during the ~14 days that the Langseth was there in July 2014.

(6) Cumulative Effects

The results of the cumulative impacts analysis in the PEIS indicated that there would not be any significant cumulative effects to marine resources from the proposed NSF-funded marine seismic research. However, the PEIS also stated that, "A more detailed, cruise-specific cumulative effects analysis would be conducted at the time of the preparation of the cruise-specific EAs, allowing for the identification of other potential activities in the area of the proposed seismic survey that may result in cumulative impacts to environmental resources." Here we focus on activities that could impact animals specifically in the proposed survey area (research activities, vessel traffic, and commercial fisheries). Additionally, the 2014 NMFS EA Cumulative Effects Section on Climate Change is incorporated into this Draft Amended EA by reference as if fully set forth herein.

(a) Past and future research activities in the area

Most recently, as part of the Integrated Ocean Drilling Program (IODP), the liftboat *Kayd* conducted scientific research and drilling on Expedition 313, New Jersey Shallow Shelf, at several sites off New Jersey during 30 April–17 July 2008. In the more distant past, there have been other scientific drilling activities in the vicinity. There have also been numerous prior seismic surveys, all of which were 2-D, ranging from poor quality, low resolution data collected in 1978 to the most recent, excellent quality, high resolution but shallow penetration data from 2002. These include surveys with a 6-airgun, 1350-in^3 array in 1990; with a single, 45-in^3 GI Gun in 1995 and 1998; and with two 45-in^3 GI Guns in 2002. No seismic sound-related marine mammal, fish, or seabird injuries or mortality were observed by crew or scientists during these past seismic surveys in the proposed survey area. Other scientific research activities may be conducted in this region in the future; however, no other marine geophysical surveys are proposed at this specific site using the *Langseth* in the foreseeable future. At the present time, the proponents of the survey are not aware of other similar research activities planned to occur in the proposed survey area during the June–August 2015 timeframe, but research activities planned by other entities are possible, although unlikely.

In 2014, the *Langseth* also supported an NSF-proposed 2-D seismic survey off the coast of North Carolina to study the U.S. mid-Atlantic margin. That cruise lasted ~34 days and collected ~5000 km of track lines in September/October 2014. Additionally, the *Langseth* conducted a 2-D seismic survey (~2700 km) for ~3 weeks in August/September 2014, and may conduct a similar survey in 2015, for the USGS in support of the delineation of the U.S. Extended Continental Shelf (ECS) along the east coast. Separate EAs were prepared for those activities, and neither project would overlap with the proposed survey area.

(b) Vessel traffic

Based on data available through the Automated Mutual-Assistance Vessel Rescue (AMVER) system managed by the U.S. Coast Guard, 15–49 commercial vessels per month travelled through the proposed survey area during the months of June and July from 2008 to 2013, and for each month in 2012 and 2013 (2013 data are available for January–June, the most recent data available as of October 2014). Over 50 commercial vessels per month were recorded during this time closer to shore (particularly around New York City), to the immediate west and northwest of the proposed survey area (USCG 2013).

Live vessel traffic information is available from MarineTraffic (2014), including vessel names, types, flags, positions, and destinations. Various types of vessels were in the general vicinity of the proposed survey area when MarineTraffic (2014) was accessed on 10 and 15 October and 14 November 2014, including fishing vessels (22), pleasure craft (11), tug/towing vessels (9), cargo vessels (16), tankers (7), and research/survey, military, and dredger vessels (1 of each). There was also one unidentified ship type, with a U.S.A. flag. All but the majority of cargo vessels, the military vessel, the tankers, and two pleasure craft were U.S.A.-flagged. During the 13 days in July 2014 that the *Langseth* was in the survey area, there was limited merchant vessel activity; most merchant traffic was lining up for "safety fairway" to the west of the survey area.

The total transit distance (~5200 km) by L-DEO's vessel *Langseth* would be minimal relative to total transit length for vessels operating in the proposed survey area during June–August 2015. Thus, the projected increases in vessel traffic attributable to implementation of the proposed activities would constitute only a negligible portion of the total existing vessel traffic in the analysis area, and only a negligible increase in overall ship disturbance effects on marine mammals.

(c) Marine Mammal Disease

As discussed in § III, since July 2013, an unusually high number of dead or dying bottlenose dolphins have washed up on the mid-Atlantic coast from New York to Florida. NOAA noted that the triggers for disease outbreaks are unknown, but that contaminants and injuries may reduce the fitness of dolphin populations by stressing the immune system. Morbillivirus outbreaks can also be triggered by a drop in the immunity of bottlenose dolphin populations if they have not been exposed to the disease over time, and natural immunity wanes (NOAA 2013b). The last morbillivirus mortality event occurred in 1987–1988, when more than 740 bottlenose dolphins died along the mid-Atlantic coast from New Jersey to Florida (NOAA 2013b). During that mortality event, fungal, bacterial, and mixed bacterial and fungal pneumonias were common in the lungs of 79 dolphins that were examined, and the frequent occurrence of the fungal and bacterial infections in dolphins that also were infected by morbillivirus was consistent with morbillivirus-induced immunosuppression resulting in secondary infections (Lipscomb et al. 1994). Dr. Teri Knowles of NOAA noted that if the current outbreak evolves like the one in 1987–1988, "we're looking at mortality being higher and morbillivirus traveling southwards and continuing until May 2014." In fact, as of mid October 2014 it is still continuing, although recently, the number of strandings appear to be decreasing, especially in the northern states; between 17 August and 19 October, there were 2, 3, 4, and 0 strandings in NY, NJ, DE, and MD, respectively. Dr. Knowles also speculated that environmental factors, such as heavy metal pollution and sea surface temperature changes, could also play a role in the current outbreak (National Geographic Daily News 2013). It seems unlikely that the short-term behavioral disturbance that could be caused by the proposed seismic survey, especially for dolphins, would contribute to the development or continuation of a morbillivirus outbreak. Although NSF has contacted the NMFS Greater Atlantic Regional Fisheries Office Marine Mammal Response Coordinator, strandings from the proposed activities would not be anticipated. Therefore, the proposed activities would not be anticipated to increase the level of coordination necessary for stranding networks and

associated budgets or impact the NJ Animal Health Diagnostic Laboratory budget, which has been involved with funding efforts related to the recent bottlenose dolphin morbillivirus mortality event.

(d) Fisheries

The commercial and recreational fisheries in the general area of the proposed survey are described in § III. No fisheries activities except vessels in transit were observed in the survey area during the 13 days that the Langseth was there in July 2014. The primary contributions of fishing to potential cumulative impacts on marine mammals and sea turtles involve direct removal of prey items, noise, potential entanglement (Reeves et al. 2003), and the direct and indirect removal of prey items. In U.S. waters, numerous cetaceans (mostly delphinids) and pinnipeds suffer serious injury or mortality each year from fisheries; for example, for the species assessed by Waring et al. (2013), average annual fishery-related mortality during 2006–2010 in U.S. Atlantic waters included 164 common dolphins, 212 Atlantic white-sided dolphins, 791 harbor porpoises, and 1466 harbor, gray, and harp seals. There may be some localized avoidance by marine mammals of fishing vessels near the proposed seismic survey area. L-DEO's operations in the proposed survey area are also limited (duration of ~1 month), and the combination of L-DEO's operations with the existing commercial and recreational fishing operations in the region is expected to produce only a negligible increase in overall disturbance effects on marine mammals and sea turtles.

(e) Military Activity

The proposed survey is located within the U.S. Navy's Atlantic City Range Complex (ACRC). The Boston, Narragansett Bay, and Atlantic City range complexes are collectively referred to as the Northeast Range Complexes. The types of activities that could occur in the ACRC would include the use of active sonar, gunnery events with both inert and explosive rounds, bombing events with both inert and explosive bombs, and other similar events. The ACRC includes special use airspace, Warning Area W-107. The ACRC is an active area, but there is typically relatively limited activity that occurs there. There has only been limited activity in the past, and there were no conflicts during the 2014 survey. L-DEO and NSF are coordinating, and would continue to coordinate, with the U.S. Navy to ensure there would be no conflicts in 2015.

(f) Oil and Gas Activities

Oil and gas activities are managed by BOEM. If BOEM were interested in oil and gas development activities in the survey area, BOEM would need to prepare the appropriate analyses under NEPA, followed by other consultation processes under such federal statutes as the MMPA, ESA, EFH, and CZMA. The proposed survey site is outside of the BOEM Atlantic Outer Continental Shelf Proposed Geological and Geophysical (G&G) Activities in the Mid-Atlantic and South Atlantic Planning Areas (BOEM 2014). The current BOEM mid-Atlantic and South Atlantic activities would be the preliminary surveys that are necessary for BOEM and industry to determine resource potential, and to provide siting information for renewable energy and marine minerals activities; lease sales in those areas have not yet been considered. The final BOEM Record of Decision for the proposed action was issued in July 2014.

Whereas it is theoretically possible that the oil and gas industry may be interested in the architecture of the passive margin area in the survey region for application to other locations (see Appendix B, page C-15, of the 1 July 2014 Final EA), there are no known interests for G&G activities, including oil and gas exploration, in or around the proposed survey site. The proposed seismic survey is not related to nor would it lead to offshore drilling; the proposed activities would evaluate sea level change as described here and in the 2014 Final EA and there are no additional activities proposed beyond those by the PIs or NSF (i.e., there are no proposed oil and gas exploration activities associated with the proposed activities).

Seismic surveys in support of research activities have occurred in the survey area in the recent past (2002, 1998, 1995, 1990). Additionally, NJDEP conducted a seismic survey (boomer/sparker source) in 1985 off the coast of New Jersey (Waldner and Hall 1991). Oil and gas activities in the proposed survey area have not resulted from these similar research seismic surveys. Therefore, it would not be logical to assume that the proposed research seismic survey would result in oil and gas development.

Given the potential distance from any future BOEM G&G activities in the region and separation in time with the proposed activities, no cumulative effects would be anticipated.

(7) Unavoidable Impacts

Unavoidable impacts to the species of marine mammals, sea turtles, seabirds, fish, and invertebrates occurring in the proposed survey area would be limited to short-term, localized changes in behavior of individuals. For cetaceans, some of the changes in behavior may be sufficient to fall within the MMPA definition of "Level B Harassment" (behavioral disturbance; no serious injury or mortality). TTS, if it occurs, would be limited to a few individuals, would be a temporary phenomenon that does not involve injury, and would be unlikely to have long-term consequences for the few individuals involved. No long-term or significant impacts would be expected on any of these individual marine mammals, sea turtles, seabirds, fish, and invertebrates or on the populations to which they belong. Effects on recruitment or survival would be expected to be (at most) negligible.

(8) Public Involvement and Coordination with Other Agencies and Processes

For the 2014 survey, NSF posted the Draft Environmental Assessment (Draft EA) on the NSF website for a 30 day public comment period from 3 February to 3 March 3, 2014, but received no comments during the open comment period. As noted below, public comments were received during the NMFS IHA process in June 2014, and although not received as part of the NSF NEPA process, NSF considered the responses with respect to the information included in the Draft EA and refinements were made and additional information included in the Final EA. The new information included in the 2014 Final EA and in this NSF Draft Amended EA remain consistent with the conclusions in the PEIS. This Draft Amended EA will also be posted on the NSF website for a 30 day public comment period.

This Draft Amended EA was prepared by LGL on behalf of L-DEO and NSF pursuant to NEPA. Potential impacts to endangered species and critical habitat were also assessed in the document; therefore, it will be used to coordinate and support other consultations with federal agencies as required and noted below.

Endangered Species Act (ESA)

For 2014 survey activities, NSF engaged in formal consultation with NMFS and informal consultation with USFWS pursuant to Section 7 of the ESA. NSF received concurrence from USFWS that the proposed activities "may affect" but "are not likely to adversely affect" species under their jurisdiction (Appendix F of the 1 July 2014 Final EA). Mitigation measures would include power-downs/shut-downs for foraging endangered or threatened seabirds. NMFS issued a Biological Opinion and an Incidental Take Statement (Appendix C of the 1 July 2014 Final EA) on 1 July 2014 for the proposed activities and consultation was concluded. For operational purposes and coordination with monitoring and mitigation measures required under the IHA, the Exclusion Zone for sea turtles and foraging seabirds was expanded to the 177db isopleth.

NSF will consult under ESA Section 7 again with NMFS and USFWS for proposed 2015 activities.

Marine Mammal Protection Act (MMPA)

For 2014 survey activities, L-DEO submitted to NMFS an IHA pursuant to the MMPA. On 17 March 2014, NMFS issued in the Federal Register a Notice of Intent to issue an IHA for the survey and 30-day public comment period. In response to public comment request, NMFS extended the public comment period an additional 30 days, for a total of 60 days. As noted above, public comments were received as part of the IHA process (Appendix G of the 1 July 2014 Final EA) and, although not received as part of the NSF NEPA process, NSF considered the responses with respect to the information included in the Draft EA. NMFS prepared a separate EA for its federal action of issuing an IHA; NMFS's EA (Appendix E of the 1 July 2014 Final EA) is hereby incorporated by reference in this NSF Draft Amended EA as appropriate and where indicated. NMFS issued an IHA on 1 July 2014 (Appendix D of the 1 July 2014 Final EA). The IHA stipulated monitoring and mitigation measures, including additional mitigation measures beyond those proposed in the NSF Draft EA and IHA Application, such as an expanded Exclusion Zone (177-dB isopleth) and a one minute shot interval for the 40-in^3 mitigation airgun.

As required by NMFS, L-DEO will submit a new IHA application to NMFS for the proposed 2015 activities. NSF and LDEO would adhere to the IHA requirements for the proposed action.

NMFS Marine Mammal Stranding Program

Although marine mammal strandings were not anticipated as a result of the 2014 survey activities, during ESA Section 7 and MMPA consultation with NMFS it was recommended that the NMFS Greater Atlantic Regional Fisheries Office Marine Mammal Response Coordinator be contacted regarding the proposed activity. Both NMFS and NSF made contact with that coordinator. NSF and NMFS will contact the NMFS Greater Atlantic Regional Fisheries Office Marine Mammal Response Coordinator again regarding proposed 2015 activities. Should any marine mammal strandings occur during the survey, NMFS and the NMFS Greater Atlantic Regional Fisheries Office Marine Mammal Response Coordinator would be contacted. No strandings associated with seismic activities were reported during 2014 survey operations.

Magnuson Stevens Act - Essential Fish Habitat (EFH)

The Magnuson Stevens Act requires that a federal action agency consult with NMFS for actions that "may adversely affect" EFH. Although adverse effects on EFH, including a reduction in quantity or quality of EFH, were not anticipated by the 2014 survey activities, NSF contacted the EFH Regional Coordinator of the NOAA Greater Atlantic Regional Fisheries Office regarding the proposed activities. The EFH Regional Coordinator concluded in a letter dated 18 June 2014, however, that some level of adverse effects to EFH may occur as a result of the proposed activities (Appendix H of the 1 July 2014 Final EA). Additional research and monitoring to gain a better understanding of the potential effects that seismic surveys may have on EFH, federal managed species, their prey, and other NOAA trust resources was recommended for future NSF activities. No project-specific EFH conservation recommendations were provided, however, and consultation was concluded.

NSF will consult again with the Regional Coordinator of the NOAA Greater Atlantic Regional Fisheries Office regarding the proposed 2015 survey activities.

Coastal Zone Management Act (CZMA)

For the 2014 survey, per the requirements of the CZMA, NSF reviewed the New Jersey Coastal Management Program (CMP) Federal Consistency Listings and determined that the proposed activity was unlisted. NSF contacted NOAA's Office of Ocean and Coastal Resource Management (OCRM) to

discuss CZMA implications regarding the proposed project. NSF, OCRM, and the New Jersey Department of Environmental Protection (NJDEP) engaged in several conversations regarding the proposed activity. On 20 May, OCRM received by email NJDEP's request for approval to review the NSF assistance to Rutgers as an unlisted activity under Subpart F and for OCRM to concur that the operation of the vessel was subject to Subpart C (Appendix I of the 1 July 2014 Final EA). OCRM submitted a letter to NSF requesting information about the proposed project (Appendix J of the 1 July 2014 Final EA). NSF provided a response to OCRM per request, also noting NSF's position that the proposed activities were applicable to Subpart F and that the NJDEP request to review was untimely (Appendix K of the 1 July 2014 Final EA). NSF further set forth its position that the operation of the vessel was pursuant to a cooperative agreement that had been approved years ago, and, thus, the time for consistency review had passed. In response to the NJDEP request, OCRM concluded in its letter dated 18 June 2014 that the proposed project falls under Subpart F, not Subpart C, of the regulations implementing CZMA and determined that the NJDEP request to review the project under Subpart F was untimely (Appendix L of the 1 July 2014 Final EA). No further action was required by NSF or the PIs under CZMA for 2014 activities.

NSF has contacted the NJDEP and OCRM regarding CZMA obligations for proposed 2015 survey activities and will comply as appropriate.

Alternative Action: Another Time

An alternative to issuing the IHA for the period requested, and to conducting the Project then, is to issue the IHA for another time, and to conduct the project at that alternative time. The proposed dates for the cruise (~34 days in June–August) are the dates when the personnel and equipment essential to meet the overall project objectives are available; if the date of the cruise were changed, for example to late spring or early fall, it is likely that the *Langseth* would not be available and, thus, the purpose and need of the proposed activities could not be met. If the IHA is issued for another period, it could result in significant delay and disruption not only of this cruise, but also of additional studies that are planned on the *Langseth* for 2015 and beyond.

The weather in the mid-Atlantic Ocean was taken into consideration when planning the proposed activities. The mid-Atlantic Ocean off New Jersey can be challenging to operate during certain times of year, precluding the ability to safely tow seismic gear. Whereas conducting the survey at an alternative time is a viable alternative if the *Langseth*, personnel, and essential equipment are available, because of the weather conditions, it would not be viable to conduct a seismic survey in winter months off the coast of New Jersey.

Marine mammals and sea turtles are expected to be found throughout the proposed survey area and throughout the time during which the project would occur. Some marine mammal species are expected to occur in the area year-round, so altering the timing of the proposed project likely would result in no net benefits for those species. Some migratory species are expected to be farther north at the time of the survey, so the survey timing is beneficial for those species (see § III, above). In particular, migration of the North Atlantic right whale occurs mostly between November and April, and the survey is timed to avoid those months. Accordingly, the alternative action would likely result in either a failure to meet the purpose and need of the proposed activities or it would raise the risk of causing impacts to species such as the North Atlantic right whale.

No Action Alternative

An alternative to conducting the proposed activities is the “No Action” alternative, i.e. do not issue an IHA and do not conduct the operations. If the research were not conducted, the “No Action” alternative would result in no disturbance to marine mammals or sea turtles attributable to the proposed activities, however valuable data about the marine environment would be lost. Research that would contribute to the understanding of the response of nearshore environments to changes in elevation of global sea level would be lost and greater understanding of Earth processes would not be gained. The “No Action” alternative could also, in some circumstances, result in significant delay of other studies that would be planned on the *Langseth* for 2015 and beyond, depending on the timing of the decision. Not conducting this cruise (no action) would result in less data and support for the academic institutions involved. Data collection would be an essential first step for a much greater effort to analyze and report information for the significant topics indicated. The field effort would provide material for years of analyses involving multiple professors, students, and technicians. The lost opportunity to collect valuable scientific information would be compounded by lost opportunities for support of research infrastructure, training, and professional career growth. The research goals and objectives cannot be achieved using existing scientific data. Existing seismic profiles occur at intervals too coarse to achieve the proposed scientific goals of this project. Both the larger spacing and the limitations inherent in processing 2-D seismic data preclude identification of key features of the past margin such as river or delta channels and shoreline adjustments. Only dense and 3-D seismic acquisition and processing can provide continuity of imaging to enable confident identification of these features, whose distributions are expected to evolve throughout the time period recorded in the sediments targeted. The no Action Alternative would not meet the purpose and need for the proposed activities.

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APPENDIX A:

ACOUSTIC MODELING OF SEISMIC ACOUSTIC SOURCES AND SCALING FACTORS FOR SHALLOW WATER[4]

For the proposed survey off New Jersey, a smaller energy source than the full airgun array available on the R/V *Langseth* would be sufficient to collect the desired geophysical data. Previously conducted calibration studies of the *Langseth*'s airgun arrays, however, can still inform the modeling process used to develop mitigation radii for the currently proposed survey.

Acoustic Source Description

This 3-D seismic data acquisition project would use two airgun subarrays that would be fired alternately as the ship progresses along track (one subarray would be towed on the port side and the other on the starboard side). Each airgun subarray would consist of four airguns (total volume 700 in^3). The subarrays would use subsets of the linear arrays or "strings" composed of Bolt 1500LL and Bolt 1900LLX airguns that are carried by the R/V *Langseth* (Figure A1): four airguns in one string would be fired simultaneously, and the other six airguns on the string would be inactive. The subarray tow depth would be either 4.5 m (desired tow depth) or 6 m (in case of weather degradation). The subarray would be fired roughly every 5.4 s. At each shot, a brief (~0.1 s) pulse of sound would be emitted, with silence in the intervening periods. This signal attenuates as it moves away from the source, decreasing in amplitude and increasing in signal duration.

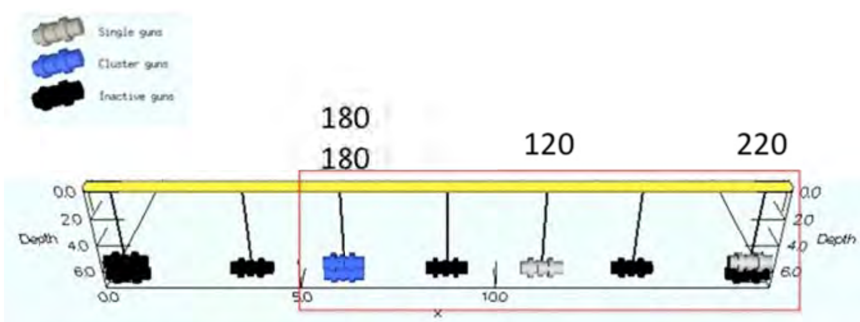


FIGURE A1. Four-airgun subset of one string that would be used as a 700-in^3 subarray for the proposed survey (individual volumes are indicated).

Four-Airgun Subarray Specifications

Energy Source	1950-psi Bolt airguns with volumes 120–220 in^3, arranged in one string of four operating airguns
Towing depth of energy source	4.5 m or 6 m
Source output (downward), 4.5 m	0-pk is 240.4 dB re 1 μPa · m; pk-pk is 246.3 dB re 1 μPa · m
Source output (downward), 6 m	0-pk is 240.4 dB re 1 μPa · m; pk-pk is 246.7 dB re 1 μPa · m
Air discharge volume	~700 in^3
Dominant frequency components	0–188 Hz

Because the actual source originates from 4 airguns rather than a single point source, the highest sound levels measurable at any location in the water is less than the nominal source level. In addition, the

[4] Helene Carton, Ph.D., L-DEO.

effective source level for sound propagating in near-horizontal directions would be substantially lower than the nominal source level applicable to downward propagation because of the directional nature of the sound from the airgun array.

Modeling and Scaling Factors

Propagation measurements were obtained in shallow water for the *Langseth*'s 18-gun, 3300-in^3 (2-string) array towed at 6 m depth, in both crossline (athwartship) and inline (fore and aft) directions. Results were presented in Diebold et al. (2010), and part of their Figures 5 and 8 are reproduced here (Figure A2). The crossline measurements, which were obtained at ranges ~2 km to ~14.5 km, are shown along with the 95th percentile fit (Figure A1, top panel). This allows extrapolation for ranges <2 km and >14.5 km, providing 150 dB SEL, 170 dB SEL and 180 dB SEL distances of 15.28 km, 1097 m, and 294 m, respectively. Note that the short ranges were better sampled in inline direction including by the 6-km long MCS streamer (Figure A2, bottom panel). The measured 170-dB SEL level is at 370-m distance in inline direction, well under the extrapolated value of 1097 m in crossline direction, and the measured 180-dB SEL level is at 140-m distance in inline direction, also less than the extrapolated value of 294 m in crossline direction. Overall, received levels are ~5 dB lower inline than they are crossline, which results from the directivity of the array (the 2-string array being spatially more extended in fore and aft than athwartship directions). Mitigation radii based on the crossline measurements are thus the more conservative ones and are therefore proposed to be used as the basis for the mitigation zone for the proposed activity.

The empirically derived crossline measurements obtained for the 18-gun, 3300-in^3 array in shallow water in the Gulf of Mexico, described above, are used to derive the mitigation radii for the proposed New Jersey margin 3-D survey that would take place in June–August 2015 (Figure A3). The entire survey area would be located in shallow water (<100 m). The source for this survey would be a 4-gun, 700-in^3 subset of 1 string at 4.5- or 6-m tow depth. The differences in array volumes, airgun configuration and tow depth are accounted for by scaling factors calculated based on the deep-water L-DEO model results (shown in Figures A4 to A6).

The scaling procedure uses radii obtained from L-DEO models. Specifically, from L-DEO modeling, 150-, 170-, and 180-dB SEL isopleths for the 18-gun, 3300-in^3 array towed at 6-m depth have radii of 4500, 450, and 142 m, respectively, in deep water (Figure A3). Similarly, the 150-, 170-, and 180-dB SEL isopleths for the 4-gun, 700-in^3 subset of 2 strings array towed at 4.5 m depth have radii of 1544, 155, and 49 m, respectively, in deep water (Figure A4). Taking the ratios between both sets of deep-water radii yields scaling factors of 0.3431–0.3451. These scaling factors are then applied to the empirically derived shallow water radii for the 3300-in^3 array at 6-m tow depth, to derive radii for the suite of proposed airgun subsets. For example, when applying the scaling ratios for the 4-gun, 700-in^3 array at 4.5-m tow depth, the distances obtained are 5.24 km for 150 dB SEL (proxy for SPL 160 dB rms), 378 m for 170 dB SEL (SPL 180 dB rms), and 101 m for 180 dB SEL (SPL 190 dB rms).

The same procedure is applied for the suite of arrays:

(1) 4-gun 700 in^3 array, subset of 1 string at 4.5 m tow depth (Figure A4)

(2) 4-gun 700 in^3 array, subset of 1 string at 6 m tow depth (Figure A5)

(3) Single 40 in^3 mitigation gun at 6 m tow depth (Figure A6)

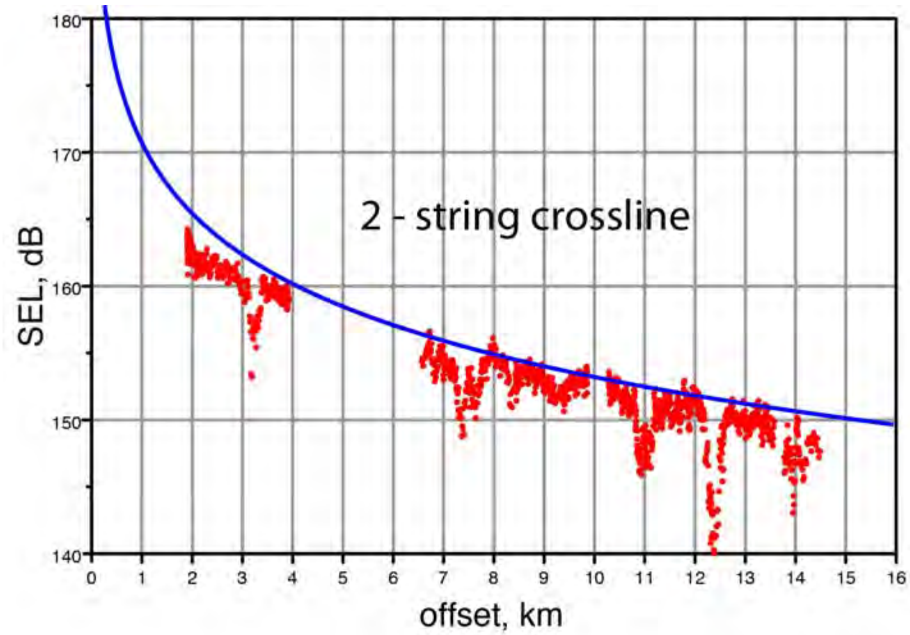


Figure 5a. Sound Exposure Levels for the crossline (side aspect) arrivals recorded along the spiral track at the shallow water calibration site, with a 95th percentile fit (using the methods described by Tolstoy et al., 2009).

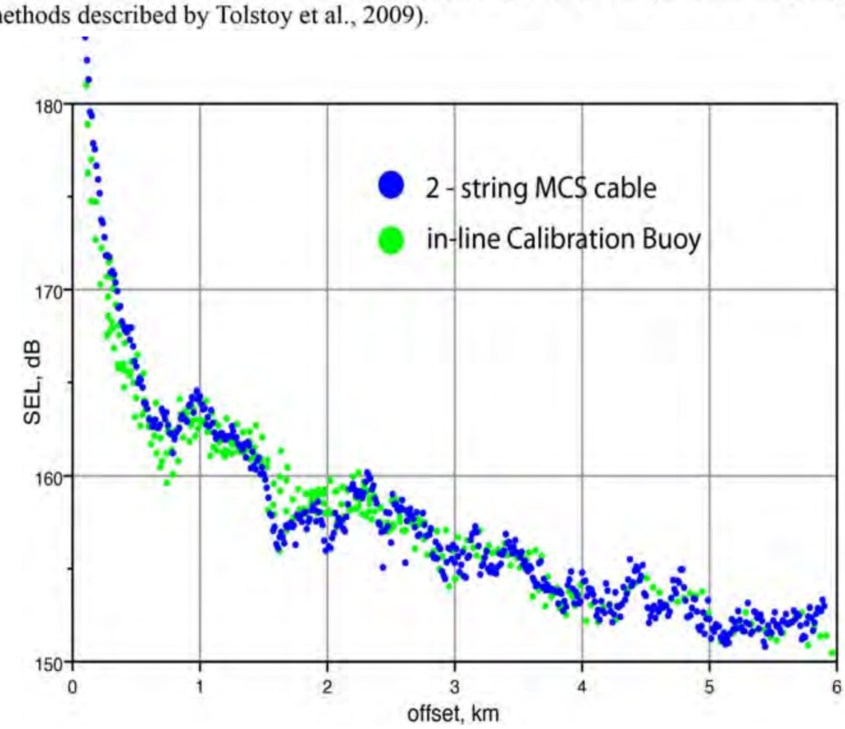
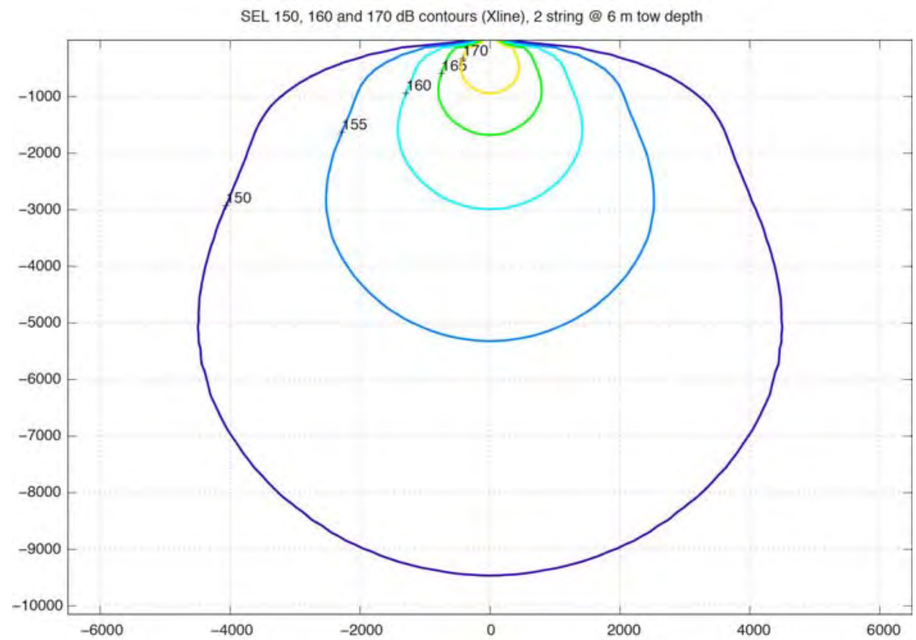


FIGURE A2. R/V *Langseth* Gulf of Mexico calibration results for the 18-gun, 3300-in^3, 2-string array at 6-m depth obtained at the shallow site (Diebold et al. 2010).



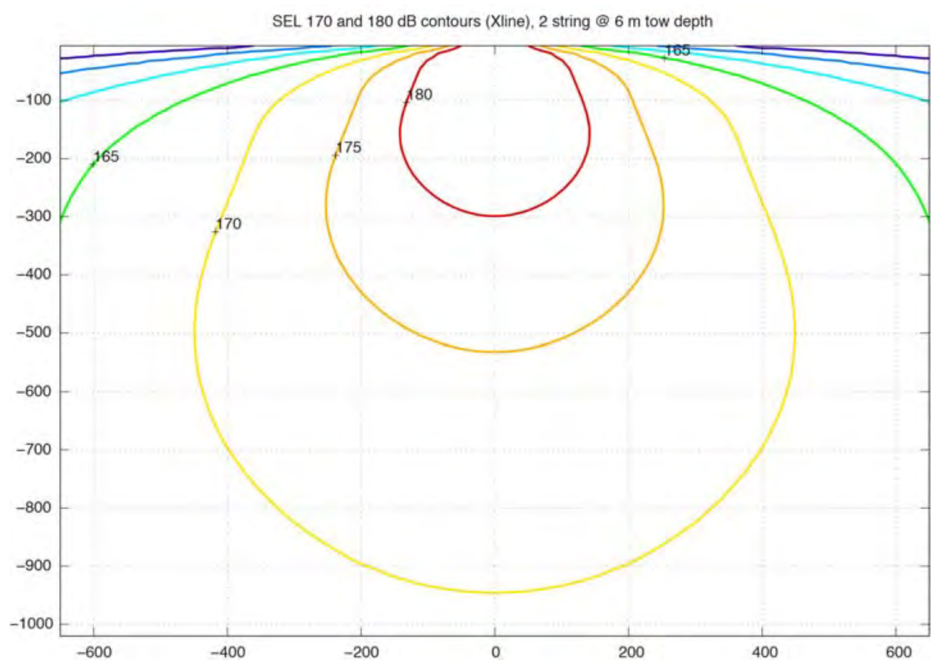


FIGURE A3. Deep-water model results for the 18-gun, 3300-in^3, 2-string array at 6-m tow depth, the configuration that was used to collect calibration measurements presented in Figure 2. The 150-dB SEL, 170-dB SEL, and 180-dB SEL (proxies for SPLs of 160, 180, and 190 dB rms[5]) distances can be read at 4500 m, 450 m, and 142 m.

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[5] Sound sources are primarily described in sound pressure level (SPL) units. SPL is often referred to as rms or "root mean square" pressure, averaged over the pulse duration. Sound exposure level (SEL) is a measure of the received energy in a pulse and represents the SPL that would be measured if the pulse energy were spread evenly across a 1-s period.

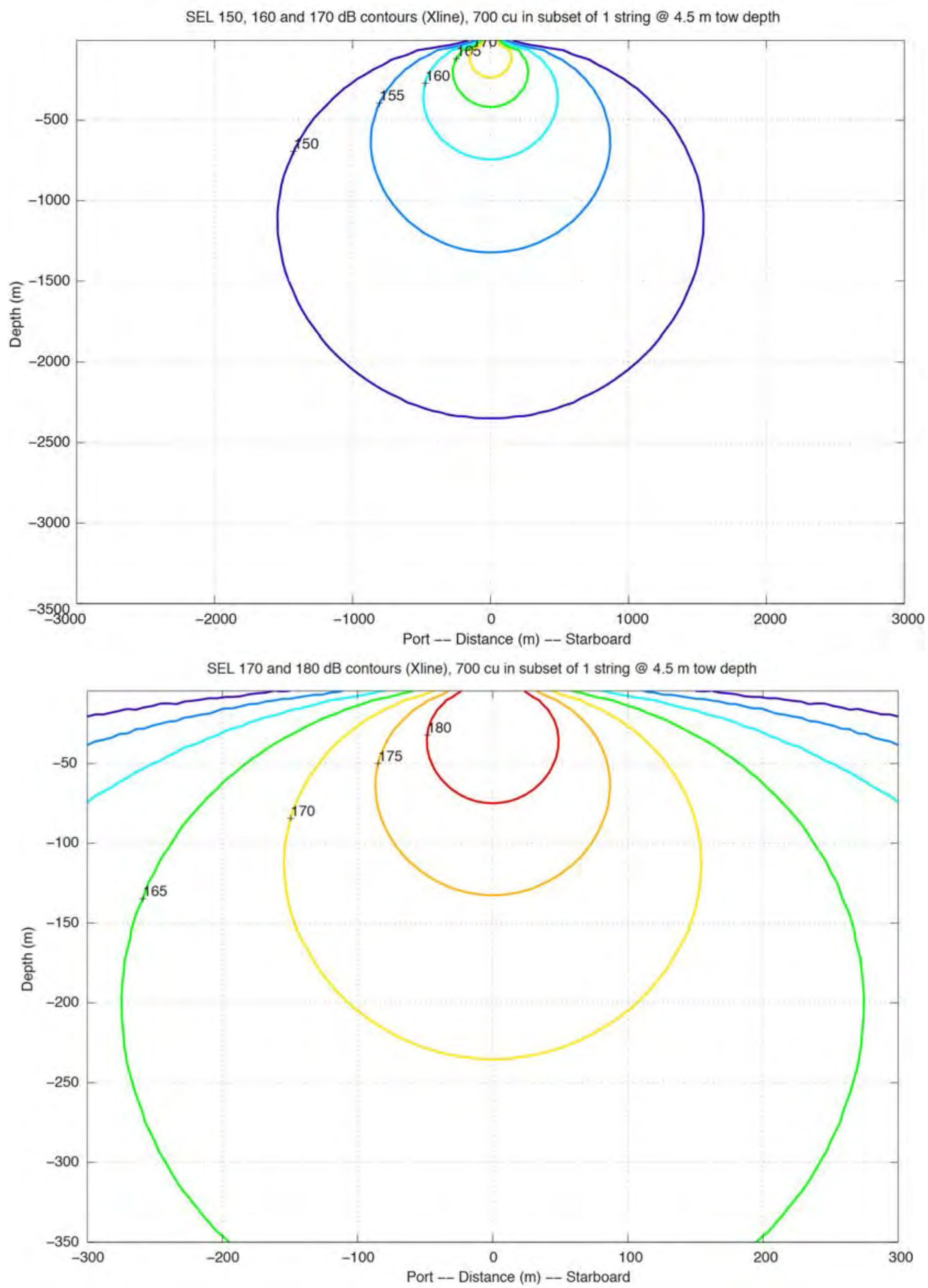

FIGURE A4. Deep-water model results for the 4-gun, 700-in^3 subset of 1-string array at 4.5-m tow depth that could be used for the NJ margin 3D survey. The 150-dB SEL, 170-dB SEL, and 180-dB SEL distances can be read at 1544 m, 155 m, and 49 m, respectively.

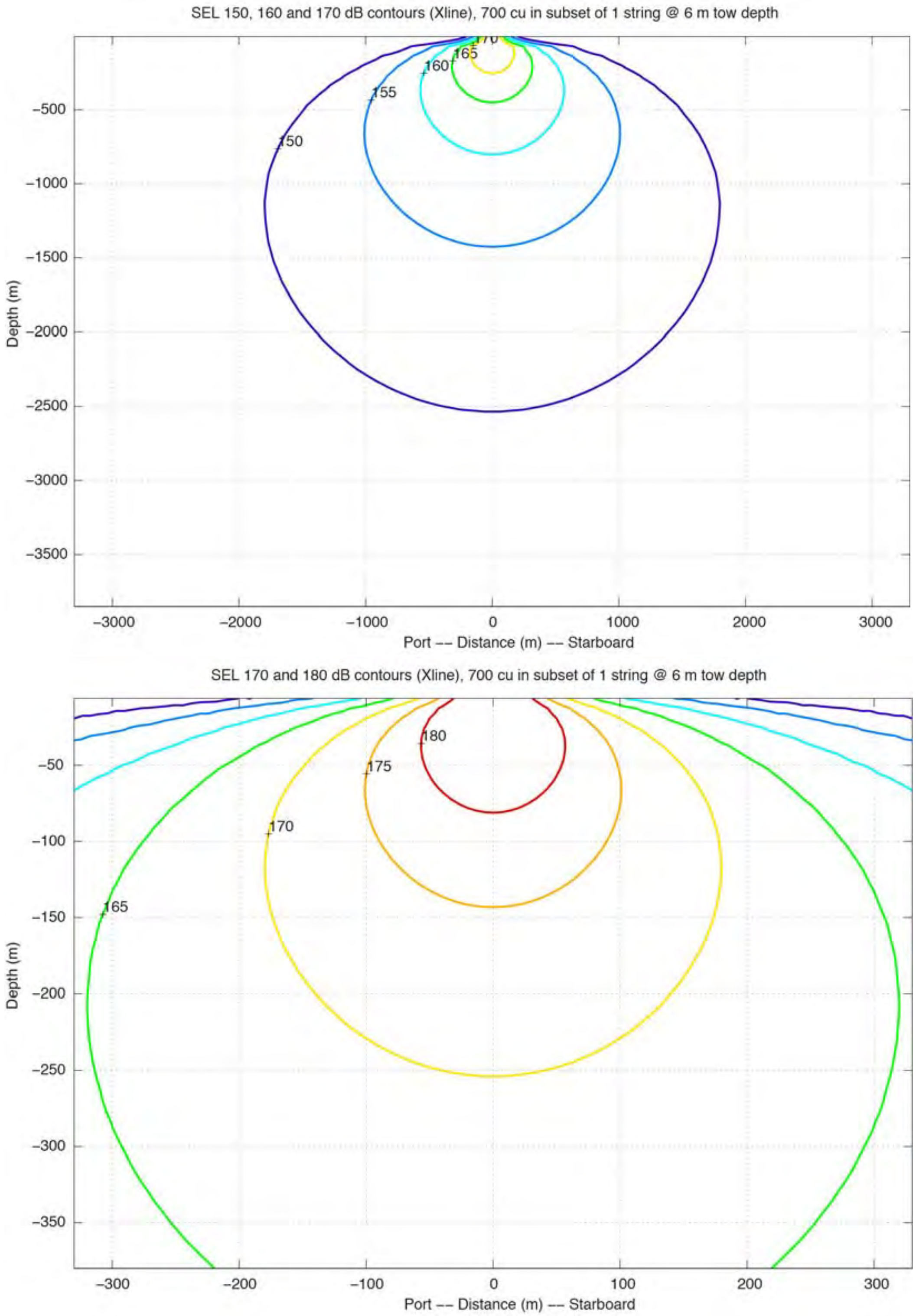

FIGURE A5. Deep-water model results for the 4-gun, 700-in^3 subset of 1-string array at 6m tow depth that could be used for the NJ margin 3-D survey. The 150-dB SEL, 170-dB SEL, and 180-dB SEL distances can be read at 1797 m, 180 m, and 57 m, respectively.

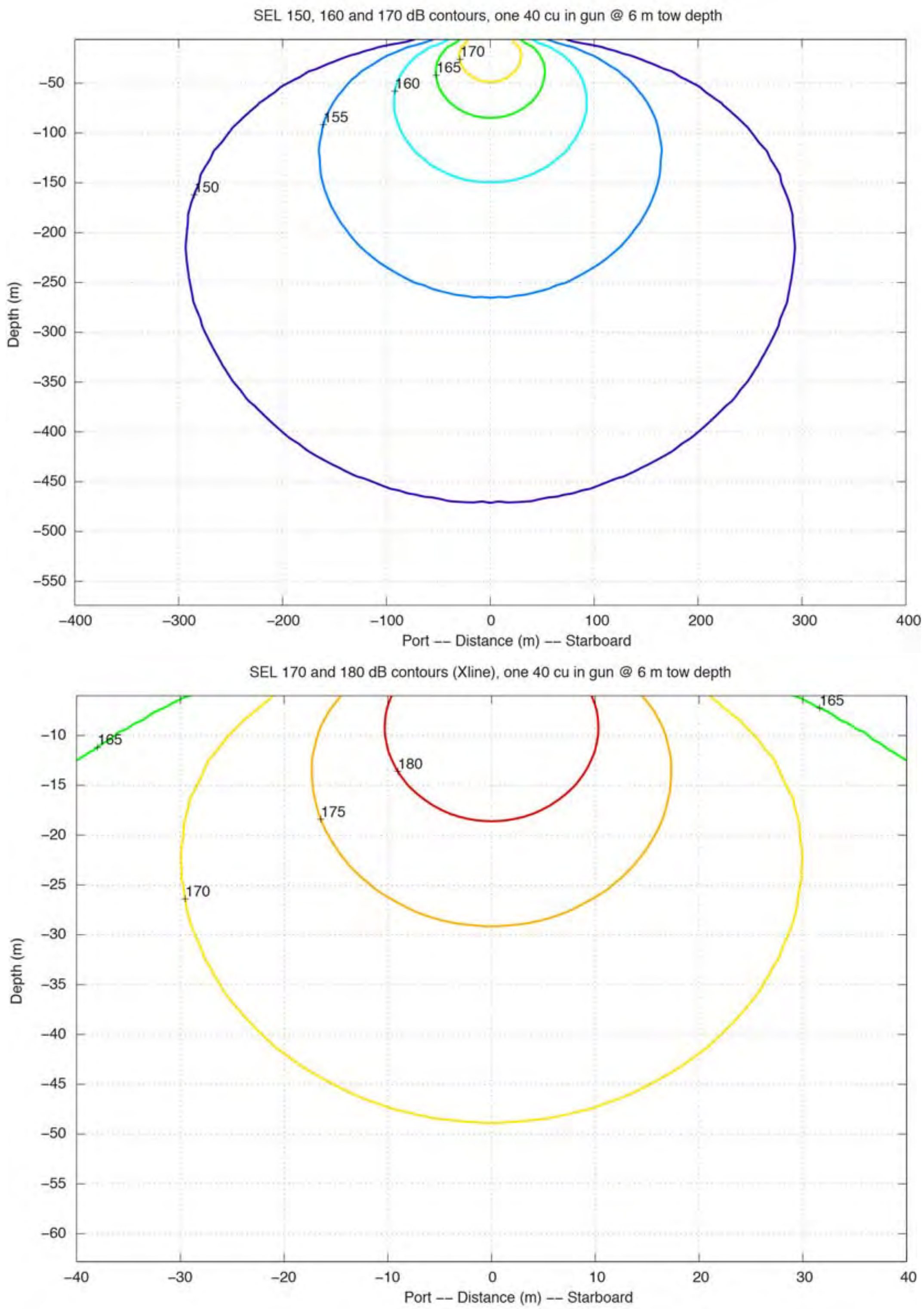

FIGURE A6. Deep-water model results for the single 40-in^3 Bolt airgun at 6-m tow depth. The 150-dB SEL, 170-dB SEL, and 180-dB SEL distances can be read at 293 m, 30 m, and 10 m, respectively.

The derived shallow water radii are presented in Table A1. The final values are reported in Table A2.

TABLE A1. Table summarizing scaling procedure applied to empirically derived shallow-water radii to derive shallow-water radii for various array subsets that could be used during the New Jersey margin 3D survey.

Calibration Study: 18-gun, 3300-in³ @ 6-m depth	**Deep water radii (m)** (from L-DEO model results)		**Shallow Water Radii (m)** (Based on empirically-derived crossline Measurements)
	150 dB SEL: 4500		15280
	170 dB SEL: 450		1097
	180 dB SEL: 142		294
Proposed Airgun sources	**Deep water radii** (from L-DEO model results)	**Scaling factor** *[Deep-water radii for 18-gun 3300-in³ array @ 6 m depth]*	**Shallow water radii (m)** *[Scaling factor **x** shallow water radii for 18-gun 3300 in³ array @ 6 m depth]*
Source #1: 4-gun, 700-in³ @ 4.5-m depth	150 dB SEL: 1544 m	0.3431	5240
	170 dB SEL: 155 m	0.3444	378
	180 dB SEL: 49 m	0.3451	101
Source #2: 4-gun, 700-in³ @ 6-m depth	150 dB SEL: 1797 m	0.3993	6100
	170 dB SEL: 180 m	0.4000	439
	180 dB SEL: 57 m	0.4014	118
Source #3: Single 40-in³ @ 6-m depth	150 dB SEL: 293 m	0.0651	995
	170 dB SEL: 30 m	0.0667	73
	180 dB SEL: 10 m	0.0704	21

TABLE A2. Predicted distances in meters to which sound levels ≥ 180 and 160 dB re 1 μPa_{rms} would be received during the proposed 3-D survey off New Jersey, using a 4-gun, 700-in^3 subset of 1 string at 4.5- or 6-m tow depth and the 40-in^3 airgun during power-downs. Radii are based on Figures A2 to A6 and scaling described in the text and Table A1, assuming that received levels on an rms basis are, numerically, 10 dB higher than the SEL values.

Source and Volume	Water Depth	Predicted RMS Radii (m) 180 dB	160 dB
4-airgun subarray (700 in³) @ 4.5 m	<100 m	378	5240
4-airgun subarray (700 in³) @ 6 m	<100 m	439	6100
Single Bolt airgun (40 in³) @ 6 m	<100 m	73	995

APPENDIX J
COASTAL ZONE MANAGEMENT ACT COMPLIANCE – NEW JERSEY

NATIONAL SCIENCE FOUNDATION
4201 WILSON BOULEVARD
ARLINGTON, VIRGINIA 22230

December 22, 2014

Ms. Virginia KopKash
Assistant Commissioner
Land Use Management
State of New Jersey
Department of Environmental Protection
P.O. Box 420
Mail Code: 401-07B
Trenton, New Jersey 08625-0420

RE: Consistency Determination for a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015

Dear Ms. KopKash:

In 2014, National Science Foundation (NSF) funded a research project proposed by lead Principal Investigator (PI) Dr. Gregory Mountain of Rutgers University and collaborators Drs. J. Austin, C. Fulthorpe, and M. Nedimovic of University of Texas Austin to study sea level rise in the Atlantic Ocean off of the coast of New Jersey which included a marine geophysical survey. NSF's environmental compliance, including all federal regulatory obligations, was completed for the research activity on July 1, 2014, and the survey commenced. Unfortunately due to mechanical issues with the vessel, the survey was unable to be completed during the effective periods of the Incidental Harassment Authorization (IHA) and Incidental Take Statement (ITS) issued for the survey. NSF is interested in rescheduling the research survey for a 30 day period during June-August 2015, approximately the same time frame as originally planned and authorized in 2014. According to National Marine Fisheries Service (NMFS), a new IHA is required to reschedule the survey in 2015. As such, per the Coastal Zone Management Act (CZMA), Subpart D, the state of New Jersey has the opportunity to review unlisted federal license or permit activities for consistency. NSF contacted New Jersey Department of Environmental Protection (NJDEP) on October 15, 2014 to confirm the State's interest in reviewing the unlisted activity and NJDEP confirmed interest. NSF has prepared a Draft Amended Environmental Assessment (EA) (Attachment 1) to address NSF's requirements under the National Environmental Policy Act (NEPA) of 1969, as amended, for the proposed NSF federal action and in support of other necessary regulatory processes.

The proposed collaborative research objectives and efforts remain unchanged from those planned in 2014. The proposed research efforts would include the collection and analysis of data on the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to the present. Despite their existence being clearly indicated in sediment cores recovered during International Ocean Discovery Program (IODP) Expedition 313, features such as river valleys cut into coastal plain sediments, now buried under a kilometer (km) of younger sediment and flooded by today's ocean, cannot be resolved in existing 2-D seismic data to the degree required to map shifting shallow-water depositional settings in the vicinity of clinoform rollovers. To achieve the project's goals, the PIs propose to use a 3-D seismic reflection survey to map sequences around existing IODP Expedition 313 drill sites and analyze their spatial/temporal evolution. Objectives that would then be met include establishing the impact of known Ice House base-level changes on the stratigraphic record; providing greater understanding of the response of nearshore environments to changes in elevation of global sea level; and determining the amplitudes and timing of global sea-level changes during the mid-Cenozoic era.

The proposed seismic survey would be conducted on the NSF-owned research vessel (R/V) *Marcus G. Langseth (Langseth)*, which is operated on our behalf by Columbia University's Lamont-Doherty Earth Observatory (L-DEO). The proposed activity is not related to energy resources or facilities, including oil and gas exploration, development, production, or lease sales, and therefore is not subject to Bureau of Ocean Energy Management regulatory jurisdiction pursuant to the Outer Continental Shelf Lands Act. The proposed activity is also not related to ocean mining.

Although NSF does not anticipate effects on the coastal resources of New Jersey as a consequence of the proposed research activity, due to the circumstances surrounding the 2014 survey and New Jersey's expressed interest in reviewing the proposed 2015 survey, NSF has chosen to submit this Consistency Determination. Due to these unique circumstances, NSF does not consider this to be precedent setting in that all future NSF seismic surveys would require a Consistency Determination but would rather depend on the unique circumstances associated with each site specific survey.

The attached NSF Consistency Determination for the proposed seismic survey is based on review of the proposed activity's conformance with New Jersey's Coastal Management Program enforceable policies, which are contained in the Coastal Zone Management rules (N.J.A.C. 7:7E), the Coastal Permit Program rules, (N.J.A.C. 7:7), the Freshwater Wetlands Protection Act rules, (N.J.A.C. 7:7A), Stormwater Management rules, (N.J.A.C. 7:8), New Jersey Pollutant Discharge Elimination Systems rules, (N.J.A.C. 7:14A, Subchapters 1, 2, 5, 6, 11, 12, 13, 15, 16, 18, 19, 20, 21, 24 and 25), and the Hackensack Meadowlands District Zoning Regulations (N.J.A.C. 19:4 portions of Subchapters 2, 3, 4, 5, 7, 8 and 9). The Hackensack Meadowlands Reclamation and Development Act, (N.J.S.A. 13:17), Freshwater Wetlands Protection Act, (N.J.S.A. 13:9B), the law concerning the transportation of dredged materials containing polychlorinated biphenyls (PCBs), (N.J.S.A. 13:19-33), and the Department's dredging technical manual titled, "The Management and Regulation of Dredging Activities and Dredged Material Disposal in New Jersey's Tidal Waters" are additional enforceable policies that NSF reviewed. Support for this Consistency Determination is provided through analysis included in the Draft Amended EA prepared pursuant to NEPA for the proposed activity (Attachment 1). The proposed activity is consistent (to the maximum extent practicable) with the enforceable policies of New Jersey's Coastal Management Program.

Pursuant to 15 CFR 930.41, the New Jersey Coastal Management Program has 60 days from the receipt of this letter in which to concur with or object to this Consistency Determination, or to request an extension under 15 CFR Section 930.41(b). If New Jersey does not provide a response to NSF within 60 days of receipt of NSF's Consistency Determination, then the State's concurrence will be presumed (15 CFR 930.41(a)).

Should you have any questions about the information provided, please feel free to contact me at hesmith@nsf.gov or (703) 292-7713.

Sincerely,

Holly Smith

Holly Smith
Environmental Compliance Officer

Attachment 1: Draft Amended Environmental Assessment for a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015

cc: Elizabeth Semple, NJDEP
John Gray, NJDEP
Megan Brunatti, NJDEP
Kerry Kehoe, NOAA Office of Ocean and Coastal Resource Management

NSF COASTAL ZONE MANAGEMENT ACT (CZMA)
CONSISTENCY DETERMINATION

This document provides the New Jersey (NJ) Coastal Management Program (CMP) with the National Science Foundation's (NSF) Consistency Determination pursuant to the CZMA implementing regulations at 15 CFR Part 930, Subpart C for a collaborative research project entitled, "Community-Based 3-D Imaging That Ties Clinoform Geometry to Facies Successions and Neogene Sea-Level Change." The research proposal has been reviewed under the NSF merit review process and identified as an NSF program priority to meet NSF's critical need to foster a better understanding of Earth processes. The information in this Consistency Determination is provided in accordance with 15 CFR 930.31(c) and 930.39.

The collaborative research activity is proposed to be conducted during the period June-August 2015 and would include a marine geophysical survey in the Atlantic Ocean off the coast of New Jersey. The proposed research activity was funded entirely by NSF and would be led by lead Principal Investigator (PI) Dr. Gregory Mountain (Rutgers University) and collaborating PIs Drs. Jamie Austin, Craig Fulthorpe, and Mladen Nedimovic (University of Texas at Austin).

NSF prepared an Environmental Assessment (EA) for the research activity to take place in 2014. NSF's environmental compliance, including all federal regulatory obligations, was completed for the research activity on July 1, 2014, and the survey commenced. Due to mechanical issues with the vessel, the survey was unable to be completed during the effective periods of the Incidental Harassment Authorization (IHA) and Incidental Take Statement (ITS) issued for the survey. Pursuant to the National Environmental Policy Act, as amended, NSF has prepared a Draft Amended EA to evaluate the potential impacts on the human and natural environment associated with the proposed activity to occur in summer 2015, including to endangered and threatened species listed under the Endangered Species Act (ESA) and marine mammals protected by the Marine Mammal Protection Act (MMPA). The Draft Amended EA identifies and includes analyses for any differences between the 2014 and proposed 2015 research activity. The Draft Amended EA, entitled, "Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015", was prepared on our behalf by LGL Limited Environmental Research Associates (LGL) (Attachment 1). The Draft Amended EA tiers to the Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey (NSF/USGS PEIS, 2011) and the 2014 Final EA and Finding of No Significant Impact (FONSI) issued by NSF (Attachment 1), and incorporates by reference the Biological Opinion, Essential Fish Habitat concurrence letter, Incidental Harassment Authorization, and Final Environmental Assessment, and FONSI issued by the National Marine Fisheries Service in 2014. The conclusions from the Draft Amended EA were used to inform the Division of Ocean Sciences (OCE) management of potential environmental impacts of the proposed activity. OCE concurs with the Draft Amended EA's findings that implementation of the proposed activity would not have a significant impact on the environment. OCE will continue to review information between now and the time of the issuance of the Final Amended EA and, if any contrary conclusion is reached during this timeframe regarding environmental impacts, we will immediately notify you of such a conclusion. The proposed research activity is not related to oil and gas exploration, development, production, or lease sales, and, therefore, is not subject to Bureau of Ocean Energy Management regulatory jurisdiction pursuant to the Outer Continental Shelf Lands Act (OCSLA).

The purpose of the proposed collaborative research activity is to collect and analyze data on the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to present. Despite their existence being clearly indicated in sediment cores recovered during International Ocean Discovery Program (IODP) Expedition 313, features such as river valleys cut into coastal plain sediments, now buried under a kilometer (km) of younger sediment and flooded by today's ocean, cannot be resolved in existing 2-D seismic data to the degree required to map shifting shallow-water depositional settings in the vicinity of clinoform rollovers. To achieve the project's goals, the lead and collaborating PIs, propose to use a 3-D seismic reflection survey to map sequences around existing IODP Expedition 313 drill sites and analyze their spatial/temporal evolution. Objectives that would then be met include establishing the impact of known Ice House base-level changes on the stratigraphic record; providing greater understanding of the response of nearshore environments to changes in elevation of global sea level; and determining the amplitudes and timing of global sea-level changes during the mid-Cenozoic era. The research objectives remain the same as those described for the 2014 survey. The proposed seismic survey would be conducted on the NSF-owned research vessel (R/V) *Marcus G. Langseth* (*Langseth*), which is operated on our behalf by Columbia University's Lamont-Doherty Earth Observatory (L-DEO) through a Cooperative Agreement entered into in 2012.

The proposed marine seismic survey would take place within the Exclusive Economic Zone of the U.S. (EEZ) and outside of NJ state waters, for approximately (~) 30 days during summer 2015. The proposed survey area is located in the Atlantic Ocean, ~25–85 kilometers (km) off the coast of NJ (Fig. 1). Water depths in the survey area are ~20–75 meters (m). The proposed full-fold 3-D box/survey area is defined by the coordinates at the four corners (including turns and run-in and run-out of each line): 39:38:00°N, 73:44:36°W; 39:43:12°N, 73:41:00°W; 39:25:30°N, 73:06:12°W; and 39:20:06°N, 73:10:06°W. Although the proposed survey area is near the Northwest Atlantic Detailed Analysis Area (NW Atlantic DAA) described in the NSF/USGS PEIS, it does not include intermediate and deep-water depths. The proposed research activity would avoid the North Atlantic right whale migration period. The survey location would be the same as analyzed for the 2014 survey.

The procedures to be used for the survey would be the same as those proposed for the 2014 survey and similar to those used during previous seismic surveys by L-DEO and would use conventional seismic methodology. The survey would involve one source vessel, the *Langseth* and potentially one support vessel. The *Langseth* would deploy two pairs of subarrays of 4 airguns as an energy source; the subarrays would fire alternately, with a total volume of ~700 inch $(in)^3$. The receiving system would be a passive component of the proposed activity and would consist of a system of hydrophones: four 3000-m hydrophone streamers at 75-m spacing, or preferentially, a combination of two 3000-m hydrophone streamers and a Geometrics P-Cable system. As the airgun array is towed along the survey lines, the hydrophone streamers would receive the returning acoustic signals and transfer the data to the on-board processing system.

A total of ~4900 km of 3-D survey lines, including turns, would be conducted in an area 12 x 50 km with a line spacing of 150 m in two 6-m wide race-track patterns (Attachment 1, Figure 1). There would be additional seismic operations in the survey area associated with airgun testing and repeat coverage of any areas where initial data quality is sub-standard. In our calculations (Attachment 1, § IV Proposed Action (1)(e)), 25% has been added for those additional operations. The survey parameters noted here support the proposed research goals and therefore differ from the NW Atlantic DAA survey parameters presented in the NSF/USGS PEIS. The same amount of surveying proposed for 2015 was analyzed for the 2014 survey. Because of mechanical/equipment issues on the survey vessel along with weather issues (including Hurricane Arthur) in 2014, the full 3-D array of equipment could not be deployed. Given equipment limitations, only ~61 hours (h) of seismic survey data were collected in 2014, with only ~43 h at full power (700 in^3) on survey tracklines. Of the 43 h of data collected, ~22 h were of substandard data quality as a result of equipment damage from rough seas. However, the existing data did allow confirmation that the smaller 700-in^3 source array was suitable for the project, thus eliminating potential use of the larger 1400-in^3 array originally proposed in 2014.

In addition to the operations of the airgun array, a multibeam echosounder (MBES) and a sub-bottom profiler (SBP) would also be operated from the *Langseth* continuously throughout the survey, however not during transit. All planned geophysical data acquisition activity would be conducted by L-DEO with on-board assistance by the scientists who have proposed the study. The vessel would be self-contained, and the crew would live aboard the vessel with potential personnel transfer on/off the *Langseth* by a small support vessel. No anchoring or installments of equipment are planned to occur as part of the proposed research survey.

Monitoring and mitigation measures would be implemented during the survey, including use of Protected Species Visual Observers (PSVOs), Passive Acoustic Monitoring (PAM), exclusion zones calculated for each airgun source and tow depths, speed or course alterations, power or shut downs, and ramp-up procedures (Attachment 1, § II Proposed Action (3)). In addition, the airgun source would be shut down at any distance for North Atlantic right whales due to their critical status and for any large concentrations of marine mammals encountered. Ultimately, should the project move forward, any monitoring and mitigation measures required by an IHA and ITS issued pursuant to the MMPA and ESA, respectively, would be implemented.

Consultations

NSF has initiated consultations with the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) under Section 7 of the ESA, and the ship operator of the *Langseth* is seeking an IHA under the MMPA for the survey. NSF will also consult on Essential Fish Habitat (EFH) pursuant to the Magnuson Stevens Act. The proposed activity is not related to oil and gas exploration, development, production, or lease sales, and therefore is not subject to Bureau of Ocean Energy Management regulatory jurisdiction pursuant to the OCSLA.

Potential Effects to New Jersey Coastal Resources

During preparation of the Draft Amended EA and in accordance with the CZMA (16 USC §1451, *et seq.*), NSF considered whether the proposed activity would have any effect on coastal uses or resources of the state of NJ. Potential impacts of the seismic survey on the environment, if any, would be primarily a result of the operation of the airgun array. The increased underwater noise may result in avoidance behavior by marine mammals, sea turtles, seabirds, and fish, and other forms of disturbance. At most, effects on marine mammals may be interpreted as falling within the MMPA definition of "Level B Harassment" for those species managed by NMFS. No long-term or significant effects would be anticipated on individual marine mammals, sea turtles, seabirds, fish, the populations to which they belong, or their habitats as a result of this proposed action. Mitigation measures proposed in the Draft Amended EA for the survey are consistent with those required by NMFS for the 2014 survey and would reduce potential risks to marine species (Attachment 1, § II Proposed Action (3) and § IV(1)(d)). The marine seismic survey, which would be conducted outside of state waters, would not preclude fisheries vessels from operating within or around the survey area. A safe distance, however, would need to be kept between the *Langseth* and other vessels to avoid entanglement with the towed seismic equipment (Attachment 1, § IV Proposed Action (2)(c)). L-DEO would use Notice to Mariners broadcasts to alert mariners, including fishermen and scuba divers, of the survey activity. During the proposed seismic survey, only a small fraction of the survey area would be ensonified by the source array at any given time (Attachment 1, § IV(4)) and the distance in which Level B harassment may be anticipated from the vessel is only 6.1 km from the source and would remain substantially outside of state waters. Disturbance to fish species would be short-term, and localized, and would not be significant on commercial and recreational fisheries (Attachment 1, § IV Proposed Action (2)(c)). No fish kills or injuries were observed during 2014 survey activity (Attachment 1, § IV(2)(c)). Given the proposed activity, including the short duration of the survey, temporary nature of potential impacts to marine species, and distance from the survey to the coastal zone, impacts on marine species within state waters are only remotely possible (i.e., if an animal near the vessel moved into state waters). Access to NJ beaches and fisheries in state waters would not be impeded by the proposed marine-based activity. Although not anticipated, any potential space-use conflicts with commercial or recreational fisheries activities outside of state waters would be avoided through communications. During 2014 survey activity no actively operating fisheries vessels were encountered by the *Langseth* within the survey area (Attachment 1, § IV Proposed Action (2)(c)).

No significant impacts on shipwrecks and dive sites, including the one known dive site within the survey area, would be anticipated. Airgun sounds would have no effects on solid structures, and no deployments of gear are anticipated during the survey. The only potential effects could be temporary displacement of fish and invertebrates from the site within the survey area. (Attachment 1, § IV Proposed Action (5))

Significant impacts on, or conflicts with, divers or diving activities would be avoided through communication with the diving community before and during the survey and publication of a Notice to Mariners about operations in the area. In particular, dive operators with dives scheduled on the shipwreck *Lillian* during the survey would be contacted directly. That dive site represents only a very small percentage of the recreational dive sites in New Jersey waters. During 2014 survey activity, L-DEO coordinated with local dive shops and no actively operating scuba vessels were encountered by the *Langseth* within the survey area (Attachment 1, § IV Proposed Action (5)).

New Jersey Enforceable Policies
NSF reviewed New Jersey's enforceable policies and responds to the following enforceable policies that it considers potentially relevant:

1- **N.J. A.C. 7:7E-3.3 Surf clam areas**
2- **N.J. A.C. 7:7E-3.4 Prime fishing areas**
3- **N.J. A.C. 7:7E-3.12 Submerged infrastructure routes**
4- **N.J. A.C. 7:7E-3.13 Shipwreck and artificial reef habitats**
5- **N.J. A.C. 7:7E-3.36 Historic and archaeological resources**
6- **N.J. A.C. 7:7E-3.38 Endangered or threatened wildlife or plant species habitats**
7- **N.J. A.C. 7:7E-3.39 Critical wildlife habitats**
8- **N.J. A.C. 7:7E-3.50 Lands and waters subject to public trust rights**
9- **N.J. A.C. 7:7E-6.3 Secondary impacts**
10- **N.J.A.C. 7: 7E-8.2 Marine fish and fisheries**
11- **N.J.A.C. 7:7E-8.11 Public Access**

NSF Proposed Research Activity
Based upon the following information, data and analysis, the NSF finds that the proposed research activity is consistent to the maximum extent practicable with the enforceable policies of the New Jersey Coastal Management Program.

1- **N.J.A.C. 7:7E-3.3 Surf clam areas:** "The surf clam (*Spisula solidissima*) fishery is one of New Jersey's most valuable fisheries. More than 80% of the total Mid-Atlantic and New England area catch of surf clams are landed in New Jersey. An annual inventory is conducted in New Jersey territorial waters to provide current information on the status of the resource. This information is used to develop various management measures such as establishing season harvest quotas and conservation zones." (Source: http://www.state.nj.us/dep/fgw/shelhome.htm)

The survey activity is proposed to take place ~25–85 km (~14–46 nautical miles (n.mi).) off the coast of New Jersey, outside of New Jersey state coastal waters and within the EEZ. The proposed research activity would not include any development which would result in the destruction, condemnation, or contamination of surf clam areas within NJ state waters. The proposed research activity would not involve any anchoring of equipment or instrumentation on the sea floor. Potential effects from the proposed research activity on invertebrates are described in § 3.2.4 and § 3.3.4 and Appendix D of the NSF/USGS PEIS and in the Draft Amended EA (Attachment 1, § IV). While the proposed survey site would be located in surf clam area, the area of the proposed survey would be relatively small, ~600 km^2 (~324 $n.mi.^2$). The overall area of NJ marine waters from shore to the EEZ encompasses ~210,768 km^2 (~113,805 $n.mi.^2$). Thus the proposed survey area represents less than one half percent (0.28%) of the area of waters from the NJ shore to the EEZ (600 km^2/210,768 km^2). The survey area plus the largest mitigation zone (6.1 km) would represent less than one percent (0.77%) of the area of waters from the NJ shore to the EEZ (1630 km^2/210,768 km^2). Significant impacts, if any, on surf clams would not be anticipated by the proposed research activity. Therefore, the proposed activity is consistent to the maximum extent practicable with New Jersey's enforceable policy found at 7:7E-3.3 concerning surf clam areas.

2- N.J.A.C. 7:7E-3.4 Prime fishing areas: Effects of seismic sound on marine fish and their fisheries are discussed in § 3.2.4 and § 3.3.4 and Appendix D of the NSF/USGS PEIS. Relevant new studies on the effects of sound on marine fish and fisheries that have been published since the release of the NSF/USGS PEIS are summarized in the Draft Amended EA (Attachment 1, § IV Proposed Action (2)). The newly available information did not affect the outcome of the effects assessment as presented in the NSF/USGS PEIS. The NSF/USGS PEIS concluded that there could be changes in behavior and other non-lethal, short-term, temporary impacts, and injurious or mortal impacts on a small number of individuals within a few meters of a high-energy acoustic source, but that there would be no significant impacts of NSF-funded marine seismic research on populations and associated EFH. The NSF/USGS PEIS also concluded that seismic surveys could cause temporary, localized reduced fish catch to some species, but that effects on commercial and recreation fisheries were not significant.

The survey activity is proposed to take place ~25–85 km (~14–46 n.mi.) off the coast of New Jersey, outside of New Jersey state coastal waters and within the EEZ. The proposed activity would be located outside of New Jersey state waters and would not include any development or construction. The proposed survey site would overlap slightly with areas identified in New Jersey's Specific Sport Ocean Fishing Grounds. The area of the proposed survey, however, is relatively small, ~600 km^2 (~324 n.mi.^{2}). The overall area of NJ marine waters from shore to the EEZ encompasses ~210,768 km^2 (~113,805 n.mi.^{2}). Thus the proposed survey area represents less than one half percent (0.28%) of the area of waters from the NJ shore to the EEZ (600 km^2/210,768 km^2). The survey area plus the largest mitigation zone (6.1 km) would represent less than one percent (0.77%) of the area of waters from the NJ shore to the EEZ (1630 km^2/210,768 km^2). As noted previously, fishing activities would not be precluded from operating in the proposed survey area. Any impacts to fish species would be anticipated to occur very close to the survey vessel, outside of NJ state waters, and would be temporary in nature.

Most commercial fish catches by weight (almost all menhaden) and most recreational fishing trips off the coast of New Jersey (87% in 2013) occur in waters within 5.6 km from shore, although the highest-value fish (e.g., flounder and tuna) are caught offshore. The closest distance between the proposed survey and shore is >25 km, so interactions between the proposed survey and recreational and some commercial fisheries would be relatively limited. Also, most of the recreational fishery "hotspots" described in the Draft Amended EA (Attachment 1 § III, Fisheries (2)) are to the north or south of the proposed survey area; however, there are several hotspots located within or very near the northwestern corner of the survey area. Two possible conflicts are the *Langseth*'s streamer entangling with fixed fishing gear and temporary displacement of fishers within the survey area, although it is relatively small (12 x 50 km). Fishing activities could occur within the survey area; however, a safe distance would need to be kept from the *Langseth* and the towed seismic equipment. Conflicts would be avoided and, therefore, impacts would be negligible, through communication with the fishing community and publication of a Notice to Mariners about operations in the area. No fisheries activities except vessels in transit were observed in the survey area during the ~13 days that the Langseth was there in July 2014. Due to the location, short duration, and nature of activity, it would not be anticipated that the proposed activity would have an effect on local economies that commercial and recreational fisheries contribute, such as marinas, charter fleets, restaurants, and lodging establishments.

Given the proposed research activity, no significant impacts on marine invertebrates, marine fish, their EFH, and their fisheries would be anticipated. In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, Protected Species Observers (PSOs) and other crew members have seen no seismic sound-related fish or invertebrate injuries or mortality. No fish kills or injuries were observed during 2014 survey activity (Attachment 1, § IV Proposed Action (2)(c)). Furthermore, past seismic surveys in the proposed survey area (2002, 1998, 1996, 1990) did not result in noticeable effects on commercial or recreational fish catches, based on a review of multi-year NMFS fish catch data in the months when seismic surveys were undertaken. (Attachment 1, § IV Proposed Action (2)(c))

The proposed research activity does not involve those activities listed in 7:7E-3.4 as prohibited: sand or gravel submarine mining or disposal or domestic or industrial wastes. Therefore, the proposed activity is consistent to the maximum extent practicable with New Jersey's enforceable policy found at 7:7E-3.4 concerning prime fishing areas.

3- **N.J.A.C. 7:7E-3.12 Submerged infrastructure routes:** The survey activity is proposed to take place ~25–85 km (~14–46 n.mi.) off the coast of New Jersey, outside of New Jersey state coastal waters and within the EEZ. The proposed research activity would be located outside of New Jersey state coastal waters. The research activity is planned to occur near the surface of the water; no anchoring or installments of equipment are planned. The research activity would not be expected to interact with any submerged infrastructure or maintenance operations. The proposed research activity, therefore, would not be anticipated to have any impacts on submerged infrastructure routes or increase the likelihood of infrastructure damage or breakage, or interfere with maintenance operations. Therefore, the proposed activity is consistent to the maximum extent practicable with New Jersey's enforceable policy found at 7:7E-3.12 concerning submerged infrastructure routes.

4- **N.J.A.C. 7:7E-3.13 Shipwreck and artificial reef habitats:** The survey activity is proposed to take place ~25–85 km (~14–46 n.mi.) off the coast of New Jersey, outside of New Jersey state coastal waters and within the EEZ. Research activity is planned to occur near the surface of the water; no anchoring or installments of equipment are planned as part of the proposed research survey. The research activity would not be expected to interact with any shipwrecks or artificial reef habitats. Locations of shipwrecks in and around the survey area were considered in the Draft Amended EA. One shipwreck, a known dive site, is in or near the survey area: the *Lillian* (Galiano 2009; Fisherman's Headquarters 2014; NOAA 2014a) (Attachment 1, § III). Shipwrecks are discussed in the Draft Amended EA in § III and IV.

No significant impacts from the proposed research activity on dive sites, including shipwrecks, would be anticipated. Airgun sounds would have no effects on solid structures. The only potential effects could be temporary displacement of fish and invertebrates from the structures. Significant impacts on, or conflicts with, divers or diving activities would be avoided through communication with the diving community before and during the survey and publication of a

Notice to Mariners about operations in the area. In particular, dive operators with dives scheduled on the shipwreck *Lillian* during the survey would be contacted directly. That dive site represents only a very small percentage of the recreational dive sites in New Jersey waters. No dive vessels were observed in the survey area during the ~13 days that the Langseth was there in July 2014. No impacts to shipwrecks or artificial reef habitats would be anticipated from the proposed research activity. Therefore, the proposed activity is consistent to the maximum extent practicable with New Jersey's enforceable policy found at 7:7E-3.13 concerning shipwrecks and artificial reef habitats.

5- **N.J.A.C. 7:7E-3.36 Historic and archaeological resources:** As noted in the Draft Amended EA (Attachment 1, § III) and above, aside from the one possible shipwreck (the *Lillian*), there are no known cultural (including prehistoric) resources in the proposed Project area. As noted above, no significant impacts on dive sites, including shipwrecks, would be anticipated. Airgun sounds would have no effects on solid structures. The only potential effects could be temporary displacement of fish and invertebrates from the structures. The proposed research activity would not involve any development or scientific recording, removal, or recovery of historic and archaeological resources. Therefore, the proposed activity is consistent to the maximum extent practicable with New Jersey's enforceable policy found at 7:7E-3.36 concerning historic and archaeological resources.

6- **N.J.A.C. 7:7E-3.38 Endangered or threatened wildlife or plant species habitats:** The NJ coastal zone, "is an aquatic region that includes the NJ portion of the Delaware and Raritan bays. It also includes the portion of the Atlantic Ocean within NJ's jurisdiction, which is defined as the area within 3-nautical miles of the NJ shoreline. This region supports commercially valuable shellfish resources as well as a number of fish species of commercial and recreational importance. Over half of NJ's Federal listed species are found exclusively within this region, including several species of whales and sea turtles. The endangered shortnose sturgeon is also found within Delaware Bay. Waters of the Delaware Bay are also critical habitat to one of the largest populations of horseshoe crab in the world. During the summer, near-shore Atlantic Ocean waters are calving and nursery grounds for bottlenose dolphins while many additional species utilize these waters as a migratory corridor." (Source: http://www.state.nj.us/dep/fgw/ensp/landscape/lp_report_3_1.pdf)

The proposed research activity would be located outside of the NJ coastal zone and within the EEZ. The proposed research activity may have impacts to federally listed endangered and threatened species (Attachment 1, § III). Since the proposed activity may have an effect on federally listed endangered and threatened species, NSF and L-DEO would consult with NMFS and USFWS to ensure compliance with federal regulations including the MMPA and ESA. Monitoring and mitigation measures would be employed to avoid or further reduce any potential impacts to endangered and threatened species (Attachment 1, § II Proposed Action (3) and § IV Proposed Action (1)(d)).

The Draft Amended EA, which tiers to the NSF/USGS PEIS, analyzed the potential impacts to endangered and threatened species, and their habitats, that may occur within the proposed survey area during the summer season (Attachment 1, § IV). The findings of the Draft Amended EA concluded that although there may be potential effects to endangered and threatened species within the survey area, they would be short term and temporary and would not have significant impacts to individuals or their populations. Additionally, the proposed research activity would not have adverse effects, direct or secondary (indirect), to endangered or threatened species' habitats. The 2014 survey activity, which was analyzed for a larger source than that currently proposed for 2015, resulted in the issuance of all necessary federal authorizations to proceed; this outcome further supported the conclusion that the proposed research activity would not have significant impacts on marine species or their habitats. Therefore, the proposed activity is consistent to the maximum extent practicable with New Jersey's enforceable policy found at 7:7E-3.38 concerning endangered or threatened wildlife or plant species habitats.

7- **N.J.A.C. 7:7E-3.39 Critical wildlife habitats:** The proposed research activity would be located outside of the NJ coastal zone and within the EEZ. The proposed research activity may have impacts on federally listed endangered and threatened species (Attachment 1, § III); however, no areas of special critical wildlife habitat have been identified within the survey area except for EFH. The proposed survey area is not located within any designated special areas such as rookeries, ecotones, or colonial waterbird habitat. Since the proposed activity may have an effect on federally listed endangered and threatened species, NSF and L-DEO are consulting with NMFS and USFWS to ensure compliance with federal regulations including the MMPA and ESA.

No temporary or permanent development would occur as a result of the proposed research activity. As described in the Draft Amended EA (Attachment 1, § IV), minimal, if any, effects on and interference with endangered and threatened species habitat would be anticipated. The proposed survey location has been selected to meet the scientific objectives proposed by the PIs. As described in the Draft Amended EA (Attachment 1, § II Proposed Action (1)), the survey site location is a unique siliciclastic passive margin which has the potential to elucidate the timing and amplitude of eustatic change during the "Ice House" period of Earth history. The proposed research would tie to and build upon research previously conducted at the survey site and allow for the acquisition of a 3-D seismic volume of the inner-middle shelf of the NJ margin. For these reasons, alternative site locations would not meet research goals and therefore would not be feasible.

The proposed research activity includes a suite of monitoring and mitigation measures. These monitoring and mitigation measures include standard monitoring and mitigation measures established by the NSF/USGS PEIS and include special mitigation measures for North Atlantic Right whales. They are described in detail in the NSF/USGS PEIS (Section 2.4.4.1) and in the Draft Amended EA (Attachment 1, § II Proposed Action (3) and § IV Proposed Action (1)(d)). These monitoring and mitigation measures are conservative and have been approved by NMFS and USFWS for other US academic research seismic surveys, including the 2014 survey off of NJ. NSF and L-DEO would adhere to any monitoring and mitigation measures required by regulatory agencies, including those defined in an IHA and ITS for the survey. Therefore, the proposed activity is consistent to the maximum extent practicable with New Jersey's enforceable policy found at 7:7E-3.39 concerning critical wildlife habitats.

8- **N.J.A.C. 7:7E-3.50 Lands and waters subject to public trust rights:** Lands and waters subject to public trust rights are tidal waterways and their shores, including both lands now or formerly below the mean high water line, and shores above the mean high water line. Tidal waterways and their shores are subject to the Public Trust Doctrine and are held in trust by the State for the benefit of all the people, allowing the public to fully enjoy those lands and waters for a variety of public uses. Public trust rights include public access which is the ability of the public to pass physically and visually to, from and along the ocean shore and other waterfronts subject to public trust rights and to use these lands and waters for activities such as navigation, fishing and recreational activities including, but not limited to, swimming, sunbathing, surfing, sport diving, bird watching, walking, and boating. Public trust rights also include the right to perpendicular and linear access. The proposed research activity includes no development. The proposed research activity would be outside of NJ public trust areas and would not impede public access to lands and waters subject to public trust rights. Due to the distance from shore to the survey site, the activity would have no impact on the viewshed from the coast. Space-use conflict may occur with fishermen or divers within the survey area, however, through coordination efforts, any space-use conflicts should be minimized or eliminated. In 2014, the *Langseth* encountered no fishing vessels actively operating within the survey area (Attachment 1, § IV Proposed Action (2)(c)), and coordination with scuba divers eliminated any potential space-use conflicts (Attachment 1, § IV Proposed Action (5)). Therefore, the proposed activity is consistent to the maximum extent practicable with New Jersey's enforceable policy found at 7:7E-3.50 concerning lands and waters subject to public trust right.

9- **N.J.A.C. 7:7E-6.3 Secondary impacts:** The proposed research activity would not involve any development, nor would it be anticipated to encourage secondary development impacts. The proposed research activity would be temporary and of short duration and would occur outside of NJ coastal waters and within the EEZ. It would not involve any construction or installment of temporary or permanent structures. Accept for possible supply and personnel transfers at sea, the *Langseth* would be self-contained, and the scientific complement, technicians, and crew would live aboard the vessel. Due to the location, short duration, and nature of activity, it would not be anticipated that the proposed activity would have an effect on local economies that commercial and recreational fisheries contribute, such as marinas, charter fleets, restaurants, and lodging establishments. Although there may be future seismic research activities proposed within the survey area in the future, at the present time, no activities are currently planned. Additionally, the proposed research activity would not be anticipated to promote any other types of development activities, such as oil and gas exploration; the area is outside of the Bureau of Ocean Energy Management (BOEM) Outer Continental Shelf Mid-Atlantic and South Atlantic Planning Areas to conduct Geological and Geophysical Activities (Attachment 1, § IV Proposed Action (6)(f)). The proposed research activity would elucidate a small, shallow area of the shelf that has already been drilled for research purposes. Seismic surveys in support of research activities have occurred in the survey area in the recent past (2002, 1998, 1996, 1990). Additionally, NJDEP conducted a seismic survey (boomer/sparker source) in 1985 off the coast of New Jersey (Attachment I, § IV Proposed Action (6)(f)). Oil and gas activities in the proposed survey area have not resulted from these similar research seismic surveys. Therefore, it would not be logical to assume that the proposed research seismic survey would result in oil and gas development

(Attachment 1, § IV Proposed Action (6)(f)). For these reasons, secondary impacts from additional development as a result of the proposed research activity would not be anticipated. Therefore, the proposed activity is consistent to the maximum extent practicable with New Jersey's enforceable policy found at 7:7E-6.3 concerning secondary impacts.

10- **N.J.A.C. 7:7E-8.2 Marine fish and fisheries:** As noted above, effects of seismic sound on marine fish and their fisheries are discussed in § 3.2.4 and § 3.3.4 and Appendix D of the NSF/USGS PEIS. Relevant new studies on the effects of sound on marine fish and fisheries that have been published since the release of the NSF/USGS PEIS are summarized in the Draft Amended EA (Attachment 1, § IV Proposed Action (2)). The newly available information did not affect the outcome of the effects assessment as presented in the NSF/USGS PEIS. The NSF/USGS PEIS concluded that there could be changes in behavior and other non-lethal, short-term, temporary impacts, and injurious or mortal impacts on a small number of individuals within a few meters of a high-energy acoustic source, but that there would be no significant impacts of NSF-funded marine seismic research on populations and associated EFH. The NSF/USGS PEIS also concluded that seismic surveys could cause temporary, localized reduced fish catch to some species, but that effects on commercial and recreation fisheries were not significant.

As noted in the Draft EA (Attachment 1, § IV Proposed Action (2) (c)), most commercial fish catches by weight (almost all menhaden) and most recreational fishing trips off the coast of New Jersey (87% in 2013) occur in waters within 5.6 km from shore, although the highest-value fish (e.g., flounder and tuna) are caught offshore. The closest distance between the proposed survey and shore is >25 km, so interactions between the proposed survey and recreational and some commercial fisheries would be relatively limited. Also, most of the recreational fishery "hotspots" described in § III of the Draft Amended EA are to the north or south of the proposed survey area; however, there are several hotspots located within or very near the northwestern corner of the survey area. Two possible conflicts are the *Langseth*'s streamer entangling with fixed fishing gear and temporary displacement of fishers within the survey area, although it is relatively small (12 x 50 km). Fishing activities could occur within the survey area; however, a safe distance would need to be kept from the *Langseth* and the towed seismic equipment. Through communication with the fishing community and publication of a Notice to Mariners about operations in the area, conflicts would be avoided and, therefore, impacts would be negligible. No fisheries activities except vessels in transit were observed in the survey area during the ~13 days that the Langseth was there in July 2014.

The survey is proposed to take place ~25–85 km (~14–46 n.mi.) off the coast of New Jersey. The area of the proposed survey is relatively small, ~600 km^2 (~324 $n.mi.^2$). The overall area of NJ marine waters from shore to the EEZ encompasses ~210,768 km^2 (~113,805 $n.mi.^2$). Thus the proposed survey area represents less than one half percent (0.28%) of the area of waters from the NJ shore to the EEZ (600 km^2/210,768 km^2). The survey area plus the largest mitigation zone (6.1 km) would represent less than one percent (0.77%) of the area of waters from the NJ shore to the EEZ (1630 km^2/210,768 km^2). The seismic survey is proposed to take place for ~30 days within the June to August timeframe in 2015. As noted previously, fishing activities would not be precluded from operating in the proposed survey area. Any impacts to fish species would occur very close to the survey vessel and would be temporary. No fish kills or injuries were observed during 2014 survey activity (Attachment 1, § IV Proposed Action (2)(c)).

Monitoring and mitigation measures would be employed to avoid or further reduce any potential impacts to endangered and threatened species (Attachment 1, § II Proposed Action (3) and § IV Proposed Action (1)(d)). Given the proposed activities, no significant impacts on marine invertebrates, marine fish, their EFH, and their fisheries would be anticipated by the proposed activities. In decades of seismic surveys carried out by the *Langseth* and the *Ewing*, PSOs and other crew members have seen no seismic sound-related fish or invertebrate injuries or mortality. Furthermore, past seismic surveys in the proposed survey area (2002, 1998, 1996, 1990) did not result in noticeable effects on commercial or recreational fish catches, based on a review of multi-year NMFS fish catch data in the months when seismic surveys were undertaken. Thus, it would not be anticipated that the proposed activity would have an effect on local economies that commercial and recreational fisheries contribute, such as marinas, charter fleets, restaurants, and lodging establishments.

NSF consulted for the survey activity in 2014 with the NMFS Greater Atlantic Regional Fisheries Office under the Magnuson-Stevens Act for EFH. The NMFS Greater Atlantic Regional Fisheries Office concluded that the activity may at some level adversely affect EFH, however, no specific conservation measures were identified for the activity (Attachment 1, § IV Proposed Action (8)). NSF will consult again with the NMFS Greater Atlantic Regional Fisheries Office for EFH for the proposed 2015 survey activity.

Impacts on New Jersey coastal fishery resources are possible, however, unlikely given the proposed research activity, including the temporary duration, distance to the coastal zone, and the monitoring and mitigation measures that would be employed. The proposed activity would occur outside of New Jersey State waters and ~25-85 km from shore. Access to New Jersey coastal zone marine fisheries would not be precluded by survey activities; any potential space-use conflict would be avoided through communications during survey activities. During the proposed seismic survey, only a small fraction of the survey area would be ensonified at any given time. Disturbance to fish species would be short-term, and fish would return to their pre-disturbance behavior once the seismic activity ceased. (Attachment 1, § IV Proposed Action (2)). Therefore, the proposed activity is consistent to the maximum extent practicable with New Jersey's enforceable policy found at 7:7E-8.2 concerning marine fish and fisheries.

11- N.J.A.C. 7:7E-8.11 Public Access: The survey activity is proposed to take place ~25–85 km (~14–46 n.mi.) off the coast of NJ and would not prohibit public access to NJ coastal waters, including fisheries, beaches, trails, etc. Given the distance to shore the only main human-related activities with which the proposed activity might interfere would be fishing, scuba diving, and ship traffic transiting through the area. These activities would not, however, be precluded from occurring during the survey effort; coordination may be required to avoid space-use conflicts. The proposed activity would be located outside of New Jersey state waters where the majority of recreational fishing occurs. The proposed survey site would overlap slightly with areas identified in New Jersey's Specific Sport Ocean Fishing Grounds. The area of the proposed survey, however, is relatively small, ~600 km^2 (~324 n.mi.^{2}). The overall area of NJ marine waters from shore to the EEZ encompasses ~210,768 km^2 (~113,805 $n.mi.^2$). Thus the proposed survey area represents less than one half percent (0.28%) of the area of waters from the NJ shore to the EEZ (600 km^2/210,768 km^2). The survey area plus the largest mitigation zone (6.1 km) would represent less than one percent (0.77%) of the area of waters from the NJ shore to the EEZ (1630 km^2/210,768 km^2). There is only one known scuba diving site within the survey area. Coordination with local dive shops would avoid space-use conflicts. A Notice to Mariners would be used to alert vessels operating and transiting through the area of the research activities and to avoid entanglement with gear. No temporary or permanent construction would be conducted at the survey site to inhibit future access to the site or to the NJ coastal zone. Survey activity in 2014 resulted in no known space-use conflicts and no issues with public access to the NJ coastal zone. Therefore, the proposed activity is consistent to the maximum extent practicable with New Jersey's enforceable policy found at 7:7E-8.11 concerning public access.

Required State and Local Permits

No state, county, and local permits are necessary for the proposed activity.

Conclusion

The proposed would not have any significant impacts to coastal resources. Therefore, the proposed activity is consistent, to the maximum extent practicable, with the enforceable policies of New Jersey's federally approved coastal management program.

Pursuant to CFR 930.41, the New Jersey Coastal Management Program has 60 days from the receipt of this letter in which to concur with or object to this Consistency Determination, or to request an extension under 15 CFR Section 930.41(b). The State's concurrence will be presumed if the States' response is not received by NSF on the 60th day from receipt of this Determination.

The States' response should be sent via email to:

Holly Smith
National Science Foundation
Division of Ocean Sciences
4201 Wilson Blvd.
Room 725
Arlington, VA 22230
Email: hesmith@nsf.gov

Attachment 1: Draft Environmental Assessment for a Marine Geophysical Survey by the R/V *Marcus G. Langseth* off New Jersey, Summer 2015

Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015

Prepared for

Lamont-Doherty Earth Observatory
61 Route 9W, P.O. Box 1000
Palisades, NY 10964-8000

and

National Science Foundation
Division of Ocean Sciences
4201 Wilson Blvd., Suite 725
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18 December 2014

LGL Report TA8349-3

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ABSTRACT

The State University of New Jersey at Rutgers (Rutgers), with funding from the U.S. National Science Foundation (NSF), proposes to conduct a high-energy, 3-D seismic survey on the R/V *Marcus G. Langseth* in the northwest Atlantic Ocean ~25–85 km from the coast of New Jersey in summer 2015. The NSF-owned *Langseth* is operated by Columbia University's Lamont-Doherty Earth Observatory (L-DEO) under an existing Cooperative Agreement. Although the *Langseth* is capable of conducting high energy seismic surveys using up to 36 airguns with a discharge volume of 6600 in^3, the proposed seismic survey would only use a small towed subarray of 4 airguns with a total discharge volume of ~700 in^3. The seismic survey would take place outside of U.S. state waters within the U.S. Exclusive Economic Zone (EEZ) in water depths ~20–75 m.

NSF, as the funding agency, has a mission to "promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense…". The proposed seismic survey would collect data in support of a research proposal that has been reviewed under the NSF merit review process and identified as an NSF program priority. It would provide data necessary to study the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to present and enable follow-on studies to identify the magnitude, time, and impact of major changes in sea level.

The survey was originally proposed for implementation in 2014. NSF environmental compliance, including all federal statutory and regulatory obligations, was completed for the survey on 1 July 2014, and the survey commenced. Because of mechanical issues with the vessel, the survey was unable to be completed during the effective periods set forth in the Incidental Harassment Authorization (IHA) and Incidental Take Statement (ITS) issued for the survey. According to the U.S. National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS), although the survey has not changed from what was approved in 2014, a new IHA will be required to conduct the same survey during a rescheduled time in 2015. This Draft Amended Environmental Assessment (Draft Amended EA) has been prepared on behalf of NSF pursuant to the National Environmental Policy Act (NEPA) to address any impacts associated with the rescheduled time for the survey, and in support of other necessary regulatory processes, including the IHA process.

As operator of the *Langseth,* L-DEO has requested an Incidental Harassment Authorization (IHA) from the U.S. National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) to authorize the incidental, i.e., not intentional, harassment of small numbers of marine mammals should this occur during the seismic survey. The analysis in the Draft Amended EA also supports the IHA application process and provides information on marine species not addressed by the IHA application, including seabirds and sea turtles that are listed under the U.S. Endangered Species Act (ESA), including candidate species. As analysis on endangered/threatened species was included, the Draft Amended EA is being used to support ESA Section 7 consultations with NMFS and U.S. Fish and Wildlife Service (USFWS). The Draft Amended EA will also be used in support of consultation with NMFS Greater Atlantic Regional Fisheries Office for Essential Fish Habitat (EFH) under the Magnuson-Stevens Act. Alternatives addressed in this Draft Amended EA consist of a corresponding program at a different time with issuance of an associated IHA and the no action alternative, with no IHA and no seismic survey. This document tiers to the Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey (June 2011) and Record of Decision (June 2012), referred to herein as PEIS. It also tiers to the Final EA for the proposed survey off New Jersey dated 1 July 2014. The proposed survey area off the coast of New Jersey is near one of the detailed

analysis areas (DAAs) in the PEIS; however, this Draft Amended EA and the 2014 Final EA were prepared because a different energy source level and configuration would be used for the proposed survey, and the proposed survey covers only shelf waters whereas the DAA was on the shelf and slope. Additionally, this Draft Amended EA addresses the differences from and updates to the Final EA for the 2014 survey.

Numerous species of marine mammals inhabit the proposed survey area off the coast of New Jersey. Several of these species are listed as ***endangered*** under the U.S. Endangered Species Act (ESA): the sperm, North Atlantic right, humpback, sei, fin, and blue whales. Other ESA-listed species that could occur in the area are the ***endangered*** leatherback, hawksbill, green, and Kemp's ridley turtles and roseate tern, and the ***threatened*** loggerhead turtle and piping plover. The ***endangered*** Atlantic sturgeon and shortnose sturgeon could also occur in or near the study area. ESA-listed ***candidate species*** that could occur in the area are the cusk, dusky shark, and great hammerhead shark.

Potential impacts of the seismic survey on the environment would be primarily a result of the operation of the airgun array. A multibeam echosounder and sub-bottom profiler would also be operated. Impacts would be associated with underwater noise, which could result in avoidance behavior by marine mammals, sea turtles, seabirds, and fish, and other forms of disturbance. An integral part of the planned survey is a monitoring and mitigation program designed to minimize potential impacts of the proposed activities on marine animals present during the proposed research, and to document as much as possible the nature and extent of any effects. Injurious impacts to marine mammals, sea turtles, and seabirds have not been proven to occur near airgun arrays, and are not likely to be caused by the other types of sound sources to be used. However, despite the relatively low levels of sound emitted by the subarray of airguns, a precautionary approach would still be taken. The planned monitoring and mitigation measures would reduce the possibility of any effects.

As was the case with the approved 2014 survey, protection measures designed to mitigate the potential environmental impacts to marine mammals and sea turtles would include the following: ramp ups; typically two, but a minimum of one dedicated observer maintaining a visual watch during all daytime airgun operations; two observers 30 min before and during ramp ups during the day and at night; no start ups during poor visibility or at night unless at least one airgun has been operating; passive acoustic monitoring (PAM) via towed hydrophones during both day and night to complement visual monitoring (unless operational issues prevent it or the system and back-up system are both damaged during operations); and power downs (or if necessary shut downs) when marine mammals or sea turtles are detected in or about to enter designated exclusion zones. L-DEO and its contractors are committed to applying these measures in order to minimize potential effects on marine mammals and sea turtles and other environmental impacts.

With the planned monitoring and mitigation measures, unavoidable impacts to each species of marine mammal and sea turtle that could be encountered would be expected to be limited to short-term, localized changes in behavior and distribution near the seismic vessel. At most, effects on marine mammals may be interpreted as falling within the U.S. Marine Mammal Protection Act (MMPA) definition of "Level B Harassment" for those species managed by NMFS. No long-term or significant effects would be expected on individual marine mammals, sea turtles, seabirds, fish, the populations to which they belong, or their habitats.

LIST OF ACRONYMS

~	approximately
ADCP	Acoustic Doppler current profiler
ALWTRP	Atlantic Large Whale Take Reduction Plan
AMVER	Automated Mutual-Assistance Vessel Rescue
BOEM	Bureau of Ocean Energy Management
CETAP	Cetacean and Turtle Assessment Program
CITES	Convention on International Trade in Endangered Species
CZMA	Coastal Zone Management Act
DAA	Detailed Analysis Area
dB	decibel
DoN	Department of the Navy
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ESA	(U.S.) Endangered Species Act
EZ	Exclusion Zone
FAO	Food and Agriculture Organization of the United Nations
FM	Frequency Modulated
GIS	Geographic Information System
h	hour
hp	horsepower
HRTRP	Harbor Porpoise Take Reduction Plan
Hz	Hertz
IHA	Incidental Harassment Authorization (under MMPA)
in	inch
IOC	Intergovernmental Oceanographic Commission of UNESCO
IODP	Integrated Ocean Drilling Program
IUCN	International Union for the Conservation of Nature
kHz	kilohertz
km	kilometer
kt	knot
L-DEO	Lamont-Doherty Earth Observatory
LFA	Low-frequency Active (sonar)
m	meter
min	minute
MBES	Multibeam Echosounder
MFA	Mid-frequency Active (sonar)
MMPA	(U.S.) Marine Mammal Protection Act
ms	millisecond
NEPA	(U.S.) National Environmental Policy Act
NJ	New Jersey
NEFSC	Northeast Fisheries Science Center
NMFS	(U.S.) National Marine Fisheries Service
NRC	(U.S.) National Research Council

NSF	National Science Foundation
OBIS	Ocean Biogeographic Information System
OCS	Outer Continental Shelf
OEIS	Overseas Environmental Impact Statement
OAWRS	Ocean Acoustic Waveguide Remote Sensing
p or pk	peak
PEIS	Programmatic Environmental Impact Statement
PI	Principal Investigator
PTS	Permanent Threshold Shift
PSO	Protected Species Observer
PSVO	Protected Species Visual Observer
RL	Received level
rms	root-mean-square
R/V	research vessel
s	second
SAR	U.S. Marine Mammal Stock Assessment Report
SBP	Sub-bottom Profiler
SCUBA	Self contained underwater breathing apparatus
SEFSC	Southeast Fisheries Science Center
TTS	Temporary Threshold Shift
SEL	Sound Exposure Level
SPL	Sound Pressure Level
UNEP	United Nations Environment Programme
U.S.	United States of America
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
USN	U.S. Navy
μPa	microPascal
vs.	versus
WCMC	World Conservation Monitoring Centre

I. PURPOSE AND NEED

The purpose of this Draft Amended EA is to provide the information needed to assess the potential environmental impacts associated with the use of a 4-airgun subarray during the proposed seismic survey off the coast of New Jersey. The survey was originally proposed for implementation in 2014. NSF environmental compliance, including all federal legal and regulatory obligations, was completed for the project on 1 July 2014, and the survey commenced. Because of mechanical issues with the vessel, the survey was unable to be completed during the effective periods of the Incidental Harassment Authorization (IHA) and Incidental Take Statement (ITS) issued for the survey. According to NMFS, a new IHA Application is required to reschedule the survey in 2015.

This Draft Amended EA was prepared pursuant to the National Environmental Policy Act (NEPA), and tiers to the Programmatic Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) for Marine Seismic Research funded by the National Science Foundation or Conducted by the U.S. Geological Survey (NSF and USGS 2011) and Record of Decision (NSF 2012), referred to herein as the PEIS. It also tiers to the Final EA for the proposed survey off New Jersey dated 1 July 2014. The proposed survey area off the coast of New Jersey is near one of the detailed analysis areas (DAAs) presented in the PEIS; however, a different energy source level and configuration would be used for the proposed survey, and the proposed survey covers only shelf waters whereas the DAA was on the shelf and slope. This Draft Amended EA was prepared to consider the survey proposed for 2015, provide updates, and address differences in the analysis prepared for the 2014 survey and the PEIS DAA. The Draft Amended EA provides details of the proposed action at the site-specific level and addresses potential impacts of the proposed seismic survey on marine mammals, as well as other species of concern in the area, including sea turtles, seabirds, fish, and invertebrates. The Draft Amended EA will be used in support of an application for an Incidental Harassment Authorization (IHA) from the National Marine Fisheries Service (NMFS), and re-initiation of Section 7 consultations under the Endangered Species Act (ESA). The IHA would allow for non-intentional, non-injurious "take by harassment" of small numbers of marine mammals during the proposed seismic survey directed by Rutgers in the Atlantic Ocean off New Jersey. The Draft Amended EA will also be used in support of consultation with NMFS Greater Atlantic Regional Fisheries Office for Essential Fish Habitat (EFH) under the Magnuson-Stevens Act.

To be eligible for an IHA under the U.S. Marine Mammal Protection Act (MMPA), the proposed "taking" (with mitigation measures in place) must not cause serious physical injury or death of marine mammals, must have negligible impacts on the species and stocks, must "take" no more than small numbers of those species or stocks, and must not have an unmitigable adverse impact on the availability of the species or stocks for legitimate subsistence uses.

Mission of NSF

NSF was established by Congress under the National Science Foundation Act of 1950 (Public Law 810507, as amended) and is the only federal agency dedicated to the support of fundamental research and education in all scientific and engineering disciplines. Further details on the mission of NSF are described in § 1.2 of the PEIS.

Purpose of and Need for the Proposed Action

As noted in the PEIS, § 1.3, NSF has a continuing need to fund seismic surveys that enable scientists to collect data essential to understanding complex Earth processes recorded in sediments on and beneath the ocean floor. The purpose of the proposed action is to collect data across existing Integrated Ocean Drilling Program (IODP) Expedition 313 drill sites on the inner-middle shelf of the New Jersey continental margin

to reveal the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to the present. Features such as river valleys cut into coastal plain sediments, now buried under a km of younger sediment and flooded by today's ocean, cannot be identified and traced with existing 2-D seismic data, despite their existence being clearly indicated in sediment cores recovered during IODP Expedition 313. These and other erosional and depositional features would be imaged using 3-D seismic data and would enable follow-on studies to identify the magnitude, time, and impact of major changes in sea level. The proposed seismic survey would collect data in support of a research proposal that has been reviewed under the NSF merit review process and identified as an NSF program priority to meet NSF's critical need to foster an understanding of Earth processes.

Background of NSF-funded Marine Seismic Research

The background of NSF-funded marine seismic research is described in § 1.5 of the PEIS.

Statutory and Regulatory Setting

The statutory and regulatory setting of this Draft Amended EA is described in § 1.8 of the PEIS, including the

- National Environmental Protection Act (NEPA);
- Marine Mammal Protection Act (MMPA);
- Endangered Species Act (ESA);
- Magnuson-Stevens Act for Essential Fish Habitat (EFH); and
- Coastal Zone Management Act (CZMA).

II. ALTERNATIVES INCLUDING PROPOSED ACTION

In this Draft Amended EA, three alternatives are evaluated: (1) the proposed seismic survey and issuance of an associated IHA, (2) a corresponding seismic survey at an alternative time, along with issuance of an associated IHA, and (3) no action alternative. Additionally, two alternatives were considered but were eliminated from further analysis. A summary table of the proposed action, alternatives, and alternatives eliminated from further analysis is provided at the end of this section.

Proposed Action

The project objectives and context, activities, and mitigation measures for Rutger's planned seismic survey are described in the following subsections. The proposed action remains the same as described for the 2014 survey, except where noted.

(1) Project Objectives and Context

Rutgers plans to conduct a 3-D seismic survey using the L-DEO operated R/V *Marcus G. Langseth* (*Langseth*) on the inner-middle shelf of the New Jersey continental margin (Fig. 1). As noted previously, the goal of the proposed research is to collect and analyze data on the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to present. Despite their existence being clearly indicated in sediment cores recovered during IODP Expedition 313, features such as river valleys cut into coastal plain sediments, now buried under a km of younger sediment and flooded by today's ocean, cannot be resolved in existing 2-D seismic data to the degree required to map shifting shallow-water depositional settings in the vicinity of clinoform rollovers. To achieve the project's goals, the lead Principal Investigator (PI), Dr. G. Mountain (Rutgers University), and collaborating PIs Drs. J.

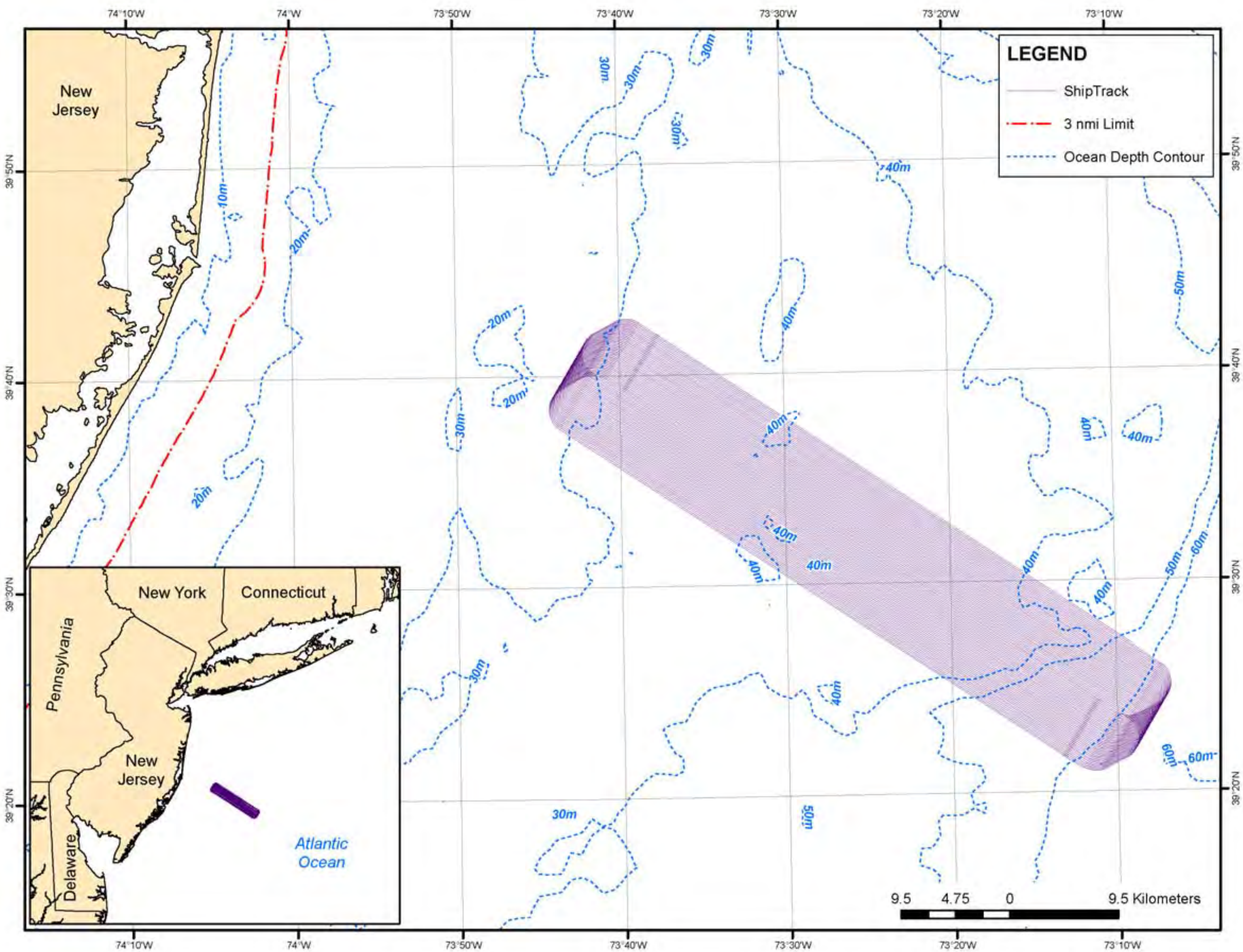

Figure 1. Location of the proposed seismic survey in the Atlantic Ocean off the coast of New Jersey.

Austin, C. Fulthorpe, and M. Nedimović (University of Texas at Austin), propose to use a 3-D seismic reflection survey to map sequences around existing IODP Expedition 313 drill sites and analyze their spatial/temporal evolution. Objectives that would then be met include establishing the impact of known Ice House base-level changes on the stratigraphic record; providing greater understanding of the response of nearshore environments to changes in elevation of global sea level; and determining the amplitudes and timing of global sea-level changes during the mid-Cenozoic. The project objectives remain the same as those described for the 2014 survey.

(2) Proposed Activities

(a) Location of the Activities

The proposed full-fold 3-D box/survey area is located in the Atlantic Ocean, ~25–85 km off the coast of New Jersey (Fig. 1). This area is defined by the coordinates at the four corners (including turns and run-in and run-out of each line): 39:38:00°N, 73:44:36°W; 39:43:12°N, 73:41:00°W; 39:25:30°N, 73:06:12°W; and 39:20:06°N, 73:10:06°W.

Water depths across the survey area are ~20–75 m. The seismic survey would be conducted outside of state waters and within the U.S. EEZ, and is scheduled to occur for ~30 days during June–August 2015. Although the proposed survey area is near the NW Atlantic DAA described in the PEIS, it does not include intermediate- and deep-water depths. The survey location would be the same as that for the 2014 survey.

(b) Description of the Activities

The procedures to be used for the survey would be the same as those proposed for the 2014 survey and similar to those used during previous NSF-funded seismic surveys and would use conventional seismic methodology. The survey would involve one source vessel, the *Langseth,* which is owned by NSF and operated on its behalf by Columbia University's L-DEO through a Cooperative Agreement entered into in 2012, and one support vessel. The *Langseth* would deploy two pairs of subarrays of 4 airguns as an energy source; the subarrays would fire alternately, with a total volume of ~700 in^3. The receiving system would be a passive component of the proposed activity and would consist of a system of hydrophones: four 3000-m hydrophone streamers at 75-m spacing, or preferentially, a combination of two 3000-m hydrophone streamers and a Geometrics P-Cable system. As the airgun array is towed along the survey lines, the hydrophone streamers would receive the returning acoustic signals and transfer the data to the on-board processing system.

A total of ~4900 km of 3-D survey lines, including turns, would be shot in an area 12 x 50 km with a line spacing of 150 m in two 6-m wide race-track patterns (Fig. 1). There would be additional seismic operations in the survey area associated with airgun testing and repeat coverage of any areas where initial data quality is sub-standard. In our calculations [see § IV(3)], 25% has been added for those additional operations. The survey parameters noted here support the proposed research goals and therefore differ from the NW Atlantic DAA survey parameters presented in the PEIS. The same transect lengths and area of survey proposed for 2015 was analyzed for the 2014 survey. Because of mechanical/equipment issues on the survey vessel along with weather issues (including Hurricane Arthur), the full 3-D array of equipment could not be deployed. Given equipment limitations, only ~61 h of seismic survey data were collected in 2014, with only ~43 h at full power (700 in^3) on survey tracklines. Of the 43 h of data collected, ~22 h were of substandard data quality because of equipment damage from rough seas. However, the existing data did allow confirmation that the smaller 700-in^3 source array was suitable for the project, thus eliminating potential use of the larger 1400-in^3 array originally proposed in 2014.

In addition to the operations of the airgun array, a multibeam echosounder (MBES) and a sub-bottom profiler (SBP) would be operated from the *Langseth* continuously throughout the survey, but not during transits. All planned geophysical data acquisition activities would be conducted with on-board assistance by

the scientists who have proposed the study. The vessel would be self-contained, and the crew would live aboard the vessel with some personnel transfer on/off the *Langseth* by a small vessel.

(c) Schedule

The *Langseth* would depart from New York, NY, and spend ~8 h in transit to the proposed survey area. Setup, deployment, and streamer ballasting would take ~3 days. The seismic survey would take 30 days plus 2 contingency days, and the *Langseth* would spend one day for gear retrieval and transit back to New York. The survey would be conducted during summer (June–August) 2015. Operations could be delayed or interrupted because of a variety of factors including equipment malfunctions and weather-related issues, but use of the airguns would not occur outside of the effective IHA period.

(d) Vessel Specifications

The *Langseth* is described in § 2.2.2.1 of the PEIS. The vessel speed during seismic operations would be ~4.5 kt (~8.3 km/h).

The support vessel would be a multi-purpose offshore utility vessel similar to the *Northstar Commander*, which is 28 m long with a beam of 8 m and a draft of 2.6 m. It is powered by a twin-screw Volvo D125-E, with 450 hp for each screw.

(e) Airgun Description

During the survey, the airgun array to be used would be the full 4-string array with most of the airguns turned off (see § II 3(a) for an explanation of the source level selection). The active airguns would be 4 airguns in one string on the port side forming Source 1, and 4 airguns in one string on the starboard side forming Source 2. These identical port and starboard sources would be operated in "flip-flop" mode, firing alternately as the ship progresses along the track, as is common for 3-D seismic data acquisition. Thus, the source volume would not exceed 700 in^3 at any time. Whereas the full array is described and illustrated in § 2.2.3.1 of the PEIS, the smaller subarrays proposed for this survey are described further in Appendix A. The subarrays would be towed at a depth of 4.5 or 6 m. The shot interval would be ~5-6 s (~12.5 m). Because the choice of the precise tow depth would not be made until the survey because of sea and weather conditions, we have assumed the use of 6 m for the impacts analysis and take estimate calculations, as that results in the farthest sound propagation. Mitigation zones have been calculated for the source level and tow depths, (see below and Appendix A, Table A2), and during operations the relevant mitigation zone would be applied.

During the attempted survey in 2014, the 700-in^3 airgun array was determined to be sufficient to image the geological targets of research interest. Thus, the 1400-in^3 array proposed as an operational possibility in the 1 July 2014 Final EA has been eliminated from the analysis in this Draft Amended EA.

(f) Additional Acoustical Data Acquisition Systems

Along with the airgun operations, two additional acoustical data acquisition systems would be operated during the survey, but not during transits: a multibeam echosounder (MBES) and sub-bottom profiler (SBP). The ocean floor would be mapped with the Kongsberg EM 122 MBES and a Knudsen Chirp 3260 SBP. These sources are described in § 2.2.3.1 of the PEIS.

(3) Monitoring and Mitigation Measures

Standard monitoring and mitigation measures for seismic surveys are described in § 2.4.4.1 of the PEIS and are described to occur in two phases: pre-cruise planning and during operations. The following sections describe the efforts during both stages for the proposed actions.

(a) Planning Phase

As discussed in § 2.4.1.1 of the PEIS, mitigation of potential impacts from the proposed activities begins during the planning phase of the proposed activities. Several factors were considered during the planning phase of the proposed activities, including

1. Energy Source—Part of the considerations for the proposed survey was to evaluate whether the research objectives could be met with a smaller energy source than the full, 36-airgun, 6600-in^3 *Langseth* array, and it was decided that the scientific objectives could be met using an energy source comprising 4 airguns (total volume 700 in^3 volume) towed at a depth of ~4.5 or 6 m. Two such subarrays of 4 airguns would be used alternately (flip-flop mode); one would be towed on the port side, the other one on the starboard side. Thus, the source volume would not exceed 700 in^3 at any time. We have assumed in the impacts analysis and take estimate calculations the use of the 4-airgun array towed at 6 m as that would result in the farthest sound propagation. Based on the research goals and current knowledge of environmental conditions in the survey area based on 2014 activities, the 1400-in^3 source level proposed for possible use in 2014 is no longer viewed necessary and has not been included in this analysis. For the DAA off the coast of New Jersey included in the PEIS, the energy source level analyzed was a pair of 45/105-in^3 GI guns, however this source level was not viewed as adequate for meeting the research goals of the proposed survey.
2. Survey Timing—The PIs worked with L-DEO and NSF to identify potential times to carry out the survey taking into consideration key factors such as environmental conditions (i.e., the seasonal presence of marine mammals, sea turtles, and seabirds), weather conditions, equipment, and optimal timing for other proposed seismic surveys using the *Langseth*. Some marine mammal species are expected to occur in the area year-round, so altering the timing of the proposed project likely would result in no net benefits for those species. Some migratory species are expected to be farther north at the time of the survey, so the survey timing is beneficial for those species.
3. Mitigation Zones—During the planning phase, mitigation zones for the proposed survey were calculated based on modeling by L-DEO for both the exclusion zone (EZ) and the safety zone; these zones are given in Table 1 and Appendix Table A2. A more detailed description of the modeling process used to develop the mitigation zones can be found in Appendix A. Received sound levels in deep water have been predicted by L-DEO for the 4-airgun array and the single Bolt 1900LL 40-in^3 airgun that would be used during power downs. Scaling factors between those arrays and the 18-airgun, 3300-in^3 array, taking into account tow depth differences, were developed and applied to empirical data for the 18-airgun array in shallow water in the Gulf of Mexico from Diebold et al. (2010). The use of the 4-airgun array towed at 6 m is assumed in the impacts and take estimate analysis as that would result in the farthest sound propagation. During actual operations, however, the corresponding mitigation zone would be applied for the selected source level. The 1 July 2014 Final EA included mitigation zones and take calculations for a 1400-in^3 array, however, that source level has been determined to be unnecessary and is not included in this analysis.

   Table 1 shows the 180-dB EZ and 160-dB "Safety Zone" (distances at which the rms sound levels are expected to be received) for the mitigation airgun and the 4-airgun subarray. The 160 and 180-dB re 1 μPa_{rms} distances are the criteria currently specified by NMFS (2000) for cetaceans. The 180-dB distance has also been used as the EZ for sea turtles, as required by NMFS in most other recent seismic projects per the IHAs. Per the Biological Opinion issued in 2014 (Appendix C of the 1 July 2014 Final EA), a 166-dB distance would be used for Level B takes for sea turtles. Per the IHA for this survey issued in 2014 (Appendix D of the 1 July

TABLE 1. Predicted distances to which sound levels ≥180 and 160 dB re 1 μPa$_{rms}$ would be received during the proposed 3-D survey off New Jersey, using a 4-airgun, 700-in^3 subset of 1 string at 4.5- or 6-m tow depth and the 40-in^3 airgun. Radii are based on scaling described in the text of Appendix A and Figures A2 to A6, and the assumption that received levels on an rms basis are, numerically, 10 dB higher than the SEL values.[1]

Source and Volume	Water Depth	Predicted RMS Radii (m) 180 dB	Predicted RMS Radii (m) 160 dB
4-airgun subarray (700 in^3) @ 4.5 m	<100 m	378	5240
4-airgun subarray (700 in^3) @ 6 m	<100 m	439	6100
Single Bolt airgun (40 in^3) @ 6 m	<100 m	73	995

2014 Final EA), the Exclusion Zone was increased by 3 dB (thus operational mitigation would be at the 177-dB isopleth), which adds ~50% to the power-down/shut-down radius. NSF does not view this overly precautionary approach appropriate, and it is not included here. A recent retrospective analysis of acoustic propagation of *Langseth* sources in a coastal/shelf environment from the Cascadia Margin off Washington suggests that predicted radii (using an approach similar to that used here) for *Langseth* sources were 2–3 times larger than measured in shallow water, so in fact were very conservative (Crone et al. 2014).

Southall et al. (2007) made detailed recommendations for new science-based noise exposure criteria. In December 2013, NOAA published draft guidance for assessing the effects of anthropogenic sound on marine mammals (NOAA 2013a), although at the time of preparation of this Draft Amended EA, the date of release of the final guidelines and how they would be implemented are unknown. As such, this Draft Amended EA has been prepared in accordance with the current NOAA acoustic practices, and the procedures are based on best practices noted by Pierson et al. (1998), Weir and Dolman (2007), Nowacek et al. (2013), and Wright (2014).

Enforcement of mitigation zones via power and shut downs would be implemented in the Operational Phase, as noted below unless otherwise prescribed by the IHA.

(b) Operational Phase

Marine species, including marine mammals and sea turtles, are known to occur in the proposed survey area. However, the number of individual animals expected to be approached closely during the proposed activities would be relatively small in relation to regional population sizes. To minimize the likelihood that potential impacts could occur to the species and stocks, monitoring and mitigation measures proposed during the operational phase of the proposed activities, which are consistent with the PEIS and past IHA requirements, include

1. monitoring by protected species visual observers (PSVOs) for marine mammals, sea turtles, and seabirds;

[1] Sound sources are primarily described in sound pressure level (SPL) units. SPL is often referred to as rms or “root mean square” pressure, averaged over the pulse duration. Sound exposure level (SEL) is a measure of the received energy in a pulse and represents the SPL that would be measured if the pulse energy were spread evenly over a 1-s period.

2. passive acoustic monitoring (PAM);
3. PSVO data and documentation;
4. mitigation during operations (speed or course alteration; power-down, shut-down, and ramp-up procedures; and special mitigation measures for rare species, species concentrations, and sensitive habitats).

The proposed operational mitigation measures are standard for all high energy seismic cruises, per the PEIS, and therefore are not discussed further here. Special mitigation measures were considered for this cruise. Although it is very unlikely that a North Atlantic right whale would be encountered, the airgun array would be shut down if one is sighted at any distance from the vessel because of the species' rarity and conservation status. It is also unlikely that concentrations of large whales of any species would be encountered, but if so, they would be avoided.

With the proposed monitoring and mitigation provisions, potential effects on most if not all individuals would be expected to be limited to minor behavioral disturbances. Those potential effects would be expected to have negligible impacts both on individual marine mammals and on the associated species and stocks. Ultimately, survey operations would be conducted in accordance with all applicable U.S. federal regulations and IHA requirements.

Alternative 1: Alternative Survey Timing

An alternative to issuing the IHA for the period requested and to conducting the project then would be to conduct the project at an alternative time, such as late spring or early fall (avoiding the North Atlantic right whale migration season) implementing the same monitoring and mitigation measures as under the Proposed Action, and requesting an IHA to be issued for that alternative time. An evaluation of the effects of this Alternative Action is given in § IV.

Alternative 2: No Action Alternative

An alternative to conducting the proposed activities is the "No Action" alternative, i.e., do not issue an IHA and do not conduct the research operations. If the research is not conducted, the "No Action" alternative would result in no disturbance to marine mammals because of the absence of the proposed activities. Although the No-Action Alternative is not considered a reasonable alternative because it does not meet the purpose and need for the Proposed Action, per CEQ regulations it is included and carried forward for analysis in § IV.

Alternatives Considered but Eliminated from Further Analysis

(1) Alternative E1: Alternative Location

The New Jersey (NJ) continental margin has for decades been recognized as among the best siliciclastic passive margins for elucidating the timing and amplitude of eustatic change during the "Ice House" period of Earth history, when glacioeustatic changes shaped continental margin sediment sections around the world. There is a fundamental need to constrain the complex forcing functions tying evolution and preservation of the margin stratigraphic record to base-level changes. This could be accomplished by following the transect strategy adopted by the international scientific ocean drilling community. This strategy involves integration of drilling results with seismic imaging. In keeping with this strategy, the proposed seismic survey would acquire a 3-D seismic volume encompassing the three existing IODP Expedition 313 (Exp313) drill sites on the inner-middle shelf of the NJ margin. Exp313, the latest chapter in the multi-decade Mid-Atlantic Transect, represents the scientific community's best opportunity to link excellently sampled and logged late Paleogene-Neogene prograding clinoforms to state-of-the-art

3-D images. Exp313 borehole data would provide lithostratigraphy, geochronology, and paleobathymetry. 3-D seismic imaging would put these sampled records in a spatially accurate, stratigraphically meaningful context. Such imagery would allow researchers to map sequences around Exp313 sites with a resolution and confidence previously unattainable, and to analyze their spatio-temporal evolution.

No other scientific ocean drilling boreholes are available on the NJ shelf or elsewhere that provide such high sediment recoveries and high-quality well logs as those of Exp313. The need to tie the proposed 3-D survey to Exp313 drill sites means that it is not possible to conduct the survey in a different area. Also, positioning a 3-D volume requires broad coverage by pre-existing 2-D seismic data. Such data, collected over more than two decades, are readily available on the NJ shelf. Furthermore, the proposed research underwent the NSF merit review process, and the science, including the site location, was determined to be meritorious.

(2) Alternative E2: Use of Alternative Technologies

As described in § 2.6 of the PEIS, alternative technologies to the use of airguns were investigated to conduct high-energy seismic surveys. At the present time, these technologies are still not feasible, commercially viable, or appropriate to meet the Purpose and Need. Additional details about these technologies are given in the Final USGS EA (RPS 2014).

Table 2 provides a summary of the proposed action, alternatives, and alternatives eliminated from further analysis.

III. AFFECTED ENVIRONMENT

As described in the PEIS, Chapter 3, the description of the affected environment focuses only on those resources potentially subject to impacts. Accordingly, the discussion of the affected environment (and associated analyses) has focused mainly on those related to marine biological resources, as the proposed short-term activities have the potential to impact marine biological resources within the proposed Project area. These resources are identified in Section III, and the potential impacts to these resources are discussed in Section IV. Initial review and analysis of the proposed Project activities determined that the following resource areas did not require further analysis in this Draft Amended EA:

- *Air Quality/Greenhouse Gases*—Project vessel emissions would result from the proposed activities; however, these short-term emissions would not result in any exceedance of federal Clean Air standards. Emissions would be expected to have a negligible impact on the air quality within the survey area;
- *Land Use*—All proposed activities would be in the marine environment. Therefore, no changes to current land uses or activities in the Project area would result from the proposed Project;
- *Safety and Hazardous Materials and Management*—No hazardous materials would be generated or used during proposed activities. All Project-related wastes would be disposed of in accordance with federal and international requirements;
- *Geological Resources (Topography, Geology and Soil)*—The proposed Project would result in no displacement of soil and seafloor sediments. Proposed activities would not adversely affect geologic resources as no impacts would occur;
- *Water Resources*—No discharges to the marine environment are proposed within the Project area that would adversely affect marine water quality. Therefore, there would be no impacts to water resources resulting from the proposed Project activities;
- *Terrestrial Biological Resources*—All proposed Project activities would occur in the marine environment and would not impact terrestrial biological resources;

Table 2. Summary of Proposed Action, Alternatives Considered, and Alternatives Eliminated

Proposed Action	Description
Proposed Action: Conduct a marine geophysical survey and associated activities in the Atlantic Ocean off New Jersey	Under the Proposed Action, a 3-D seismic reflection survey would take place in the Atlantic Ocean off New Jersey during the summer of 2015. When considering transit; equipment deployment, maintenance, and retrieval; weather; marine mammal activity; and other contingencies, the proposed activities would be expected to be completed in ~34 days. The standard monitoring and mitigation measures identified in the NSF PEIS would apply and are described in further detail in this document (§ II [3]), along with any additional requirements identified by regulating agencies. All necessary permits and authorizations, including an IHA, were requested and received from regulatory bodies in 2014 and would be requested again for 2015.
Alternatives	Description
Alternative 1: Alternative Survey Timing	Under this Alternative, the survey operations would be conducted at a different time of the year, such as late spring or early fall. The standard monitoring and mitigation measures identified in the NSF PEIS would apply. These measures are described in further detail in this document (§ II [3]) and would apply to survey activities conducted during an alternative survey time period, along with any additional requirements identified by regulating agencies as a result of the change. All necessary permits and authorizations, including an IHA, would be requested from regulatory bodies.
Alternative 2: No Action	Under this Alternative, no proposed activities would be conducted and seismic data would not be collected. No permits and authorizations, including an IHA, would be requested from regulatory bodies, as the Proposed Action would not be conducted.
Alternatives Eliminated from Further Analysis	Description
Alternative E1: Alternative Location	The survey location has been specifically identified because of the data available for that location, including borehole data from three IODP Expedition 313 drill sites that would provide lithostratigraphy, geochronology, and paleobathymetry, and broad coverage by pre-existing 2-D seismic data. The proposed 3-D seismic imaging would put these sampled records in a spatially accurate, stratigraphically meaningful context. Such imagery would allow researchers to map sequences around the drill sites with a resolution and confidence previously unattainable, and to analyze their spatio-temporal evolution. Furthermore, the proposed science underwent the NSF merit review process, and the science, including the site location, was determined to be meritorious. Thus, conducting the proposed survey at a different location was eliminated from further consideration.
Alternative E2: Alternative Survey Techniques	Under this alternative, alternative survey techniques would be used, such as marine vibroseis, which could potentially reduce impacts on the marine environment. Alternative technologies were evaluated in the PEIS, § 2.6. At the present time, however, these technologies are still not feasible, commercially viable, or appropriate to meet the Purpose and Need. NSF currently owns the *Langseth*, and its primary capability is to conduct seismic surveys; no other viable technologies are available to NSF. Thus, this Alternative was eliminated from further consideration.

- *Socioeconomic and Environmental Justice*—Implementation of the proposed Project would not affect, beneficially or adversely, socioeconomic resources, environmental justice, or the protection of children. No changes in the population or additional need for housing or schools would occur. Because of the location of the proposed activity and distance from shore, human activities in the area around the survey vessel would be limited to SCUBA diving, commercial and recreational fishing activities and other vessel traffic. Fishing, SCUBA diving, vessel traffic, and potential impacts are described in further detail in §§ III and IV. Additionally, there is a marine mammal watching industry in New Jersey. Because of the distance from shore to the proposed survey site, it would be unlikely that marine mammal watching boat tours would coincide with the proposed survey site or be impacted by

the proposed activities. Most activities are conducted within ~20 km of the coast, with the majority occurring closer inshore. Some boat tours occur well south (~100 km) of the proposed survey area around Cape May and in Delaware Bay. Some dolphin watching cruises take place off Atlantic City fairly close to shore. Tours typically are ~1.5–3 h long. Although marine mammals around the seismic survey may avoid the vessel during operations, this behavior would be of short duration and temporary. Given the distance from shore to the proposed activities, the likely distance from any of the few marine mammal watching activities, and the short and temporary duration of any potential impacts to marine mammals, it would be unlikely that the marine mammal watching industry would be affected by the proposed activities and, therefore, this issue is not analyzed further in this assessment. Furthermore, no whale watching vessels were encountered by the *Langseth* during the ~13 days the vessel was in the survey area in 2014. No other socioeconomic impacts would be anticipated as a result of the proposed activities;

- *Visual Resources*—No visual resources would be anticipated to be negatively impacted as the area of operation is significantly outside of the land and coastal view shed; and
- *Cultural Resources*—With the following possible exceptions, there are no known cultural resources in the proposed Project area. One shipwreck, a known dive site, is in or near the survey area (see Fig. 2 in § III): the *Lillian* (Galiano 2009; Fisherman's Headquarters 2014; NOAA 2014a). Shipwrecks are discussed further in § IV. Airgun sounds would have no effects on solid structures; no significant impacts on shipwrecks would be anticipated (§ IV). No impacts to cultural resources would be anticipated.

Physical Environment and Oceanography

The water off the U.S. east coast consists of three water masses: coastal or shelf waters, slope waters, and the Gulf Stream. Coastal waters off Canada, which originate mostly in the Labrador Sea, move southward over the continental shelf until they reach Cape Hatteras, NC, where they are entrained between the Gulf Stream and slope waters. North of Cape Hatteras, an elongated cyclonic gyre of slope water that forms because of the southwest flow of coastal water and the northward flowing Gulf Stream is present most of the year and shifts seasonally relative to the position of the north edge of the Gulf Stream. Slope water eventually merges with the Gulf Stream water. The Gulf Stream flows through the Straits of Florida and then parallel to the continental margin, becoming stronger as it moves northward. It turns seaward near Cape Hatteras and moves northeast into the open ocean.

The shelf waters off New Jersey are part of the Mid-Atlantic Bight, which includes shelf waters from Cape Hatteras, NC, to southern Cape Cod. The shelf is dominated by a sandy to muddy-sandy bottom (Steimle and Zetlin 2000; USGS 2000 *in* DoN 2005). The shelf off New Jersey slopes gently and uniformly seaward to the shelf-slope transition 120–150 km offshore in water depths 120–160 m (Carey et al. 1998 *in* GMI 2010). The shelf edge off New Jersey is incised by the Hudson Canyon to the north and the Wilmington Canyon to the south. Several smaller canyons also occur along the shelf edge. The Hudson Canyon is the largest canyon off the east coast of the U.S. The proposed survey area is entirely on the shelf.

The shelf waters off New Jersey become stratified in the spring as the water warms, and are fully stratified throughout the summer, i.e., warmer, fresher water accumulates at the surface and denser, colder, more saline waters occur near the seafloor. The stratification breaks down in fall because of mixing by wind and surface cooling (Castelao et al. 2008). Summer upwelling occurs off New Jersey, where nutrient-rich cold water is brought closer to the surface and stimulates primary production (Glenn et al. 2004; NEFSC 2013a). The primary production of the northeast U.S. continental shelf is

1536 mg C/m^2/day (Sea Around Us 2013). The salinity of shelf water usually increases with depth and is generally lower than the salinity of water masses farther offshore primarily because of the low-salinity input from rivers and estuaries.

There are numerous artificial reefs in shelf waters off New Jersey, including materials such as decommissioned ships, barges, and reef balls or hollow concrete domes (Steimle and Zetlin 2000; Figley 2005); these reefs can provide nursery habitat, protection, and foraging sites to marine organisms. Since 1984, more than 3500 of these artificial patch reefs have been constructed off New Jersey (Figley 2005).

Protected Areas

Several federal Marine Protected Areas (MPAs) or sanctuaries have been established ~500 km north of the proposed survey area, primarily with the intention of preserving cetacean habitat (Hoyt 2005; CetaceanHabitat 2013). These include the Cape Cod Bay Northern Right Whale Critical Habitat Area, the Great South Channel Northern Right Whale Critical Habitat Area east of Cape Cod, the Gerry E Studds Stellwagen Bank National Marine Sanctuary in the Gulf of Maine, and Jeffrey's Ledge, a proposed extension to the Stellwagen Bank National Marine Sanctuary. The Monitor National Marine Sanctuary is located to the southeast of Cape Hatteras, North Carolina. There are also five state Ocean Sanctuaries in Massachusetts waters including Cape Cod, Cape Cod Bay, Cape and Islands, North Shore, and South Essex Ocean Sanctuaries (Mass.Gov 2013). These sanctuaries include most Massachusetts state waters except for the area east of Boston. In addition, three Canadian protected areas also occur in the Northwest Atlantic for cetacean habitat protection, including the Bay of Fundy Right Whale Conservation Area, Roseway Basin Right Whale Conservation Area, and Gully Marine Protected Area off the Scotian Shelf. The proposed survey is not located within or near any federal, state, or international MPA or sanctuary.

The Harbor Porpoise Take Reduction Plan (HPTRP) is intended to reduce the interactions between harbor porpoises and commercial gillnets in four management areas: waters off New Jersey, Mudhole North, Mudhole South, and Southern Mid Atlantic (NOAA 2010b). The HPTRP is not relevant to this EA because harbor porpoises are not expected to occur in the survey area.

Marine Mammals

Thirty-one cetacean species (6 mysticetes and 25 odontocetes) could occur near the proposed survey site (Table 3). Six of the 31 species are listed under the U.S. Endangered Species Act (ESA) as ***Endangered***: the North Atlantic right, humpback, blue, fin, sei, and sperm whales. In fact, only five species were observed during the 13-day cruise in 2014, including one humpback whale, plus one unidentified baleen whale and one unidentified dolphin (Ingram et al. 2014). An additional four cetacean species, although present in the wider western North Atlantic Ocean, likely would not be found near the proposed survey area between ~39–40°N because their ranges generally do not extend as far north (Clymene dolphin, *Stenella clymene*; Fraser's dolphin, *Lagenodelphis hosei*; melon-headed whale, *Peponocephala electra*; and Bryde's whale, *Balaenoptera brydei*). Although the secondary range of the beluga whale (*Delphinapterus leucas*) may range as far south as New Jersey (Jefferson et al. 2008), and there have been at least two sightings off the coast of New Jersey (IOC 2013), this species is not included here as it is unlikely to be encountered during the proposed survey. Similarly, no pinnipeds are included; harp seals (*Pagophilus groenlandicus*) and hooded seals (*Cystophora cristata*) are rare in the proposed survey area, and gray (*Halichoerus grypus*) and harbor seals (*Phoca vitulina*) have a more northerly distribution during the summer (DoN 2005) and are therefore not expected to occur there during the survey. No pinnipeds were observed during the 13-day cruise in 2014. Information on grey, harbor, and harp seals is included in the 2014 NMFS EA for this project, and is incorporated into this Draft Amended EA by reference as if fully set forth herein (Appendix E of the 1 July 2014 Final EA).

TABLE 3. The habitat, occurrence, regional population sizes, and conservation status of marine mammals that could occur in or near the proposed survey area in the Northwest Atlantic Ocean off New Jersey.

Species	Habitat	Occurrence in survey area in summer	Regional/SAR abundance estimates[1]	ESA[2]	IUCN[3]	CITES[4]
Mysticetes						
North Atlantic right whale	Coastal and shelf	Rare	455 / 455[5]	EN	EN	I
Humpback whale	Mainly coastal, banks	Common	11,600[6] / 823[7]	EN	LC	I
Minke whale	Mainly coastal	Rare	138,000[8] / 20,741[9]	NL	LC	I
Sei whale	Mainly offshore	Uncommon	10,300[10] / 357[11]	EN	EN	I
Fin whale	Slope, pelagic	Uncommon	26,500[12] / 3522[5]	EN	EN	I
Blue whale	Coastal, shelf, pelagic	Rare	855[13] / 440[5]	EN	EN	I
Odontocetes						
Sperm whale	Pelagic	Common	13,190[14] / 2288[15]	EN	VU	I
Pygmy sperm whale	Off shelf	Uncommon	N.A. / 3785[16]	NL	DD	II
Dwarf sperm whale	Off shelf	Uncommon	N.A. / 3785[16]	NL	DD	II
Cuvier's beaked whale	Pelagic	Uncommon	N.A. / 6532[17]	NL	LC	II
Northern bottlenose whale	Pelagic	Rare	N.A. / N.A.	NL	DD	II
True's beaked whale	Pelagic	Rare	N.A. / 7092[18]	NL	DD	II
Gervais' beaked whale	Pelagic	Rare	N.A. / 7092[18]	NL	DD	II
Sowerby's beaked whale	Pelagic	Rare	N.A / 7092[18]	NL	DD	II
Blainville's beaked whale	Pelagic	Rare	N.A. / 7092[18]	NL	DD	II
Rough-toothed dolphin	Mainly pelagic	Rare	N.A. / 271[5]	NL	LC	II
Bottlenose dolphin	Coastal, offshore	Common	N.A / 89,080[19]	NL^	LC	II
Pantropical spotted dolphin	Mainly pelagic	Rare	N.A. / 3333[5]	NL	LC	II
Atlantic spotted dolphin	Mainly coastal	Common	N.A. / 44,715[5]	NL	DD	II
Spinner dolphin	Coastal, pelagic	Rare	N.A. / N.A.	NL	DD	II
Striped dolphin	Off shelf	Uncommon	N.A. / 54,807[5]	NL	LC	II
Short-beaked common dolphin	Shelf, pelagic	Common	N.A. / 173,486[5]	NL	LC	II
White-beaked dolphin	Shelf <200 m	Rare	10s–100s of 1000s[20] / 2003[5]	NL	LC	II
Atlantic white-sided dolphin	Shelf and slope	Uncommon	10s–100s of 1000s[21] / 48,819[5]	NL	LC	II
Risso's dolphin	Mainly shelf, slope	Common	N.A. /18,250[5]	NL	LC	II
False killer whale	Pelagic	Extralimital	N.A. / N.A.	NL	DD	II
Pygmy killer whale	Mainly pelagic	Rare	N.A. / N.A.	NL	DD	II
Killer whale	Coastal	Rare	N.A. / N.A.	NL*	DD	II
Long-finned pilot whale	Mainly pelagic	Uncommon	780K[22] / 26,535[5]	NL[†]	DD	II
Short-finned pilot whale	Mainly pelagic	Uncommon	780K[22] / 21,515[5]	NL	DD	II
Harbor porpoise	Coastal	Rare	~500K[23] / 79,883[24]	NL	LC	II

N.A. = Data not available or species status was not assessed.
[1] SAR (stock assessment report) abundance estimates are from the 2013 U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments (Waring et al. 2014) as noted, and regional abundance estimates are for the North Atlantic regions as noted.
[2] U.S. Endangered Species Act; EN = Endangered, NL = Not listed
[3] Codes for IUCN classifications from IUCN Red List of Threatened Species (IUCN 2013): EN = Endangered; VU = Vulnerable; LC = Least Concern; DD = Data Deficient
[4] Convention on International Trade in Endangered Species of Wild Fauna and Flora (UNEP-WCMC 2013): Appendix I = Threatened with extinction; Appendix II = not necessarily now threatened with extinction but may become so unless trade is closely controlled
[5] Estimate for the Western North Atlantic Stock (Waring et al. 2014)
[6] Best estimate for the western North Atlantic in 1992–1993 (IWC 2013)
[7] Minimum estimate for the Gulf of Maine stock (Waring et al. 2014)
[8] Best estimate for the North Atlantic in 2002–2007 (IWC 2013)

[9] Estimate for the Canadian East Coast Stock (Waring et al. 2014)
[10] Estimate for the Northeast Atlantic in 1989 (Cattanach et al. 1993)
[11] Estimate for the Nova Scotia Stock (Waring et al. 2014)
[12] Best estimate for the North Atlantic in 2007 (IWC 2013)
[13] Estimate for the central and northeast Atlantic in 2001 (Pike et al. 2009)
[14] Estimate for the North Atlantic (Whitehead 2002)
[15] Estimate for the North Atlantic Stock (Waring et al. 2014)
[16] Combined estimate for pygmy and dwarf sperm whales, Western North Atlantic Stock (Waring et al. 2014)
[17] Estimate for the Western North Atlantic Stock (Waring et al. 2014)
[18] Combined estimate for *Mesoplodon* spp. Western North Atlantic stocks (Waring et al. 2014)
[19] Combined estimate for the Western North Atlantic Offshore Stock and the Northern Migratory Coastal Stock (Waring et al. 2014)
[20] High tens to low hundreds of thousands in the North Atlantic (Reeves et al. 1999a)
[21] Tens to low hundreds of thousands in the North Atlantic (Reeves et al. 1999b)
[22] Estimate for both long- and short-finned pilot whales in the central and eastern North Atlantic in 1989 (IWC 2013)
[23] Estimate for the North Atlantic (Jefferson et al. 2008)
[24] Estimate for the Gulf of Maine/Bay of Fundy Stock (Waring et al. 2014)
* Killer whales in the eastern Pacific Ocean, near Washington state, are listed as endangered under the U.S. ESA but not in the Atlantic Ocean.
^ The Western North Atlantic Coastal Morphotype stocks, ranging from NJ to FL, are listed as depleted under the U.S. Marine Mammal Protection Act, as are some other stocks to the south of the proposed survey area.
† Considered a strategic stock.

General information on the taxonomy, ecology, distribution and movements, and acoustic capabilities of marine mammals are given in § 3.6.1 and § 3.7.1 of the PEIS. The proposed survey area off New Jersey is near one of the DAAs in the PEIS. The general distributions of mysticetes and odontocetes in this region of the Atlantic Ocean are discussed in § 3.6.2.1 and § 3.7.2.1 of the PEIS, respectively. Additionally, information on marine mammals in this region is included in § 4.2.2.1 of the Bureau of Ocean Energy Management (BOEM) Final PEIS for Atlantic OCS Proposed Geological and Geophysical Activities, Mid-Atlantic and South Atlantic Planning Areas (BOEM 2014). The rest of this section deals with more specific species distribution off the coast of New Jersey. For the sake of completeness, an additional six odontocetes that are expected to be rare or extralimital in the proposed survey area were included here, but were not included in the PEIS.

The main sources of information used here are the 2010 and 2013 U.S. Atlantic and Gulf of Mexico marine mammal stock assessment reports (SARs: Waring et al. 2010, 2014), the Ocean Biogeographic Information System (OBIS: IOC 2013), and the Cetacean and Turtle Assessment Program (CETAP 1982). The SARs include maps of sightings for most species from NMFS' Northeast and Southeast Fisheries Science Centers (NEFSC and SEFSC) surveys in summer 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010, and 2011. OBIS is a global database of marine species sightings. CETAP covered 424,320 km of trackline on the U.S. outer continental shelf from Cape Hatteras to Nova Scotia. Aerial and shipboard surveys were conducted over a 39-month period from 1 November 1978 to 28 January 1982. The mid-Atlantic area referred to in the following species accounts included waters south of Georges Bank down to Cape Hatteras, and from the coast out to ~1830 m depth.

(1) Mysticetes

North Atlantic Right Whale (*Eubalaena glacialis*)

The North Atlantic right whale is known to occur primarily in the continental shelf waters off the eastern U.S. and Canada, from Florida to Nova Scotia (Winn et al. 1986; Jefferson et al. 2008). There are five well-known habitats in the northwest Atlantic used annually by right whales (Winn et al. 1986; NMFS 2005). These include the winter calving grounds in coastal waters of the southeastern U.S. (Florida/Georgia); spring feeding grounds in the Great South Channel (east of Cape Cod); late winter/spring feeding grounds and nursery grounds in Massachusetts Bay and Cape Cod Bay; summer/fall feeding and nursery grounds in the Bay of Fundy; and summer/fall feeding grounds on the Nova Scotian

Shelf. In addition, Jeffreys Ledge, off the coast of northern Massachusetts, New Hampshire, and Maine, could be an important fall feeding area for right whales and an important nursery area during summer, especially in July and August (Weinrich et al. 2000). The first three habitats were designated as Critical Habitat Areas by NMFS (1994).

There is a general seasonal north-south migration of the North Atlantic population between feeding and calving areas, but right whales could be seen anywhere off the Atlantic U.S. throughout the year (Gaskin 1982). The seasonal occurrence of right whales in mid Atlantic waters is mostly between November and April, with peaks in December and April (Winn et al. 1986) when whales transit through the area on their migrations to and from breeding grounds or feeding grounds. The migration route between the Cape Cod summer feeding grounds and the Georgia/Florida winter calving grounds, known as the mid-Atlantic corridor, has not been considered to include "high use" areas, yet the whales clearly move through these waters regularly in all seasons (Reeves and Mitchell 1986; Winn et al. 1986; Kenney et al. 2001; Reeves 2001; Knowlton et al. 2002; Whitt et al. 2013).

North Atlantic right whales are found commonly on the northern feeding grounds off the north-eastern U.S. during early spring and summer. The highest abundance in Cape Cod Bay is in February and April (Winn et al. 1986; Hamilton and Mayo 1990) and from April to June in the Great South Channel east of Cape Cod (Winn et al. 1986; Kenney et al. 1995). Throughout the remainder of summer and into fall (June–November), they are most commonly seen farther north on feeding grounds in Canadian waters, with peak abundance during August, September, and early October (Gaskin 1987). Morano et al. (2012) and Mussoline et al. (2012) indicated that right whales are present in the southern Gulf of Maine year-round and that they occur there over longer periods than previously thought.

Some whales, including mothers and calves, remain on the feeding grounds through the fall and winter. However, the majority of the right whale population leaves the feeding grounds for unknown wintering habitats and returns when the cow-calf pairs return. The majority of the right whale population is unaccounted for on the southeastern U.S. winter calving ground, and not all reproductively-active females return to the area each year (Kraus et al. 1986; Winn et al. 1986; Kenney et al. 2001). Other wintering areas have been suggested, based upon sparse data or historical whaling logbooks; these include the Gulf of St. Lawrence, Newfoundland and Labrador, coastal waters of New York and between New Jersey and North Carolina, Bermuda, and Mexico (Payne and McVay 1971; Aguilar 1986; Mead 1986; Lien et al. 1989; Knowlton et al. 1992; Cole et al. 2009; Patrician et al. 2009).

Knowlton et al. (2002) provided an extensive and detailed analysis of survey data, satellite tag data, whale strandings, and opportunistic sightings along State waters of the mid-Atlantic migratory corridor[2], from the border of Georgia/South Carolina to south of New England, including waters in the proposed seismic survey area, spanning the period from 1974 to 2002. The majority of sightings (94%) along the migration corridor were within 56 km of shore, and more than half (64%) were within 18.5 km of shore (Knowlton et al. 2002). Water depth preference was for shallow waters; 80% of all sightings were in depths <27 m, and 93% were in depths <45 m (Knowlton et al. 2002). Most sightings >56 km from shore occurred at the northern end of the corridor, off New York and south of New England. North of Cape Hatteras, most sightings were reported for March–April. Sighting data analyzed by Winn et al. (1986) dating back to 1965 showed that the occurrence of right whales in the mid Atlantic, including the

[2] Multi-year datasets for the analysis were provided by the New England Aquarium, North Atlantic Right Whale Consortium, Oregon State University, Coastwise Consulting Inc., Georgia Department of Natural Resources, University of North Carolina Wilmington, Continental Shelf Associates, CETAP, NOAA, and University of Rhode Island.

proposed survey area, peaked in April and December (Winn et al. 1986). A review of the mid-Atlantic whale sighting and tracking data archive from 1974 to 2002 showed right whale sightings off the coast of New Jersey throughout the year, except during May–June, August, and November (Beaudin Ring 2002).

The Interactive North Atlantic Right Whale Sighting Map showed 32 sightings in the shelf waters off New Jersey between 2006 and 2012 (NEFSC 2013b). Two of these sightings occurred just to the north of the proposed survey site. Three sightings were made in June, and none were made in July. However, two sightings were made during July to the far east of the proposed survey area (NEFSC 2013b). There are also at least eight sightings of right whales off New Jersey in the Ocean Biogeographic Information System (OBIS; IOC 2013), which were made during the 1978–1982 Cetacean and Turtle Assessment Program (CETAP) surveys (CETAP 1982).

Palka (2006) reviewed North Atlantic right whale density in the U.S. Navy NE Operating Area based on summer abundance surveys conducted during 1998–2004. One of the lowest whale densities (including right whales) was found in the mid-Atlantic stratum, which includes the proposed survey area. However, survey effort for this stratum was also the lowest; only two surveys were conducted. No right whales were sighted.

Whitt et al. (2013) surveyed for right whales off the coast of New Jersey using acoustic and visual techniques from January 2008 to December 2009. Whale calls were detected off New Jersey year-round and four sightings were made: one in November, one in December, one in January just to the west of the survey area, and one cow-calf pair in May. In light of these findings, Whitt et al. (2013) suggested expanding the existing critical habitat to include waters of the mid-Atlantic. NMFS (2010) previously noted that such a revision could be warranted, but no revisions have been made to the critical habitat yet.

Federal and Other Action.—In 2002, NMFS received a petition to revise and expand the designation of critical habitat for the North Atlantic right whale. The revision was declined and the critical habitat designated in 1994 remained in place (NMFS 2005). Another petition for a revision to the critical habitat was received in 2009 that sought to expand the currently designated critical feeding and calving habitat areas and include a migratory corridor as critical habitat (NMFS 2010). NMFS noted that the requested revision may be warranted, but no revisions have been made as of June 2014. The designation of critical habitat does not restrict activities within the area or mandate any specific management action. However, actions authorized, funded, or carried out by federal agencies that may have an impact on critical habitat must be consulted upon in accordance with Section 7 of the ESA, regardless of the presence of right whales at the time of impacts. Impacts on these areas that could affect primary constituent elements such as prey availability and the quality of nursery areas must be considered when analyzing whether habitat may be adversely modified.

A number of other actions have been taken to protect North Atlantic right whales, including establishing the Right Whale Sighting Advisory System designed to reduce collisions between ships and right whales by alerting mariners to the presence of the whales (see NEFSC 2012); a Mandatory Ship Reporting System implemented by the U.S. Coast Guard in the right whale nursery and feeding areas (USCG 1999, 2001; Ward-Geiger et al. 2005); recommended shipping routes in key right whale aggregation areas (NOAA 2006, 2007, 2013b); regulations to implement seasonal mandatory vessel speed restrictions in specific locations (Seasonal Management Areas or SMAs) during times when whales are likely present, including ~37 km around points near the Ports of New York/New Jersey (40.495ºN, 73.933ºW) and Philadelphia and Wilmington (38.874ºN, 75.026ºW) during 1 November–30 April (NMFS 2008); temporary Dynamic Management Areas (DMAs) in response to actual whale sightings, requiring gear modifications to traps/pots and gillnets in areas north of 40°N with unexpected right whale aggregations (NOAA 2012a); and a voluntary seasonal (April 1 to July 31) Area to be Avoided in the

Great South Channel off Massachusetts (NOAA 2013b). Furthermore, in its Final PEIS (BOEM 2014), BOEM proposed that no seismic surveys would be authorized within right whale critical habitat from 15 November to April 15, nor within the Mid-Atlantic and Southeast U.S. SMAs from 1 November to 30 April 30. Additionally, G&G seismic surveys would not be allowed in active DMAs. The proposed survey area is not in any of these areas.

North Atlantic right whales likely would not be encountered during the proposed survey.

Humpback Whale (*Megaptera novaeangliae*)

In the North Atlantic, a Gulf of Maine stock of the humpback whale is recognized off the northeastern U.S. coast as a distinct feeding stock (Palsbøll et al. 2001; Vigness-Raposa et al. 2010). Whales from this stock feed during spring, summer, and fall in areas ranging from Cape Cod to Newfoundland. In the spring, greatest concentrations of humpback whales occur in the western and southern edges of the Gulf of Maine. During summer, the greatest concentrations are found throughout the Gulf of Maine, east of Cape Cod, and near the coast from Long Island to northern Virginia. Similar distribution patterns are seen in the fall, although sightings south of Cape Cod Bay are less frequent than those near the Gulf of Maine. From December to March, there are few occurrences of humpback whales over the continental shelf of the Gulf of Maine, and in Cape Cod and Massachusetts Bay (Clapham et al. 1993; Fig. B-5a *in* DoN 2005).

GMI (2010) reported 17 sightings of humpback whales during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with sightings during every season (including 1 in spring and 4 in summer[3]). There are >40 OBIS sighting records of humpback whales for the continental shelf off New Jersey, including sightings near the proposed survey area (IOC 2013). There was one sighting of a humpback whale during the 13-day cruise in 2014.

Common Minke Whale (*Balaenoptera acutorostrata*)

Four populations of the minke whale are recognized in the North Atlantic, including the Canadian East Coast stock that ranges from the eastern U.S. coast to Davis Strait (Waring et al. 2013). Minke whales are common off the U.S. east coast over continental shelf waters, especially off New England during spring and summer (CETAP 1982). Seasonal movements in the Northwest Atlantic are apparent, with animals moving south and offshore from New England waters during the winter (Fig. B-11a *in* DoN 2005; Waring et al. 2013). There are approximately 30 OBIS sightings of minke whales off New Jersey (IOC 2013), most of which were observed in the spring and summer during CETAP surveys (CETAP 1982).

GMI (2010) reported four sightings of minke whales during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009: two during winter and two during spring. Two sightings were also reported during summer NEFSC and SEFSC surveys between 1998 and 2011 on the shelf break off New Jersey (Waring et al. 2013). Minke whales likely would not be encountered during the proposed survey.

Sei Whale (*Balaenoptera borealis*)

Two stocks of the sei whale are recognized in the North Atlantic: the Labrador Sea Stock and the Nova Scotia Stock; the latter has a distribution that includes continental shelf waters from the northeastern U.S. to areas south of Newfoundland (Waring et al. 2013). The southern portion of the Nova Scotia stock's range includes the Gulf of Maine and Georges Bank during spring and summer (Waring et

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[3] GMI defined spring as 11 April–21 June and summer as 22 June–27 September.

al. 2013). Peak sightings occur in spring and are concentrated along the eastern edge of Georges Bank into the Northeast Channel and the southwestern edge of Georges Bank (Fig. B-6a *in* DoN 2005; Waring et al. 2013). Mitchell and Chapman (1977) suggested that this stock moves from spring feeding grounds on or near Georges Bank to the Scotian Shelf in June and July, eastward to Newfoundland and the Grand Banks in late summer, back to the Scotian Shelf in fall, and offshore and south in winter. During summer and fall, most sei whale sightings occur in feeding grounds in the Bay of Fundy and on the Scotian Shelf; sightings south of Cape Cod are rare (Fig. B-6a *in* DoN 2005).

There are at least three OBIS sightings of sei whales off New Jersey, and several more sightings to the south of the proposed survey area (IOC 2013). Palka (2012) reported one sighting on the shelf break off New Jersey in water depths ranging from 100–2000 m during June–August 2011 surveys. There were no sightings of sei whales during the CETAP surveys (CETAP 1982).

Fin Whale (*Balaenoptera physalus*)

Fin whales are present in U.S. shelf waters during winter, and are sighted more frequently than any other large whale at this time (DoN 2005). They occur year-round in shelf waters of New England and New Jersey (CETAP 1982; Fig. B-8a *in* DoN 2005). Winter sightings are most concentrated around Georges Bank and in Cape Cod Bay. During spring and summer, most fin whale sightings are north of 40ºN, with smaller numbers on the shelf south of there, including off New Jersey (Fig. B-8a *in* DoN 2005). During fall, almost all fin whales move out of U.S. waters to feeding grounds in the Bay of Fundy and on the Scotian Shelf, remain at Stellwagen Bank and Murray Basin (Fig. B-8a *in* DoN 2005), or begin a southward migration (Clark 1995).

GMI (2010) reported 37 sightings of fin whales during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with sightings during every season (including 11 in spring and 4 in summer). Acoustic detections were also made during all seasons (GMI 2010). Numerous sightings were also made off New Jersey during NEFSC and SEFSC summer surveys between 1995 and 2011, with two sightings on the shelf and other sightings on the shelf break and beyond (Waring et al. 2013). There are 170 OBIS sightings of fin whales off New Jersey (IOC 2013), most of which were made during the CETAP surveys (CETAP 1982).

Blue Whale (*Balaenoptera musculus*)

In the western North Atlantic, the distribution of the blue whale extends as far north as Davis Strait and Baffin Bay (Sears and Perrin 2009). Little is known about the movements and wintering grounds of the stocks (Mizroch et al. 1984). Acoustic detection of blue whales using the U.S. Navy's Sound Surveillance System (SOSUS) program has tracked blue whales throughout most of the North Atlantic, including deep waters east of the U.S. Atlantic EEZ and subtropical waters north of the West Indies (Clark 1995).

Wenzel et al. (1988) reported the occurrence of three blue whales in the Gulf of Maine in 1986 and 1987, which were the only reports of blue whales in shelf waters from Cape Hatteras to Nova Scotia. Several other sightings for the waters off the east coast of the U.S. were reported by DoN (2005). Wenzel et al. (1988) suggested that it is unlikely that blue whales occur regularly in the shelf waters off the U.S. east coast. Similarly, Waring et al. (2010) suggested that the blue whale is, at best, an occasional visitor in the U.S. Atlantic EEZ.

During CETAP surveys, the only two sightings of blue whales were made south of Nova Scotia (CETAP 1982). There are two offshore sightings of blue whales in the OBIS database to the southeast of New Jersey and several sightings to the north off New England and in the Gulf of Maine (IOC 2013). Blue whales likely would not be encountered during the proposed survey.

(2) Odontocetes

Sperm Whale (*Physeter macrocephalus*)

In the northwest Atlantic, the sperm whale generally occurs in deep water along the continental shelf break from Virginia to Georges Bank, and along the northern edge of the Gulf Stream (Waring et al. 2001). Shelf edge, oceanic waters, seamounts, and canyon shelf edges are also predicted habitats of sperm whales in the Northwest Atlantic (Waring et al. 2001). Off the eastern U.S. coast, they are also known to concentrate in regions with well-developed temperature gradients, such as along the edges of the Gulf Stream and warm core rings, which may aggregate their primary prey, squid (Jaquet 1996).

Sperm whales appear to have a well-defined seasonal cycle in the Northwest Atlantic. In winter, most historical records are in waters east and northeast of Cape Hatteras, with few animals north of 40ºN; in spring, they shift the center of their distribution northward to areas east of Delaware and Virginia, but they are widespread throughout the central area of the Mid-Atlantic Bight and southern tip of Georges Bank (Fig. B-10a in DoN 2005; Waring et al. 2013). During summer, they expand their spring distribution to include areas east and north of Georges Bank, the Northeast Channel, and the continental shelf south of New England (inshore of 100 m deep). By fall, sperm whales are most common south of New England on the continental shelf but also along the shelf edge in the Mid-Atlantic Bight (Fig. B-10a in DoN 2005; Waring et al. 2013).

There are several hundred OBIS records of sperm whales in deep waters off New Jersey and New England (IOC 2013), and numerous sightings were reported on and seaward of the shelf break during CETAP surveys (CETAP 1982) and during summer NEFSC and SEFSC surveys between 1998 and 2011 (Waring et al. 2013).

Pygmy and Dwarf Sperm Whales (*Kogia breviceps* and *K. sima*)

In the northwest Atlantic, both pygmy and dwarf sperm whales are thought to occur as far north as the Canadian east coast, with the pygmy sperm whale ranging as far as southern Labrador; both species prefer deep, offshore waters (Jefferson et al. 2008). Between 2006 and 2010, 127 pygmy and 32 dwarf sperm whale strandings were recorded from Maine to Puerto Rico, mostly off the southeastern U.S. coast; five strandings of pygmy sperm whales were reported for New Jersey (Waring et al. 2013).

There are 14 OBIS sightings of pygmy or dwarf sperm whales in offshore waters off New Jersey (IOC 2013). Several sightings of *Kogia* sp. (pygmy or dwarf sperm whales) for shelf-break waters off New Jersey were also reported during summer NEFSC and SEFSC surveys between 1995 and 2011 (Waring et al. 2013).

Cuvier's Beaked Whale (*Ziphius cavirostris*)

In the northwest Atlantic, Cuvier's beaked whale has stranded and been sighted as far north as the Nova Scotian shelf, and occurs most commonly from Massachusetts to Florida (MacLeod et al. 2006). Most sightings in the northwest Atlantic occur in late spring or summer, particularly along the continental shelf edge in the mid-Atlantic region (CETAP 1982; Waring et al. 2001, 2013). Mapping of combined beaked whale sightings in the northwest Atlantic suggests that beaked whales are rare in winter and fall, uncommon in spring, and abundant in summer in waters north of Virginia, off the shelf break and over the continental slope and areas of high relief, including the waters off New Jersey (Fig. B-13a *in* DoN 2005).

DoN mapped several sightings of Cuvier's beaked whales during the summer along the shelf break off New Jersey (Fig. B-13a *in* DoN 2005). One sighting was made off New Jersey during the CETAP surveys (CETAP 1982). Palka (2012) reported one sighting on the shelf break off New Jersey in water depths 100–2000 m during June–August 2011 surveys. There are eight OBIS sighting records of Cuvier's beaked whale in offshore waters off New Jersey (IOC 2013).

Northern Bottlenose Whale (*Hyperoodon ampullatus*)

Northern bottlenose whales are considered extremely uncommon or rare within waters of the U.S. Atlantic EEZ (Reeves et al. 1993; Waring et al. 2010), but there are known sightings off New England and New Jersey (CETAP 1982; McLeod et al. 2006; Waring et al. 2010). Two sightings of three individuals were made during the CETAP surveys; one sighting was made during May to the east of Cape Cod and the second sighting was made on 12 June along the shelf edge east of Cape May, New Jersey (CETAP 1982). Three sightings were made during summer surveys along the southern edge of Georges Bank in 1993 and 1996, and another three sightings were made in water depths 1000–4000 m at ~38–40ºN during NEFSC and SEFSC surveys between 1998 and 2006 (Waring et al. 2010). In addition, there is one OBIS sighting off New England in 2005 made by the Canadian Department of Fisheries and Oceans (IOC 2013). DoN (2005) also reported northern bottlenose whale sightings beyond the shelf break off New Jersey during spring and summer. Northern bottlenose whales likely would not be encountered during the proposed survey.

True's Beaked Whale (*Mesoplodon mirus*)

In the Northwest Atlantic, True's beaked whale occurs from Nova Scotia to Florida and the Bahamas (Rice 1998). Carwardine (1995) suggested that this species could be associated with the Gulf Stream. DoN did not report any sightings of True's beaked whale off New Jersey (Fig. B-13a *in* DoN 2005); however, several sightings of undifferentiated beaked whales were reported for shelf break waters off New Jersey during summer NEFSC and SEFSC surveys between 1995 and 2011 (Waring et al. 2013). There are no OBIS sightings of True's beaked whale off New Jersey, but there is one stranding record off North Carolina and one record off New England (IOC 2013). There are numerous other stranding records for the east coast of the U.S. (Macleod et al. 2006). True's beaked whales likely would not be encountered during the proposed survey.

Gervais' Beaked Whale (*Mesoplodon europaeus*)

Based on stranding records, Gervais' beaked whale appears to be more common in the western Atlantic than in the eastern Atlantic (Macleod et al. 2006; Jefferson et al. 2008). Off the U.S. east coast, it occurs from Cape Cod Bay, Massachusetts (Moore et al. 2004) to Florida, with a few records in the Gulf of Mexico (Mead 1989). DoN mapped two sightings of Gervais' beaked whale during summer to the south of the proposed survey area and numerous other sightings along the shelf break off the northeast coast of the U.S. (Fig. B-13a *in* DoN 2005). Palka (2012) reported three sightings in deep offshore waters during June–August 2011 surveys off the northeastern coast of the U.S. There are four OBIS stranding records of Gervais' beaked whale for Virginia, but no records for New Jersey (IOC 2013). Gervais' beaked whales likely would not be encountered during the proposed survey.

Sowerby's Beaked Whale (*Mesoplodon bidens*)

Sowerby's beaked whale occurs in cold temperate waters of the North Atlantic (Mead 1989). In the western North Atlantic, it is found from at least Massachusetts to the Labrador Sea (Mead et al. 2006; Jefferson et al. 2008). Palka (2012) reported one sighting on the shelf break off New Jersey during June–August 2011 surveys. There are also at least five OBIS sighting records in deep waters off New Jersey (IOC 2013). DoN mapped one stranding in New Jersey in fall and one in Delaware in spring, but no sightings off New Jersey (Fig. B-13a *in* DoN 2005). Sowerby's beaked whales likely would not be encountered during the proposed survey.

Blainville's Beaked Whale (*Mesoplodon densirostris*)

In the western North Atlantic, Blainville's beaked whale is found from Nova Scotia to Florida, the Bahamas, and the Gulf of Mexico (Würsig et al. 2000). There are numerous strandings records along the east coast of the U.S. (Macleod et al. 2006). DoN mapped several sightings of Blainville's beaked whale during summer along the shelf break off the northeastern coast of the U.S. (Fig. B-13a *in* DoN 2005). There is one OBIS sighting record in offshore waters to the southeast of New Jersey and one in offshore waters off New England (IOC 2013). Blainville's beaked whales likely would not be encountered during the proposed survey.

Rough-toothed Dolphin (*Steno bredanensis*)

The rough-toothed dolphin is distributed worldwide in tropical, subtropical, and warm temperate waters (Miyazaki and Perrin 1994). They are generally seen in deep, oceanic water, although they can occur in shallow coastal waters in some locations (Jefferson et al. 2008). The rough-toothed dolphin rarely ranges north of 40°N (Jefferson et al. 2008).

One sighting of 45 individuals was made south of Georges Bank seaward of the shelf edge during the CETAP surveys (CETAP 1982), and another sighting was made in the same areas during 1986 (Waring et al. 2010). In addition, two sightings were made off New Jersey to the southeast of the proposed survey area during 1979 and 1998 (Waring et al. 2010; IOC 2013). Palka (2012) reported a sighting in deep offshore waters off New Jersey during June–August 2011 surveys. Rough-toothed dolphins likely would not be encountered during the proposed survey.

Common Bottlenose Dolphin (*Tursiops truncatus*)

In the northwest Atlantic, the common bottlenose dolphin occurs from Nova Scotia to Florida, the Gulf of Mexico and the Caribbean, and south to Brazil (Würsig et al. 2000). There are regional and seasonal differences in the distribution of the offshore and coastal forms of bottlenose dolphins off the U.S. east coast. Although strandings of bottlenose dolphins are a regular occurrence along the U.S. east coast, since July 2013, an unusually high number of dead or dying bottlenose dolphins (971 as of 8 December 2013; 1175 as of 16 March 2014; 1283 as of 18 May 2014; and 1546 as of 19 October 2014) have washed up on the mid-Atlantic coast from New York to Florida (NOAA 2014b). NOAA declared an unusual mortality event (UME), the tentative cause of which is thought to be cetacean morbillivirus. As of 20 October 2014, 266 of 280 dolphins tested were confirmed positive or suspect positive for morbillivirus. NOAA personnel observed that the affected dolphins occur in nearshore waters, whereas dolphins in offshore waters >50 m deep did not appear to be affected (Environment News Service 2013), but have stated that it is uncertain exactly what populations have been affected (NOAA 2014b). In addition to morbillivirus, the bacteria *Brucella* was confirmed in 30 of 95 dolphins tested as of 20 October 2014 (NOAA 2014b). The NOAA web site is updated frequently, and it is apparent that the strandings initially had been moving south; in the 4 November update, dolphins had been reported washing up only as far south as South Carolina, and in the 8 December update, strandings were also reported in Georgia and Florida. Recently, the numbers of strandings appear to be decreasing, especially in the northern states; between 17 August and 19 October, there were 2, 3, 4, and 0 strandings in NY, NJ, DE, and MD, respectively.

Evidence of year-round or seasonal residents and migratory groups exist for the coastal form of bottlenose dolphins, with the so-called "northern migratory management unit" occurring north of Cape Hatteras to New Jersey, but only during summer and in waters <25 m deep (Waring et al. 2010). The offshore form appears to be most abundant along the shelf break and is differentiated from the coastal form by occurring in waters typically >40 m deep (Waring et al. 2010). Bottlenose dolphin records in the Northwest Atlantic suggest that they generally can occur year-round from the continental shelf to deeper waters over the abyssal plain, from the Scotian Shelf to North Carolina (Fig. B-14a *in* DoN 2005).

GMI (2010) reported 319 sightings of bottlenose dolphins during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with most sightings made during spring and summer. Palka (2012) also reported numerous sightings on the shelf break off New Jersey in water depths ranging from 100–2000 m during June–August 2011 surveys. There are also several hundred OBIS records off New Jersey, including sightings near the proposed survey area on the shelf and along the shelf edge (IOC 2013). There was one sighting of 10 bottlenose dolphins during the 13-day cruise in 2014.

Pantropical Spotted Dolphin (*Stenella attenuata*)

Pantropical spotted dolphins generally occur in deep offshore waters between 40°N and 40°S (Jefferson et al. 2008). There have been a few sightings at the southern edge of Georges Bank (Waring et al. 2010). In addition, there are at least 10 OBIS sighting records for waters off New Jersey that were made during surveys by the Canadian Wildlife Service between 1965 and 1992 (IOC 2013). Pantropical spotted dolphins likely would not be encountered during the proposed survey.

Atlantic Spotted Dolphin (*Stenella frontalis*)

In the western Atlantic, the distribution of the Atlantic spotted dolphin extends from southern New England, south to the Gulf of Mexico, the Caribbean Sea, Venezuela, and Brazil (Leatherwood et al. 1976; Perrin et al. 1994; Rice 1998). During summer, Atlantic spotted dolphins are sighted in shelf waters south of Chesapeake Bay, and near the continental shelf edge, on the slope, and offshore north of there, including the waters of New Jersey (Fig. B-15a *in* DoN 2005; Waring et al. 2014). Several sightings were also reported during summer NEFSC and SEFSC surveys between 1998 and 2011 on the shelf break off New Jersey (Waring et al. 2014). There are two OBIS sighting records northeast of the survey area and at least eight records to the southeast of the survey area (IOC 2013). There was one sighting of 12 Atlantic spotted dolphins during the 13-day cruise in 2014.

Spinner dolphin (*Stenella longirostris*)

The spinner dolphin is pantropical in distribution, with a range nearly identical to that of the pantropical spotted dolphin, including oceanic tropical and sub-tropical waters between 40ºN and 40ºS (Jefferson et al. 2008). The distribution of spinner dolphins in the Atlantic is poorly known, but they are thought to occur in deep waters along most of the U.S. coast; sightings off the northeast U.S. coast have occurred exclusively in offshore waters >2000 m (Waring et al. 2010). Several sightings were mapped by DoN (Fig. B-16 *in* DoN 2005) for offshore waters to the far east of New Jersey. There are also seven OBIS sighting records off the eastern U.S. but no records near the proposed survey area or in shallow water (IOC 2013). Spinner dolphins likely would not be encountered during the proposed survey.

Striped Dolphin (*Stenella coeruleoalba*)

In the western North Atlantic, the striped dolphin occurs from Nova Scotia to the Gulf of Mexico and south to Brazil (Würsig et al. 2000). Off the northeastern U.S. coast, striped dolphins occur along the continental shelf edge and over the continental slope from Cape Hatteras to the southern edge of Georges Bank (Waring et al. 2014). In all seasons, striped dolphin sightings have been centered along the 1000-m depth contour, and sightings have been associated with the north edge of the Gulf Stream and warm core rings (Waring et al. 2014). Their occurrence off the northeastern U.S. coast seems to be highest in the summer and lowest during the fall (Fig. B-17a *in* DoN 2005).

There are approximately 100 OBIS sighting records of striped dolphins for the waters off New Jersey to the east of the proposed survey area, mainly along the shelf break (IOC 2013). Numerous

sightings were also reported during summer NEFSC and SEFSC surveys between 1998 and 2011 off the shelf break (Waring et al. 2014).

Short-beaked Common Dolphin (*Delphinus delphis*)

The short-beaked common dolphin occurs from Cape Hatteras to Georges Bank during mid January–May, moves onto Georges Bank and the Scotian Shelf during mid summer and fall, and has been observed in large aggregations on Georges Bank in fall (Selzer and Payne 1988; Waring et al. 2014). Sightings off New Jersey have been made during all seasons (Fig. B-19a *in* DoN 2055). GMI (2010) reported 32 sightings of short-beaked common dolphins during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with sightings during fall and winter. There are over 100 OBIS sighting records near the proposed survey area off New Jersey, with most sightings near the shelf edge, but there are also several sightings in shelf waters (IOC 2013). There were 4 sightings of a total of 45 short-beaked common dolphins during the 13-day cruise in 2014.

White-beaked Dolphin (*Lagenorhynchus albirostris*)

The white-beaked dolphin is widely distributed in cold temperature and subarctic North Atlantic waters (Reeves et al. 1999a), and mainly occurs over the continental shelf, especially along the shelf edge (Carwardine 1995). It occurs in immediate offshore waters of the east coast of the North America, from Labrador to Massachusetts (Rice 1998). Off the northeastern U.S. coast, white-beaked dolphins are mainly found in the western Gulf of Maine and around Cape Cod (CETAP 1982; Fig. B-20a *in* DoN 2005; Waring et al. 2010). There are two OBIS sighting records to the east of the proposed survey area off New Jersey, and one to the south off North Carolina (IOC 2013). White-beaked dolphins likely would not be encountered during the proposed survey.

Atlantic White-sided Dolphin (*Lagenorhynchus acutus*)

The Atlantic white-sided dolphin occurs in cold temperate to subpolar waters of the North Atlantic in deep continental shelf and slope waters (Jefferson et al. 2008). In the western North Atlantic, it ranges from Labrador and southern Greenland to ~38ºN (Jefferson et al. 2008). There are seasonal shifts in Atlantic white-sided dolphin distribution off the northeastern U.S. coast, with low numbers in winter from Georges Basin to Jeffrey's Ledge and very high numbers in spring in the Gulf of Maine. In summer, Atlantic white-sided dolphins are mainly distributed northward from south of Cape Cod with the highest numbers from Cape Cod north to the lower Bay of Fundy; sightings off New Jersey appear to be sparse (Fig. B-21a *in* DoN 2005). There are over 20 OBIS sighting records in the shelf waters off New Jersey, including near the proposed survey area (IOC 2013).

Risso's Dolphin (*Grampus griseus*)

The highest densities of Risso's dolphin occur in mid latitudes ranging from 30° to 45°, and primarily in outer continental shelf and slope waters (Jefferson et al. 2013). Off the northeast U.S. coast during spring, summer, and autumn, Risso's dolphins are distributed along the continental shelf edge from Cape Hatteras to Georges Bank, but they range into oceanic waters during the winter (Waring et al. 2014). Mapping of Risso's dolphin sightings off the U.S. east coast suggests that they could occur year-round from the Scotian Shelf to the coast of the southeastern U.S. in waters extending from the continental shelf to the continental rise (DoN 2005). Off New Jersey, the greatest number of sightings occurs near the continental slope during summer (Fig. B-22a *in* DoN 2005).

There are at least 170 OBIS records near the proposed survey area off New Jersey, including shelf waters and at the shelf edge (IOC 2013). Numerous sightings were also reported during summer NEFSC

and SEFSC surveys between 1998 and 2011 for the shelf break off New Jersey (Waring et al. 2014). There was one sighting of a Risso's dolphin during the 13-day cruise in 2014.

Pygmy Killer Whale (*Feresa attenuata*)

The pygmy killer whale is pantropical/subtropical, generally occurring between 40ºN and 35ºS (Jefferson et al. 2008). There is no abundance estimate for the pygmy killer whale off the U.S. east coast because it is rarely sighted during surveys (Waring et al. 2010). One group of six pygmy killer whales was sighted off Cape Hatteras in waters >1500 m deep during a NMFS vessel survey in 1992 (Hansen et al. 1994 *in* Waring et al. 2010). There are an additional three OBIS sighting records to the southeast of the proposed survey area (Palka et al. 1991 *in* IOC 2013). Pygmy killer whales likely would not be encountered during the proposed survey.

False Killer Whale (*Pseudorca crassidens*)

The false killer whale is found worldwide in tropical and temperate waters generally between 50ºN and 50ºS (Odell and McClune 1999). It is widely distributed, but not abundant anywhere (Carwardine 1995). In the western Atlantic, it occurs from Maryland to Argentina (Rice 1998). Very few false killer whales were sighted off the U.S. northeast coast in the numerous surveys mapped by DoN (2005). There are 13 OBIS sighting records for the waters off the eastern U.S., but none are near the proposed survey area (IOC 2013). False killer whales likely would not be encountered during the proposed survey.

Killer Whale (*Orcinus orca*)

In the western North Atlantic, killer whales occur from the polar ice pack to Florida and the Gulf of Mexico (Würsig et al. 2000). Based on historical sightings and whaling records, killer whales apparently were most often found along the shelf break and offshore in the northwest Atlantic (Katona et al. 1988). They are considered uncommon or rare in waters of the U.S. Atlantic EEZ (Katona et al. 1988). Killer whales represented <0.1 % of all cetacean sightings (12 of 11,156 sightings) in CETAP surveys during 1978–1981 (CETAP 1982). Four of the 12 sightings made during the CETAP surveys were made offshore from New Jersey. Off New England, killer whales are more common in summer than in any other season, occurring nearshore and off the shelf break (Fig. B-24 *in* DoN 2005). There are 39 OBIS sighting records for the waters off the eastern U.S., but none off New Jersey (IOC 2013). Killer whales likely would not be encountered during the proposed survey.

Long- and Short-finned Pilot Whales (*Globicephala melas* and *G. macrorhynchus*)

There are two species of pilot whale, both of which could occur in the survey area. The long-finned pilot whale (*G. melas*) is distributed antitropically, whereas the short-finned pilot whale (*G. macrorhynchus*) is found in tropical, subtropical, and warm temperate waters (Olson 2009). In the northwest Atlantic, pilot whales often occupy areas of high relief or submerged banks and associated with the Gulf Stream edge or thermal fronts along the continental shelf edge (Waring et al. 1992). The ranges of the two species overlap in the shelf/shelf-edge and slope waters of the northeastern U.S. between New Jersey and Cape Hatteras, with long-finned pilot whales occurring to the north (Bernard and Reilly 1999). During winter and early spring, long-finned pilot whales are distributed along the continental shelf edge off the northeast U.S. coast and in Cape Cod Bay, and in summer and fall they also occur on Georges Bank, in the Gulf of Maine, and north into Canadian waters (Fig. B-25a *in* DoN 2005).

There are at least 200 OBIS sighting records for pilot whales for the waters off New Jersey, including sightings over the shelf; these sightings include *Globicephala* sp. and *G. melas* (IOC 2013). Numerous sightings were also reported during summer NEFSC and SEFSC surveys between 1998 and 2007 for the shelf break off New Jersey (Waring et al. 2014).

Harbor Porpoise (*Phocoena phocoena*)

The harbor porpoise inhabits cool temperate to subarctic waters of the Northern Hemisphere (Jefferson et al. 2008). There are likely four populations in the western North Atlantic: Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, Newfoundland, and Greenland (Gaskin 1984, 1992). Individuals found off the eastern U.S. coast likely would be almost exclusively from the Gulf of Maine/Bay of Fundy stock.

Harbor porpoises concentrate in the northern Gulf of Maine and southern Bay of Fundy during July–September, with a few sightings ranging as far south as Georges Bank and one off Virginia (Waring et al. 2014). In summer, sightings mapped from numerous sources extended only as far south as off northern Long Island, New York (Fig. B-26a *in* DoN 2005). During October–December and April–June, harbor porpoises are dispersed and range from New Jersey to Maine, although there are lower densities at the northern and southern extremes (DoN 2005; Waring et al. 2014). Most would be found over the continental shelf, but some are also encountered over deep waters (Westgate et al. 1998). During January–March, harbor porpoises concentrate farther south, from New Jersey to North Carolina, with lower densities occurring from New York to New Brunswick (DoN 2005; Waring et al. 2014).

GMI (2010) reported 51 sightings of harbor porpoise during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with sightings during fall and winter. There are 10 OBIS sighting records for the waters off New Jersey during March–June, most of which are from the CETAP surveys (CETAP 1982; IOC 2013). Harbor porpoises likely would not be encountered during the proposed survey.

Sea Turtles

Two species of sea turtle, the leatherback and loggerhead turtles, are common off the U.S. east coast. Kemp’s ridley and green turtles also occur in this area at much lower densities. A fifth species, the hawksbill turtle, is considered very rare in the northwest Atlantic Ocean. In fact, only one species was observed and identified during the 13-day cruise in 2014, the loggerhead turtle. Thirteen additional shelled sea turtles were also sighted, but were not identified. General information on the taxonomy, ecology, distribution and movements, and acoustic capabilities of sea turtles are given in § 3.4.1 of the PEIS. The general distribution of sea turtles in the northwest Atlantic is also discussed in § 3.4.2.1 of the PEIS and § 4.2.3.1 of the BOEM Final PEIS (BOEM 2014). The rest of this section deals specifically with their distribution off the northeastern coast of the U.S., particularly off New Jersey.

(1) Leatherback Turtle (*Dermochelys coriacea*)

Leatherback turtles commonly occur along the eastern U.S. coast and as far north as New England (Eckert 1995a), although important nesting areas occur only as far north as Florida (NMFS and USFWS 2013a). Leatherback occurrence in New England waters has been documented for many years, with most historic records during March–August focused around the Gulf of Maine and Georges and Browns Banks; in fall, they were focused more southerly in New England bays and sounds (Lazell 1980). Leatherbacks tagged off Cape Breton and mainland Nova Scotia during summer remained off eastern Canada and the northeastern U.S. coast before most began migrating south in October (James et al. 2005); foraging adults off Nova Scotia mainly originate from Trinidad (NMFS and USFWS 2013a). Some of these tags remained attached long enough to observe northward migrations, with animals leaving nesting grounds during February–March and typically arriving north of 38ºN during June, usually in areas within several hundred km of where they were observed in the previous year. Virtually all of the leatherbacks in sighting records off the northeastern U.S. occurred in summer off southern New Jersey, the southeastern tip of Long Island, and southern Nova Scotia (Fig. C-2a *in* DoN 2005).

GMI (2010) reported 12 sightings of leatherback sea turtles on the continental shelf off New Jersey during surveys conducted in January 2008–December 2009, with all sightings occurring during summer. There are over 200 OBIS sighting records for the waters off New Jersey (IOC 2013). Palka (2012) also reported several sightings off northern New Jersey south of Long Island during June–August 2011 surveys.

(2) Green Turtle (*Chelonia mydas*)

Important feeding areas for green turtles in U.S. waters are primarily located in Florida and southern Texas, but Long Island Sound and inshore waters of North Carolina appear to be important to juveniles during summer months (NMFS and USFWS 2007). Small numbers of juvenile green turtles have occurred historically in Long Island and Nantucket Sounds in New England (Lazell 1980). There are few sighting records, but DoN (Fig. C-5 *in* DoN 2005) suggested that small numbers can be found from spring to fall as far north as Cape Cod Bay, including off New Jersey. There are seven OBIS sightings of green turtles off the coast of New Jersey (IOC 2013). Palka (2012) also reported several sightings off northern New Jersey south of Long Island during June–August 2011 surveys.

(3) Loggerhead Turtle (*Caretta caretta*)

Major nesting areas for loggerheads in the western North Atlantic are located in the southeastern U.S., principally southern Florida, but also as far north as the Carolinas and occasionally Virginia; the nesting season is from May to August (Spotila 2004). Most females tagged on North Carolina nesting beaches traveled north to forage at higher latitudes (primarily off New Jersey, Maryland, and Delaware) during summer, and south to wintering grounds off the southeastern U.S. in the fall (Hawkes et al. 2007).

Some juveniles make seasonal foraging migrations into temperate latitudes as far north as Long Island, New York (Shoop and Kenney 1992 *in* Musick and Limpus 1997). Lazell (1980) reported that loggerheads were historically common in New England waters and the Gulf of Maine. Sighting records of loggerheads off the northeastern U.S. were in all seasons in continental shelf and slope waters from Cape Cod to southern Florida, with greatest concentrations in mid-continental shelf waters off New Jersey during the summer (Fig. C-3a *in* DoN 2005). There are increased stranding records of loggerheads from Cape Cod Bay and Long Island Sound in the fall (DoN 2005); loggerheads may be unable to exit these inshore habitats, which can result in hypothermia as temperatures drop in late fall (Burke et al. 1991 *in* DoN 2005).

GMI (2010) reported 69 sightings of loggerhead turtles on the continental shelf off New Jersey during surveys conducted in January 2008–December 2009; sightings occurred from spring through fall, with most sightings during summer. There are over 1000 OBIS sighting records off the coast of New Jersey, including within the proposed project area (IOC 2013). Palka (2012) also reported several sightings off northern New Jersey south of Long Island during June–August 2011 surveys. There were 16 sightings of a single loggerhead turtle during the 13-day cruise in 2014.

(4) Hawksbill Turtle (*Eretmochelys imbricata*)

The hawksbill is the most tropical of all sea turtles, generally occurring between ~30ºN and ~30ºS (Eckert 1995b). In the Atlantic Ocean, most nesting beaches are in the Caribbean Sea as far north as Cuba and the Bahamas (NMFS and USFWS 2013b). It is considered very rare and possibly extralimital in the northwest Atlantic (Lazell 1980; Eckert 1995b). Nonetheless, DoN (Fig. C-6 *in* DoN 2005) mapped two hawksbill turtle sightings off New Jersey (one during spring and one during fall) and several south of New Jersey. In addition, there is one OBIS sighting record offshore New Jersey, east of the proposed survey area (SEFSC 1992 *in* IOC 2013).

(5) Kemp's Ridley Turtle (*Lepidochelys kempii*)

Kemp's ridley turtle has a more restricted distribution than other sea turtles, with adults primarily located in the Gulf of Mexico; some juveniles also feed along the U.S. east coast, including Chesapeake Bay, Delaware Bay, Long Island Sound, and waters off Cape Cod (Spotila 2004). Nesting occurs primarily along the central and southern Gulf of Mexico coast during May–late July (Morreale et al. 2007). There have also been some rare records of females nesting on Atlantic beaches of Florida, North Carolina, and South Carolina (Plotkin 2003). After nesting, female Kemp's ridley turtles travel to foraging areas along the coast of the Gulf of Mexico, typically in waters <50 m deep from Mexico's Yucatan Peninsula to southern Florida; males tend to stay near nesting beaches in the central Gulf of Mexico year-round (Morreale et al. 2007). Only juvenile and immature Kemp's ridley turtles appear to move beyond the Gulf of Mexico into more northerly waters along the U.S. east coast.

Hatchlings are carried by the prevalent currents off the nesting beaches and do not reappear in the neritic zone until they are about two years old (Musick and Limpus 1997). Those juvenile and immature Kemp's ridley turtles that migrate northward past Cape Hatteras probably do so in April and return southward in November (Musick et al. 1994). North of Cape Hatteras, juvenile and immature Kemp's ridleys prefer shallow-water areas, particularly along North Carolina and in Chesapeake Bay, Long Island Sound, and Cape Cod Bay (Musick et al. 1994; Morreale et al. 1989; Danton and Prescott 1988; Frazier et al. 2007). There are historical summer sightings and strandings of Kemp's ridley turtles from Massachusetts into the Gulf of Maine (Lazell 1980). Occasionally, individuals can be carried by the Gulf Stream as far as northern Europe, although those individuals are considered lost to the breeding population. Virtually all sighting records of Kemp's ridley turtles off the northeastern U.S. were in summer off the coast of New Jersey (Fig. C-4a *in* DoN 2005). There are 60 OBIS sighting records off the coast of New Jersey, some within the proposed survey area (SEFSC 1992 *in* IOC 2013).

Seabirds

Two ESA-listed seabird species could occur in or near the Project area: the ***Threatened*** piping plover and the ***Endangered*** roseate tern. Neither species was observed during the 13-day cruise in 2014. General information on the taxonomy, ecology, distribution and movements, and acoustic capabilities of seabird families are given in § 3.5.1 of the PEIS.

(1) Piping Plover (*Charadrius melodus*)

The Atlantic Coast Population of the piping plover is listed as ***Threatened*** under the U.S. ESA, and the species is listed as ***Near Threatened*** on the IUCN Red List of Threatened Species (IUCN 2013). It breeds on coastal beaches from Newfoundland to North Carolina during March–August and it winters along the Atlantic Coast from North Carolina south, along the Gulf Coast, and in the Caribbean (USFWS 1996). Its marine nesting habitat consists of sandy beaches, sandflats, and barrier islands (Birdlife International 2013). Feeding areas include intertidal portions of ocean beaches, mudflats, sandflats, and shorelines of coastal ponds, lagoons, or salt marshes (USFWS 1996). Wintering plovers are generally found on barrier islands, along sandy peninsulas, and near coastal inlets (USFWS 1996).

Because it is strictly coastal, the piping plover likely would not be encountered at the proposed survey site.

(2) Roseate Tern (*Sterna dougallii*)

The Northeast Population of the roseate tern is listed as ***Endangered*** under the U.S. ESA, and the species is listed as ***Near Threatened*** on the IUCN Red List of Threatened Species (IUCN 2013). It breeds on islands along the northeast coast of the U.S from New York to Maine and north into Canada,

and historically as far south as Virginia (USFWS 1998, 2010). It is thought to migrate beginning in mid September through the eastern Caribbean and along the north coast of South America, and to winter mainly on the east coast of Brazil (USFWS 2010). During the breeding season, roseate terns forage over shallow coastal waters, especially in water depths <5 m, sometimes near the colony and at other times at distances of over 30 km. They usually forage over shallow bays, tidal inlets and channels, tide rips, and sandbars (USFWS 2010).

Because of its distribution during the breeding season, the roseate tern likely would not be encountered at the proposed survey site.

Fish, Essential Fish Habitat, and Habitat Areas of Particular Concern

(1) ESA-Listed Fish and Invertebrate Species

There are two fish species listed under the ESA as ***Endangered*** that could occur in the study area: the New York Bight distinct population segment (DPS) of the Atlantic sturgeon, and the shortnose sturgeon. There are two species that are candidates for ESA listing: the cusk and the Northwest Atlantic and Gulf of Mexico DPS of the dusky shark. There are no listed or candidate invertebrate species.

Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*)

Five DPSs of the Atlantic sturgeon are listed under the U.S. ESA, one as ***Threatened*** and four as ***Endangered***, including the New York Bight DPS, and the species is listed as ***Near Threatened*** on the IUCN Red List of Threatened Species (IUCN 2014). It is a long-lived, late maturing (11–21 years in the Hudson River), anadromous fish. Spawning adults migrate upriver in spring, beginning in April–May in the mid Atlantic. The New York Bight DPS primarily uses the Delaware and Hudson rivers for spawning. Following spawning, males can remain in the river or lower estuary until fall, and females usually exit the rivers within 4–6 weeks. Juveniles move downstream and inhabit brackish waters for a few months before moving into nearshore coastal waters (NOAA 2012b).

Shortnose Sturgeon (*Acipenser brevirostrum*)

The shortnose sturgeon is listed as ***Endangered*** throughout its range under the U.S. ESA and ***Vulnerable*** on the IUCN Red List of Threatened Species (IUCN 2014). It is an anadromous species that spawns in coastal rivers along the east coast of North America from Canada to Florida. The shortnose sturgeon prefers the nearshore marine, estuarine, and riverine habitats of large river systems, and apparently does not make long-distance offshore migrations (NOAA 2013c).

Cusk (*Brosme brosme*)

The cusk is an ESA ***Candidate Species*** throughout its range, and has not been assessed for the IUCN Red List. In the Northwest Atlantic, it occurs from New Jersey north to the Strait of Belle Isle and the Grand Banks of Newfoundland and rarely to southern Greenland. It is a solitary, benthic species found in rocky, hard bottom areas to a depth of 100 m. In U.S waters, it occurs primarily in deep water of the central Gulf of Maine (NOAA 2013d).

Dusky Shark (*Carcharhinus obscurus*)

The Northwest Atlantic and Gulf of Mexico DPS of the dusky shark is an ESA ***Candidate Species***, and the species is listed as ***Vulnerable*** on the IUCN Red List of Threatened Species (IUCN 2014). It is a coastal-pelagic species that inhabits warm temperate and tropical waters throughout the world. In the Northwest Atlantic, it is found from southern Massachusetts and Georges Bank to Florida and the northern Gulf of Mexico. The dusky shark occurs in both inshore and offshore waters, although it avoids

areas of low salinity from the surface to depths of 575 m. Along U.S. coasts, it undertakes long temperature-related migrations, moving north in summer and south in fall (NMFS 2013b).

(2) Essential Fish Habitat (EFH)

EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity". "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish. "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities (NMFS 2013c). The entire eastern sea-board from the coast to the limits of the EEZ is EFH for one or more species or life stage for which EFH has been designated.

Two fishery management councils, created by the 1976 Magnuson Fisheries Conservation and Management Act (renamed Magnuson Stevens Fisheries Conservation and Management Act in 1996) are responsible for the management of fishery resources, including designation of EFH, in federal waters of the survey area: the Mid-Atlantic Fishery Management Council (MAFMC) and the New England Fishery Management Council (NEFMC). The Highly Migratory Division of the National Marine Fisheries Service in Silver Spring, MD, manages highly migratory species (sharks, swordfish, billfish, and tunas).

The life stages and associated habitats for those species with EFH in the survey area are described in Table 4.

Two EFH areas located ~150 km northeast of the proposed survey area, the Lydonia and Oceanographer canyons, were previously protected from fishing. Bottom trawling was prohibited in these areas because of the presence of *Loligo* squid eggs, under the Fisheries Management Plan for Atlantic mackerel, butterfish, and *Illex* and *Loligo* squid. This protection was valid as of 31 July 2008 for up to three years, after which it was to be subject to review for the possibility of extension (NOAA 2008).

(3) Habitat Areas of Particular Concern

Habitat Areas of Particular Concern (HAPC) are subsets of EFH that provide important ecological functions and/or are especially vulnerable to degradation, and are designated by Fishery Management Councils. All four life stages of summer flounder have EFH within the proposed survey area, whereas HAPC have only been designated for the juvenile and adult EFH: demersal waters over the continental shelf, from the coast to the limits of the EEZ, from the Gulf of Maine to Cape Hatteras, North Carolina (NOAA 2012c). Specifically, the HAPC include "all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile EFH. If native species of submerged aquatic vegetation are eliminated then exotic species should be protected because of functional value, however, all efforts should be made to restore native species" (NOAA 2012c). No other HAPC have been designated for those species with EFH within the proposed survey area.

Fisheries

Commercial and recreational fisheries data are collected by NMFS, including species, gear type and landings mass and value, all of which are reported by state of landing (NOAA 2013e). Fisheries data from 2008 to 2013 were used in the analysis of New Jersey's commercial and recreational fisheries near the proposed study area.

(1) Commercial Fisheries

The average annual catch weights and values, fishing season, and gear types for major commercial species are summarized in Table 5. In the waters off New Jersey, commercial fishery catches are dominated by menhaden, various shellfish, and squid. Menhaden accounted for 33% of the catch weight, followed by

Table 4. Marine species with Essential Fish Habitat (EFH) overlapping the proposed survey area.

	Life stage[1] and habitat[2]				
Species	E	L/N	J	A	SA
Atlantic cod *Gadus morhua*				B	B
Atlantic haddock *Melanogrammus aeglefinus*		P	B		
Pollock *Pollachius virens*				B	
Black sea bass *Centropristis striata*	P	P	D	D	D
Bluefish *Pomatomus saltatrix*	P	P	P	P	P
Butterfish *Peprilus triacanthus*	P	P	P	P	P
Atlantic herring *Clupea harengus*			P	P	B
Atlantic mackerel *Scomber scombrus*	P	P	P	P	P
Red hake *Urophycis chuss*	P	P	B		
Silver hake *Merluccius bilinearis*	P	P	B		
Scup *Stenotomus chrysops*			D	D	
Monkfish *Lophius americanus*	P	P	B	B	B
Ocean pout *Macrozoarces americanus*	B	B	B	B	B
Summer flounder *Paralichthys dentatus*	P	P	B	B	B
Windowpane flounder *Scophthalmus acquosus*	P	P		B	B
Winter flounder *Pleuronectes americanus*	B	D/P	B	B	B
Witch flounder *Glyptocephalus cynoglossus*	P	P			B
Yellowtail flounder *Limanda ferruginea*	P				
Albacore tuna *Thunnus alalunga*			P		
Bigeye tuna *Thunnus obesus*				P	
Bluefin tuna *Thunnus thynnus*			P		
Skipjack tuna *Katsuwonus pelamis*				P	
Yellowfin tuna *Thunnus albacres*			P		
Swordfish *Xiphias gladius*			P		
Little skate *Leucoraja erinacea*			B	B	
Winter skate *Leucoraja ocellata*			B		
Basking shark *Cetorhinus maximus*			P	P	
Blue shark *Prionace glauca*		P	P	P	
Dusky shark *Carcharhinus obscurus*		P	P	P	
Common thresher shark *Alopias vulpinus*		P	P	P	
Porbeagle shark *Lamna nasus*				P	
Sandbar shark *Carcharhinus plumbeus*		B	B	B	
Scalloped hammerhead shark *Sphyrna lewini*			P	P	
Shortfin mako shark *Isurus oxyrinchus*		P	P	P	
Smooth (spiny) dogfish *Squalus acanthias*		P	P	P	
Sand tiger shark *Carcharias taurus*		P	P		
Tiger shark *Galeocerdo cuvier*			P	P	
White shark *Carcharodon carcharias*		P	P	P	
Atlantic sea scallop *Placopecten magellanicus*	B	P	B	B	B
Atlantic surfclam *Spisula solidissima*	P	P	B	B	B
Ocean quahog *Arctica islandica*	P	P	B	B	B
Northern shortfin squid *Illex illecebrosus*	P	P	D/P	D/P	D/P
Longfin inshore squid *Loligo pealeii*	B	P	D/P	D/P	D/P

Source: NOAA 2012c

[1] E = eggs; L/N = larvae for bony fish and invertebrates, neonate for sharks; J = juvenile; A = adult; SA = spawning adult

[2] P = pelagic; D = demersal; B = benthic

Table 5. Commercial fishery catches for major marine species for New Jersey waters by weight, value, season, and gear type, averaged from 2008 to 2013.

Species	Average annual landings (mt)	% total	Average annual landings (1000$)	% total	Fishing season (peak season)	Gear Type: Fixed	Gear Type: Mobile
Menhaden	24,056	34	5,328	3	Year-round (May–Oct)	Gill nets, pots, traps, pound nets	Dip nets, trawls, dredge, purse seines, tongs, grabs
Atlantic surf clam	12,324	18	16,745	10	Year-round	N/A	Dredge, tongs, grabs
Ocean quahog	6,697	10	9,245	6	Year-round (spring–fall)	N/A	Dredge
Sea scallop	5,524	8	101,497	63	Year-round (Mar–Oct)	Gill nets, long lines, pots, traps, pound nets	Dredge, trawls
Northern shortfin squid	4,593	7	3,424	2	Year-round (Jun–Oct)	N/A	Dredge, trawls
Shellfish	3,607	5	1,464	1	Year-round (May–Oct)	Gill nets, long lines, pots, traps, pound nets, weirs	Trawls, cast nets, dip nets, diving, dredge, fyke net, hand lines, Scottish seine
Blue crab	2,768	4	7,718	5	Year-round (May–Oct)	Lines trot with bait, pots, traps	Dredge, hand lines, trawls
Atlantic herring	2,284	3	574	<1	Year-round (Jan–Feb)	Gill nets, pound nets	Trawls, fyke net
Atlantic mackerel	2,007	3	769	<1	Fall–spring (Jan–Apr)	Gill nets, pound nets	Dredge, trawls
Longfin squid	1,533	2	3,278	2	Year-round (Jan–Mar; Jul–Nov)	Gill nets, pound nets	Dredge, trawls
Monkfish (Goosefish)	1,144	2	3,199	2	Year-round (Oct–Mar; May–Jun)	Gill nets, long lines, pots, traps, pound nets	Dredge, trawls
Skate	1,036	1	667	<1	Year-round (Nov–Jan; May–Jun)	Gill nets, pots, traps, pound nets	Dredge, trawls
Summer flounder	953	1	4,527	3	Year-round	Gill nets, pots, traps, pound nets	Dredge, hand lines, trawls, rod and reel
Scup	669	1	831	1	Year-round (Jan–Apr)	Gill nets, pots, traps, pound nets	Dredge, trawls, hand lines
Spiny dogfish shark	554	1	247	<1	Fall–spring (Nov–Jan; May)	Gill nets, long lines, pots, traps, pound nets	Dredge, trawls, hand lines
Bluefish	422	1	452	<1	Year-round (Apr–Nov)	Gill nets, pots, traps, pound nets	Dredge, hand lines, trawls
Total	70,172	100	159,964	100			

Source: NOAA 2013g

Atlantic surf clam (17%), ocean quahog (9%), sea scallop (7%), northern shortfin squid (6%), shellfish (5%), and blue crab (4%). Numerous other fish and invertebrate species accounted for the remaining proportion of catch weight. In 2010 (the only such dataset available in NOAA 2013g), most finfish by weight (68.8%) were caught within 5.6 km from shore; that catch was almost all (98.1%) accounted for by menhaden. Fish dominating the offshore (5.6–370 km from shore) finfish catch by weight were American mackerel (20.1% of total finfish weight), American herring (17.7%), skates (12.8%), and summer flounder (8.8%). Most finfish by value (73.3%) were caught between 5.6 and 370 km from shore; dominant fish by value were summer flounder (25.7% of total finfish value), goosefish/anglerfish (15.2%), yellowfin tuna (6.8%), and bigeye tuna (6.4%). Most shellfish and squid were captured between 5.6 and 370 km from shore, both by weight (73.6% of total shellfish and squid catch) and value (89.1%).

During 2002–2006 (the last year reported), commercial catch in the EEZ along the U.S east coast has only been landed by U.S. and Canadian vessels, with the vast majority of the catch (>99%) taken by U.S. vessels (Sea Around Us Project 2011). Typical commercial fishing vessels in the New Jersey area include trawlers, gill netters, lobster/crab boats, dredgers, longliners, and purse seiners.

(2) Recreational Fisheries

In 2013, marine recreational fishers caught over 5 million fish for harvest or bait, and >17.8 million fish in catch and release programs in New Jersey waters. These catches were taken by over 900,000 recreational fishers during more than 4 million trips. The majority of the trips (87%) occurred within 5.6 km from shore. The periods with the most boat-based trips (including charter, party, and private/rental boats) were July–August (1.03 million trips or 44% of total), followed by 1.03 million trips or 44%), and September–October (445,923 or 19%). Most shore-based trips (from beaches, marshes, docks, and/or piers; DoN 2005) occurred in July–August (600,400 or 32%), then September–October (442,464 or 23%), and May–June (370,832 or 20%).

In 2004, there were eight recreational fishing tournaments around New Jersey between May and November, all of which were within 150 km (~80 nm) from shore (DoN 2005). Of the 'hotspots' (popular fishing sites commonly visited by recreational anglers) mapped by DoN (2005), most are to the north or south of the proposed survey area; however, there are several hotspots located within or very near the northwestern corner of the survey area. As of April 2014, 11 tournaments were scheduled in 2014 for central New Jersey ports of call (Table 6). No detailed information about locations is given in the sources cited. As of 10 October 2014, lists of 2015 tournaments were not available (D. Kaldunski, AmericanFishingContests.com, pers. comm.). As of 13 November 2014, one tournament is scheduled for 15–21 August 2015 out of Cape May, New Jersey (InTheBite 2014).

In 2013, at least 75 species of fish were targeted by recreational fishers off New Jersey. Species with 2013 recreational catch numbers exceeding one million include summer flounder (33% of total catch), black sea bass (12%), Atlantic croaker (7%), bluefish (7%), striped searobin (7%), striped bass (6%), and spot (5%). Other notable species or species groups representing at least 1% each of the total catch included unidentified sea robin, tautog, smooth dogfish, Atlantic menhaden, little skate, spiny dogfish, clearnose skate, tilefish, scup, cunner, red hake, unidentified skate, northern searobin, and weakfish. Most of these species/species groups were predominantly caught within 5.6 km from shore (on average 90% of total catch); summer flounder, skates/rays, and cunner were caught roughly equally within and beyond 5.6 km from shore, and red hake were mainly taken beyond 5.6 km from shore (80%).

Recreational SCUBA Diving

Wreck diving is a popular form of recreation in the waters off New Jersey. A search for shipwrecks in New Jersey waters was made using NOAA's automated wreck and obstruction information system (NOAA 2014a). Results of the search are plotted in Figure 2 together with the survey lines. There are over 900 shipwrecks/obstructions in New Jersey waters, most (58%) of which are listed by NOAA (2014b) as unidentified. Only one shipwreck, a known dive site, is in or near the survey area (Fig. 2): the *Lillian* (Galiano 2009; Fisherman's Headquarters 2014; NOAA 2014a).

Table 6. Fishing tournaments off New Jersey, June–mid August 2014.

Dates	Tournament name	Port/ waters	Marine species/groups targeted	Source
1 Feb–14 Dec	Kayak Wars	Statewide/ all legal	Barred sand/calico/spotted bay/white sea bass; bonefish; bonito; cabezon; California barracuda; coho/king/pink salmon; corvina; dorado (mahi mahi); greenling; halibut; leopard/mako/ sevengill/thresher shark; lingcod; opaleye; rock sole; rockfish; saltwater perch; sanddab; sculpin; sheepshead; spiny dogfish; starry flounder; sturgeon; cutthroat trout; whitefish; yellowtail	1
1 Apr–30 Nov	Jersey Shore Beach N Boat Fishing Tournament	Beach Haven/out to 37 km	Black drum; bluefish; fluke; northern kingfish; sea/striped bass; tog; weakfish	1
1 May–30 Nov	Manasquan River MTC Monthly and Mako Tournament	Brielle/N/A	White/blue marlin; pelagic sharks; bigeye/albacore/yellowfin tuna	2
Spring–Fall	Annual Striper Derby – Spring Lake Live Liners Fishing Club	Spring Lake/ any NJ waters	Striped bass	1
6 Jun–27 Jul	Manasquan River Marlin & Tuna Club Bluefin Tournament	Manasquan/ Atlantic Ocean	Bluefin tuna	1
27 Jun–6 Jul	Manasquan River Marlin & Tuna Club Jack Meyer Trolling Tournament	Manasquan/ Atlantic Ocean	Unlisted	1
3–7 Jul	Manasquan River MTC Jack Meyer Memorial Tournament	Brielle/ N/A	White/blue marlin; bigeye/ albacore/yellowfin tuna	2
4 Jul	World Cup Blue Marlin Championship	Statewide/ offshore	Blue marlin	1
12–13 Jul	Manasquan River Marlin & Tuna Club Ladies & Juniors	Manasquan/ Atlantic Ocean	Mako shark	1
23–26 Jul	Beach Haven Marlin & Tuna Club White Marlin Invitational	Beach Haven/ offshore	White marlin	1, 3
31 Jul–3 Aug	Manasquan River Marlin & Tuna Club Fluke Tournament	Manasquan/ Atlantic Ocean	Mako shark	1

Sources: 1: American Fishing Contests (2014); 2: NOAA (2014c); 3: InTheBite (2014)

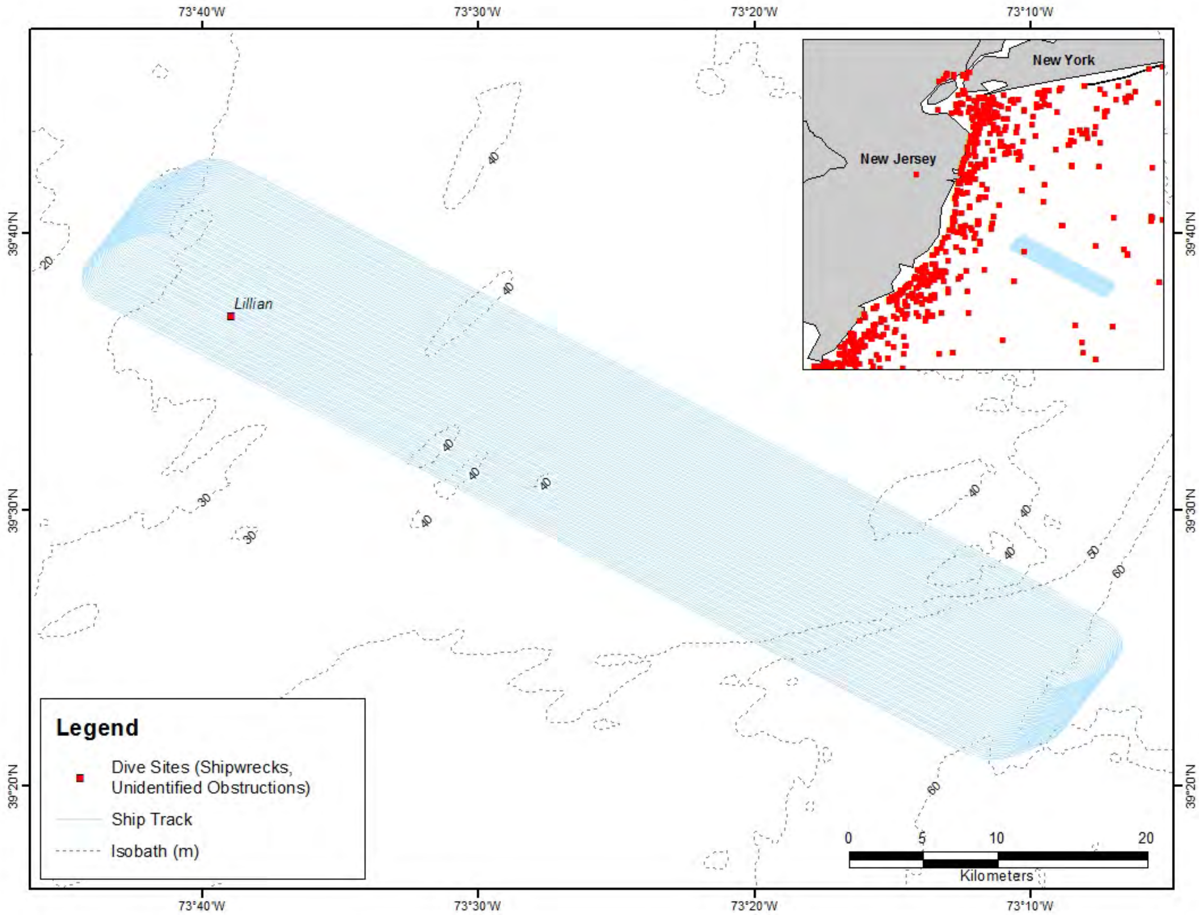

Figure 2. Potential dive sites (shipwrecks or unidentified obstructions) in New Jersey waters. Source: NOAA (2014b).

IV. Environmental Consequences

Proposed Action

The PEIS presented analyses of potential impacts from acoustic sources in general terms and for specific analysis areas. The proposed survey and effects analysis differ from those in the NW Atlantic DAA presented in the PEIS in that different sources were used, the survey areas covered a different range of depths, and different modeling methods were used. The following section includes site-specific details of the proposed survey, summary effects information from the PEIS, and updates to the effects information from recent literature. Analysis conducted for the proposed 2015 survey remains the same as described in the 2014 NSF Final EA for the 2014 survey, except for the smaller size of the airgun array. Seismic effects literature is updated in this Draft Amended EA, and additional effects literature given in the 2014 NMFS EA (Appendix E of the 1 July 2014 Final EA) is incorporated into this Draft Amended EA by reference as if fully set forth herein. In the conclusions of this section, we also refer to conclusions of the Final EA, FONSI, IHA, and Biological Opinion issued by NMFS for the New Jersey survey in 2014, and to observations made during the brief survey conducted in 2014. The effects are fully consistent with those set forth in the 2014 NSF Final EA and FONSI, and 2014 NMFS Final EA, FONSI,

IHA, and Biological Opinion, and EFH concurrence letter, and which are incorporated herein by reference.

(1) Direct Effects on Marine Mammals and Sea Turtles and Their Significance

The material in this section includes a brief summary of the anticipated potential effects (or lack thereof) of airgun sounds on marine mammals and sea turtles, and reference to recent literature that has become available since the PEIS was released in 2011. A more comprehensive review of the relevant background information, as well as information on the hearing abilities of marine mammals and sea turtles, appears in § 3.4.4.3, § 3.6.4.3, § 3.7.4.3, and Appendix E of the PEIS.

Estimates of the numbers of marine mammals that could be affected by the proposed seismic survey scheduled to occur during June–August 2015 are provided in (e) below, along with a description of the rationale for NSF's estimates of the numbers of individuals exposed to received sound levels ≥160 dB re 1 μPa_{rms}. Although the PEIS included modeling for the NW Atlantic DAA, it was done for a different energy source level and survey parameters (e.g., survey water depths and source tow depth), and modeling methods were different from those used by L-DEO (see PEIS, Appendix B, for further modeling details regarding the NW Atlantic DAA). Acoustic modeling for the proposed action was conducted by L-DEO, consistent with past EAs and determined to be acceptable by NMFS to use in the calculation of estimated takes under the MMPA (e.g., NMFS 2013d,e), including for the 2014 survey.

(a) Summary of Potential Effects of Airgun Sounds

As noted in the PEIS (§ 3.4.4.3, § 3.6.4.3, and § 3.7.4.3), the effects of sounds from airguns could include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, and at least in theory, temporary or permanent hearing impairment, or non-auditory physical or physiological effects (Richardson et al. 1995; Gordon et al. 2004; Nowacek et al. 2007; Southall et al. 2007). Permanent hearing impairment (PTS), in the unlikely event that it occurred, would constitute injury, but temporary threshold shift (TTS) is not considered an injury (Southall et al. 2007; Le Prell 2012). Rather, the onset of TTS has been considered an indicator that, if the animal is exposed to higher levels of that sound, physical damage is ultimately a possibility. Recent research has shown that sound exposure can cause cochlear neural degeneration, even when threshold shifts and hair cell damage are reversible (Liberman 2013). These findings have raised some doubts as to whether TTS should continue to be considered a non-injurious effect. Although the possibility cannot be entirely excluded, it is unlikely that the project would result in any cases of temporary or permanent hearing impairment, or any significant non-auditory physical or physiological effects. If marine mammals encounter the survey while it is underway, some behavioral disturbance could result, but this would be localized and short-term.

***Tolerance*.—**Numerous studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers (e.g., Nieukirk et al. 2012). Several studies have shown that marine mammals at distances more than a few kilometers from operating seismic vessels often show no apparent response. That is often true even in cases when the pulsed sounds must be readily audible to the animals based on measured received levels and the hearing sensitivity of that mammal group. Although various baleen whales and toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to airgun pulses under some conditions, at other times mammals of all three types have shown no overt reactions. The relative responsiveness of baleen and toothed whales are quite variable.

***Masking*.—**Masking effects of pulsed sounds (even from large arrays of airguns) on marine mammal calls and other natural sounds are expected to be limited, although there are very few specific data on this. Because of the intermittent nature and low duty cycle of seismic pulses, animals can emit and receive

sounds in the relatively quiet intervals between pulses. However, in exceptional situations, reverberation occurs for much or all of the interval between pulses (e.g., Simard et al. 2005; Clark and Gagnon 2006), which could mask calls. Situations with prolonged strong reverberation are infrequent. However, it is common for reverberation to cause some lesser degree of elevation of the background level between airgun pulses (e.g., Gedamke 2011; Guerra et al. 2011, 2013), and this weaker reverberation presumably reduces the detection range of calls and other natural sounds to some degree. Guerra et al. (2013) reported that ambient noise levels between seismic pulses were elevated because of reverberation at ranges of 50 km from the seismic source. Based on measurements in deep water of the Southern Ocean, Gedamke (2011) estimated that the slight elevation of background levels during intervals between pulses reduced blue and fin whale communication space by as much as 36–51% when a seismic survey was operating 450–2800 km away. Based on preliminary modeling, Wittekind et al. (2013) reported that airgun sounds could reduce the communication range of blue and fin whales 2000 km from the seismic source. Klinck et al. (2012) also found reverberation effects between airgun pulses. Nieukirk et al. (2012) and Blackwell et al. (2013) noted the potential for masking effects from seismic surveys on large whales.

Some baleen and toothed whales are known to continue calling in the presence of seismic pulses, and their calls usually can be heard between the seismic pulses (e.g., Nieukirk et al. 2012). Cerchio et al. (2014) suggested that the breeding display of humpback whales off Angola could be disrupted by seismic sounds, as singing activity declined with increasing received levels. In addition, some cetaceans are known to change their calling rates, shift their peak frequencies, or otherwise modify their vocal behavior in response to airgun sounds (e.g., Di Iorio and Clark 2010; Castellote et al. 2012; Blackwell et al. 2013). The hearing systems of baleen whales are undoubtedly more sensitive to low-frequency sounds than are the ears of the small odontocetes that have been studied directly (e.g., MacGillivray et al. 2014). The sounds important to small odontocetes are predominantly at much higher frequencies than are the dominant components of airgun sounds, thus limiting the potential for masking. In general, masking effects of seismic pulses are expected to be minor, given the normally intermittent nature of seismic pulses. We are not aware of any information concerning masking of hearing in sea turtles.

***Disturbance Reactions*.—**Disturbance includes a variety of effects, including subtle to conspicuous changes in behavior, movement, and displacement. Based on NMFS (2001, p. 9293), NRC (2005), and Southall et al. (2007), we believe that simple exposure to sound, or brief reactions that do not disrupt behavioral patterns in a potentially significant manner, do not constitute harassment or "taking". By potentially significant, we mean, 'in a manner that might have deleterious effects to the well-being of individual marine mammals or their populations'.

Reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, and many other factors (Richardson et al. 1995; Wartzok et al. 2004; Southall et al. 2007; Weilgart 2007; Ellison et al. 2012). If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or population (e.g., New et al. 2013). However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and populations could be significant (e.g., Lusseau and Bejder 2007; Weilgart 2007). Given the many uncertainties in predicting the quantity and types of impacts of noise on marine mammals, it is common practice to estimate how many marine mammals would be present within a particular distance of industrial activities and/or exposed to a particular level of industrial sound. In most cases, this approach likely overestimates the numbers of marine mammals that would be affected in some biologically important manner.

The sound criteria used to estimate how many marine mammals could be disturbed to some biologically important degree by a seismic program are based primarily on behavioral observations of a few species. Detailed studies have been done on humpbacks, gray whales, bowheads, and sperm whales. Less detailed data are available for some other species of baleen whales and small toothed whales, but for many species, there are no data on responses to marine seismic surveys.

Baleen Whales

Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable. Whales are often reported to show no overt reactions to pulses from large arrays of airguns at distances beyond a few kilometers, even though the airgun pulses remain well above ambient noise levels out to much longer distances. However, baleen whales exposed to strong noise pulses from airguns often react by deviating from their normal migration route and/or interrupting their feeding and moving away. In the cases of migrating gray and bowhead whales, the observed changes in behavior appeared to be of little or no biological consequence to the animals. They simply avoided the sound source by displacing their migration route to varying degrees, but within the natural boundaries of the migration corridors (Malme et al. 1984; Malme and Miles 1985; Richardson et al. 1995).

Responses of *humpback whales* to seismic surveys have been studied during migration, on summer feeding grounds, and on Angolan winter breeding grounds; there has also been discussion of effects on the Brazilian wintering grounds. Off Western Australia, avoidance reactions began at 5–8 km from the array, and those reactions kept most pods ~3–4 km from the operating seismic boat; there was localized displacement during migration of 4–5 km by traveling pods and 7–12 km by more sensitive resting pods of cow-calf pairs (McCauley et al. 1998, 2000). However, some individual humpback whales, especially males, approached within distances of 100–400 m. Studies examining the behavioral responses of humpback whales to airguns are currently underway off eastern Australia (Cato et al. 2011, 2012, 2013).

In the Northwest Atlantic, sighting rates were significantly greater during non-seismic periods compared with periods when a full array was operating, and humpback whales were more likely to swim away and less likely to swim towards a vessel during seismic vs. non-seismic periods (Moulton and Holst 2010). On their summer feeding grounds in southeast Alaska, there was no clear evidence of avoidance, despite the possibility of subtle effects, at received levels up to 172 re 1 μPa on an approximate rms basis (Malme et al. 1985). It has been suggested that South Atlantic humpback whales wintering off Brazil may be displaced or even strand upon exposure to seismic surveys (Engel et al. 2004), but data from subsequent years, indicated that there was no observable direct correlation between strandings and seismic surveys (IWC 2007).

There are no data on reactions of *right whales* to seismic surveys. However, Rolland et al. (2012) suggested that ship noise causes increased stress in right whales; they showed that baseline levels of stress-related fecal hormone metabolites decreased in North Atlantic right whales with a 6-dB decrease in underwater noise from vessels. Wright et al. (2011) also reported that sound could be a potential source of stress for marine mammals.

Results from *bowhead whales* show that their responsiveness can be quite variable depending on their activity (migrating vs. feeding). Bowhead whales migrating west across the Alaskan Beaufort Sea in autumn, in particular, are unusually responsive, with substantial avoidance occurring out to distances of 20–30 km from a medium-sized airgun source (Miller et al. 1999; Richardson et al. 1999). However, more recent research on bowhead whales corroborates earlier evidence that, during the summer feeding season, bowheads are not as sensitive to seismic sources (e.g., Miller et al. 2005). Nonetheless, Robertson et al. (2013) showed that bowheads on their summer feeding grounds showed subtle but statis-

tically significant changes in surfacing–respiration–dive cycles during exposure to seismic sounds, including shorter surfacing intervals, shorter dives, and decreased number of blows per surface interval.

Bowhead whale calls detected in the presence and absence of airgun sounds have been studied extensively in the Beaufort Sea. Bowheads continue to produce calls of the usual types when exposed to airgun sounds on their summering grounds, although numbers of calls detected are significantly lower in the presence than in the absence of airgun pulses; Blackwell et al. (2013) reported that calling rates in 2007 declined significantly where received SPLs from airgun sounds were 116–129 dB re 1 µPa. Thus, bowhead whales in the Beaufort Sea apparently decrease their calling rates in response to seismic operations, although movement out of the area could also contribute to the lower call detection rate (Blackwell et al. 2013).

A multivariate analysis of factors affecting the distribution of calling bowhead whales during their fall migration in 2009 noted that the southern edge of the distribution of calling whales was significantly closer to shore with increasing levels of airgun sound from a seismic survey a few hundred kilometers to the east of the study area (i.e., behind the westward-migrating whales; McDonald et al. 2010, 2011). It was not known whether this statistical effect represented a stronger tendency for quieting of the whales farther offshore in deeper water upon exposure to airgun sound, or an actual inshore displacement of whales.

Reactions of migrating and feeding (but not wintering) *gray whales* to seismic surveys have been studied. Off St. Lawrence Island in the northern Bering Sea, it was estimated, based on small sample sizes, that 50% of feeding gray whales stopped feeding at an average received pressure level of 173 dB re 1 µPa on an (approximate) rms basis, and that 10% of feeding whales interrupted feeding at received levels of 163 dB re 1 μPa_{rms} (Malme et al. 1986, 1988). Those findings were generally consistent with the results of experiments conducted on larger numbers of gray whales that were migrating along the California coast (Malme et al. 1984; Malme and Miles 1985), and western Pacific gray whales feeding off Sakhalin Island, Russia (e.g., Gailey et al. 2007; Johnson et al. 2007; Yazvenko et al. 2007a,b).

Various species of *Balaenoptera* (blue, sei, fin, and minke whales) have occasionally been seen in areas ensonified by airgun pulses; sightings by observers on seismic vessels off the U.K. from 1997 to 2000 suggest that, during times of good sightability, sighting rates for mysticetes (mainly fin and sei whales) were similar when large arrays of airguns were shooting vs. silent, although there was localized avoidance (Stone and Tasker 2006). Singing fin whales in the Mediterranean moved away from an operating airgun array, and their song notes had lower bandwidths during periods with versus without airgun sounds (Castellote et al. 2012).

During seismic surveys in the Northwest Atlantic, baleen whales as a group showed localized avoidance of the operating array (Moulton and Holst 2010). Sighting rates were significantly lower during seismic operations compared with non-seismic periods. Baleen whales were seen on average 200 m farther from the vessel during airgun activities vs. non-seismic periods, and these whales more often swam away from the vessel when seismic operations were underway compared with periods when no airguns were operating (Moulton and Holst 2010). Blue whales were seen significantly farther from the vessel during single airgun operations, ramp up, and all other airgun operations compared with non-seismic periods (Moulton and Holst 2010). Similarly, fin whales were seen at significantly farther distances during ramp up than during periods without airgun operations; there was also a trend for fin whales to be sighted farther from the vessel during other airgun operations, but the difference was not significant (Moulton and Holst 2010). Minke whales were seen significantly farther from the vessel during periods with than without seismic operations (Moulton and Holst 2010). Minke whales were also

more likely to swim away and less likely to approach during seismic operations compared to periods when airguns were not operating (Moulton and Holst 2010).

Data on short-term reactions by cetaceans to impulsive noises are not necessarily indicative of long-term or biologically significant effects. It is not known whether impulsive sounds affect reproductive rate or distribution and habitat use in subsequent days or years. However, gray whales have continued to migrate annually along the west coast of North America with substantial increases in the population over recent years, despite intermittent seismic exploration (and much ship traffic) in that area for decades. The western Pacific gray whale population did not seem affected by a seismic survey in its feeding ground during a previous year, and bowhead whales have continued to travel to the eastern Beaufort Sea each summer, and their numbers have increased notably, despite seismic exploration in their summer and autumn range for many years.

Toothed Whales

Little systematic information is available about reactions of toothed whales to sound pulses. However, there are recent systematic studies on sperm whales, and there is an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies. Seismic operators and marine mammal observers on seismic vessels regularly see dolphins and other small toothed whales near operating airgun arrays, but in general there is a tendency for most delphinids to show some avoidance of operating seismic vessels (e.g., Stone and Tasker 2006; Moulton and Holst 2010; Barry et al. 2012). In most cases, the avoidance radii for delphinids appear to be small, on the order of 1 km or less, and some individuals show no apparent avoidance.

During seismic surveys in the Northwest Atlantic, delphinids as a group showed some localized avoidance of the operating array (Moulton and Holst 2010). The mean initial detection distance was significantly farther (by ~200 m) during seismic operations compared with periods when the seismic source was not active; however, there was no significant difference between sighting rates (Moulton and Holst 2010). The same results were evident when only long-finned pilot whales were considered.

Preliminary findings of a monitoring study of *narwhals* (*Monodon monoceros*) in Melville Bay, Greenland (summer and fall 2012) showed no short-term effects of seismic survey activity on narwhal distribution, abundance, migration timing, and feeding habits (Heide-Jørgensen et al. 2013a). In addition, there were no reported effects on narwhal hunting. These findings do not seemingly support a suggestion by Heide-Jørgensen et al. (2013b) that seismic surveys in Baffin Bay may have delayed the migration timing of narwhals, thereby increasing the risk of narwhals to ice entrapment.

The *beluga*, however, is a species that (at least at times) shows long-distance (10s of km) avoidance of seismic vessels (e.g., Miller et al. 2005). Captive bottlenose dolphins and beluga whales exhibited changes in behavior when exposed to strong pulsed sounds similar in duration to those typically used in seismic surveys, but the animals tolerated high received levels of sound before exhibiting aversive behaviors (e.g., Finneran et al. 2000, 2002, 2005).

Most studies of *sperm whales* exposed to airgun sounds indicate that the sperm whale shows considerable tolerance of airgun pulses; in most cases the whales do not show strong avoidance (e.g., Stone and Tasker 2006; Moulton and Holst 2010), but foraging behavior can be altered upon exposure to airgun sound (e.g., Miller et al. 2009). There are almost no specific data on the behavioral reactions of *beaked whales* to seismic surveys. Most beaked whales tend to avoid approaching vessels of other types (e.g., Würsig et al. 1998) and/or change their behavior in response to sounds from vessels (e.g., Pirotta et al. 2012). However, some northern bottlenose whales remained in the general area and continued to produce high-frequency clicks when exposed to sound pulses from distant seismic surveys (e.g., Simard

et al. 2005). In any event, it is likely that most beaked whales would also show strong avoidance of an approaching seismic vessel, although this has not been documented explicitly.

The limited available data suggest that *harbor porpoises* show stronger avoidance of seismic operations than do Dall's porpoises. Thompson et al. (2013) reported decreased densities and reduced acoustic detections of harbor porpoise in response to a seismic survey in Moray Firth, Scotland, at ranges of 5–10 km (SPLs of 165–172 dB re 1 μPa, SELs of 145–151 dB $\mu Pa^2 \cdot s$); however, animals returned to the area within a few hours. The apparent tendency for greater responsiveness in the harbor porpoise is consistent with their relative responsiveness to boat traffic and some other acoustic sources (Richardson et al. 1995; Southall et al. 2007).

Odontocete reactions to large arrays of airguns are variable and, at least for delphinids, seem to be confined to a smaller radius than has been observed for the more responsive of the mysticetes and some other odontocetes. A ≥170 dB disturbance criterion (rather than ≥160 dB) is considered appropriate for delphinids, which tend to be less responsive than the more responsive cetaceans.

Sea Turtles

The limited available data indicate that sea turtles will hear airgun sounds and sometimes exhibit localized avoidance (see PEIS, § 3.4.4.3). Based on available data, it is likely that sea turtles will exhibit behavioral changes and/or avoidance within an area of unknown size near a seismic vessel. To the extent that there are any impacts on sea turtles, seismic operations in or near areas where turtles concentrate are likely to have the greatest impact. There are no specific data that demonstrate the consequences to sea turtles if seismic operations with large or small arrays of airguns occur in important areas at biologically important times of year.

Hearing Impairment and Other Physical Effects.**—**Temporary or permanent hearing impairment is a possibility when marine mammals are exposed to very strong sounds. TTS has been demonstrated and studied in certain captive odontocetes and pinnipeds exposed to strong sounds. However, there has been no specific documentation of TTS let alone permanent hearing damage, i.e., PTS, in free-ranging marine mammals exposed to sequences of airgun pulses during realistic field conditions.

Additional data are needed to determine the received sound levels at which small odontocetes would start to incur TTS upon exposure to repeated, low-frequency pulses of airgun sound with variable received levels. To determine how close an airgun array would need to approach in order to elicit TTS, one would (as a minimum) need to allow for the sequence of distances at which airgun pulses would occur, and for the dependence of received SEL on distance in the region of the seismic operation (e.g., Breitzke and Bohlen 2010; Laws 2012). At the present state of knowledge, it is also necessary to assume that the effect is directly related to total received energy, although there is recent evidence that auditory effects in a given animal are not a simple function of received acoustic energy. Frequency, duration of the exposure and occurrence of gaps within the exposure can also influence the auditory effect (Finneran and Schlundt 2010, 2011; Finneran et al. 2010a,b; Finneran 2012; Ketten 2012; Finneran and Schlundt 2011, 2013; Kastelein et al. 2013a).

The assumption that, in marine mammals, the occurrence and magnitude of TTS is a function of cumulative acoustic energy (SEL) is probably an oversimplification (Finneran 2012). Popov et al. (2011) examined the effects of fatiguing noise on the hearing threshold of Yangtze finless porpoises when exposed to frequencies of 32–128 kHz at 140–160 dB re 1 μPa for 1–30 min. They found that an exposure of higher level and shorter duration produced a higher TTS than an exposure of equal SEL but of lower level and longer duration. Kastelein et al. (2012a,b; 2013b) also reported that the equal-energy model is not valid for predicting TTS in harbor porpoises or harbor seals.

Recent data have shown that the SEL required for TTS onset to occur increases with intermittent exposures, with some auditory recovery during silent periods between signals (Finneran et al. 2010b; Finneran and Schlundt 2011). Schlundt et al. (2013) reported that the potential for seismic surveys using airguns to cause auditory effects on dolphins could be lower than previously thought. Based on behavioral tests, Finneran et al. (2011) and Schlundt et al. (2013) reported no measurable TTS in bottlenose dolphins after exposure to 10 impulses from a seismic airgun with a cumulative SEL of ~195 dB re 1 $\mu Pa^2 \cdot s$; results from auditory evoked potential measurements were more variable (Schlundt et al. 2013).

Recent studies have also shown that the SEL necessary to elicit TTS can depend substantially on frequency, with susceptibility to TTS increasing with increasing frequency above 3 kHz (Finneran and Schlundt 2010, 2011; Finneran 2012). When beluga whales were exposed to fatiguing noise with sound levels of 165 dB re 1 µPa for durations of 1–30 min at frequencies of 11.2–90 kHz, the highest TTS with the longest recovery time was produced by the lower frequencies (11.2 and 22.5 kHz); TTS effects also gradually increased with prolonged exposure time (Popov et al. 2013a). Popov et al. (2013b) also reported that TTS produced by exposure to a fatiguing noise was larger during the first session (or naïve subject state) with a beluga whale than TTS that resulted from the same sound in subsequent sessions (experienced subject state). Therefore, Supin et al. (2013) reported that SEL may not be a valid metric for examining fatiguing sounds on beluga whales. Similarly, Nachtigall and Supin (2013) reported that false killer whales are able to change their hearing sensation levels when exposed to loud sounds, such as warning signals or echolocation sounds.

It is inappropriate to assume that onset of TTS occurs at similar received levels in all cetaceans (*cf.* Southall et al. 2007). Some cetaceans could incur TTS at lower sound exposures than are necessary to elicit TTS in the beluga or bottlenose dolphin. Based on the best available information, Southall et al. (2007) recommended a TTS threshold for exposure to single or multiple pulses of 183 dB re 1 $\mu Pa^2 \cdot s$. Tougaard et al. (2013) proposed a TTS criterion of 165 dB re 1 $\mu Pa^2 \cdot s$ for porpoises based on data from two recent studies. Gedamke et al. (2011), based on preliminary simulation modeling that attempted to allow for various uncertainties in assumptions and variability around population means, suggested that some baleen whales whose closest point of approach to a seismic vessel is 1 km or more could experience TTS.

There is no specific evidence that exposure to pulses of airgun sound can cause PTS in any marine mammal, even with large arrays of airguns. However, given the likelihood that some mammals close to an airgun array might incur at least mild TTS, there has been further speculation about the possibility that some individuals occurring very close to airguns might incur PTS (e.g., Richardson et al. 1995, p. 372*ff*; Gedamke et al. 2011). In terrestrial animals, exposure to sounds sufficiently strong to elicit a large TTS induces physiological and structural changes in the inner ear, and at some high level of sound exposure, these phenomena become non-recoverable (Le Prell 2012). At this level of sound exposure, TTS grades into PTS. Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage, but repeated or (in some cases) single exposures to a level well above that causing TTS onset might elicit PTS (e.g., Kastak and Reichmuth 2007; Kastak et al. 2008).

Current NMFS policy regarding exposure of marine mammals to high-level sounds is that cetaceans and pinnipeds should not be exposed to impulsive sounds with received levels ≥180 dB and 190 dB re 1 μPa_{rms}, respectively (NMFS 2000). These criteria have been used in establishing the exclusion (shut-down) zones planned for the proposed seismic survey. However, those criteria were established before there was any information about minimum received levels of sounds necessary to cause auditory impairment in marine mammals.

Recommendations for science-based noise exposure criteria for marine mammals, frequency-weighting procedures, and related matters were published by Southall et al. (2007). Those recommendations were never formally adopted by NMFS for use in regulatory processes and during mitigation programs associated with seismic surveys, although some aspects of the recommendations have been taken into account in certain environmental impact statements and small-take authorizations. In December 2013, NOAA made available for public comment new draft guidance for assessing the effects of anthropogenic sound on marine mammals (NOAA 2013a), taking at least some of the Southall et al. recommendations into account. The new acoustic guidance and procedures could account for the now-available scientific data on marine mammal TTS, the expected offset between the TTS and PTS thresholds, differences in the acoustic frequencies to which different marine mammal groups are sensitive (e.g., M-weighting or generalized frequency weightings for various groups of marine mammals, allowing for their functional bandwidths), and other relevant factors. At the time of preparation of this Draft Amended EA, the date of release of the final guidelines and how they would be implemented are unknown.

Nowacek et al. (2013) concluded that current scientific data indicate that seismic airguns have a low probability of directly harming marine life, except at close range. Several aspects of the planned monitoring and mitigation measures for this project are designed to detect marine mammals occurring near the airgun array, and to avoid exposing them to sound pulses that might, at least in theory, cause hearing impairment (see § II and § IV[2], below). Also, many marine mammals and (to a limited degree) sea turtles show some avoidance of the area where received levels of airgun sound are high enough such that hearing impairment could potentially occur. In those cases, the avoidance responses of the animals themselves would reduce or (most likely) avoid any possibility of hearing impairment.

Non-auditory physical effects could also occur in marine mammals exposed to strong underwater pulsed sound. Possible types of non-auditory physiological effects or injuries that might (in theory) occur in mammals close to a strong sound source include stress, neurological effects, bubble formation, and other types of organ or tissue damage. It is possible that some marine mammal species (i.e., beaked whales) could be especially susceptible to injury and/or stranding when exposed to strong transient sounds.

There is no definitive evidence that any of these effects occur even for marine mammals in close proximity to large arrays of airguns. However, Gray and Van Waerebeek (2011) have suggested a cause-effect relationship between a seismic survey off Liberia in 2009 and the erratic movement, postural instability, and akinesia in a pantropical spotted dolphin based on spatially and temporally close association with the airgun array. Additionally, a few cases of strandings in the general area where a seismic survey was ongoing have led to speculation concerning a possible link between seismic surveys and strandings (e.g., Castellote and Llorens 2013).

Non-auditory effects, if they occur at all, would presumably be limited to short distances and to activities that extend over a prolonged period. Marine mammals that show behavioral avoidance of seismic vessels, including most baleen whales, some odontocetes, and some pinnipeds, are especially unlikely to incur non-auditory physical effects. The brief duration of exposure of any given mammal and the planned monitoring and mitigation measures would further reduce the probability of exposure of marine mammals to sounds strong enough to induce non-auditory physical effects.

Sea Turtles

There is substantial overlap in the frequencies that sea turtles detect vs. the frequencies in airgun pulses. We are not aware of measurements of the absolute hearing thresholds of any sea turtle to waterborne sounds similar to airgun pulses. In the absence of relevant absolute threshold data, we cannot estimate how far away an airgun array might be audible. Moein et al. (1994) and Lenhardt (2002) reported TTS for loggerhead turtles exposed to many airgun pulses (see PEIS). This suggests that sounds

from an airgun array might cause temporary hearing impairment in sea turtles if they do not avoid the (unknown) radius where TTS occurs. However, exposure duration during the proposed survey would be much less than during the aforementioned studies. Also, recent monitoring studies show that some sea turtles do show localized movement away from approaching airguns. At short distances from the source, received sound level diminishes rapidly with increasing distance. In that situation, even a small-scale avoidance response could result in a significant reduction in sound exposure.

The PSVOs stationed on the *Langseth* would also watch for sea turtles, and airgun operations would be shut down if a turtle enters the designated EZ.

(b) Possible Effects of Other Acoustic Sources

The Kongsberg EM 122 MBES, Knudsen Chirp 3260 SBP, and Teledyne OS75 75-kHz ADCP would be operated from the source vessel during the proposed survey, but not during transits. Information about this equipment was provided in § 2.2.3.1 of the PEIS (MBES, SBP) or § II of this Draft Amended EA (ADCP). A review of the anticipated potential effects (or lack thereof) of MBESs, SBPs, and pingers on marine mammals and sea turtles appears in § 3.4.4.3, § 3.6.4.3, § 3.7.4.3, and Appendix E of the PEIS.

There has been some recent attention given to the effects of MBES on marine mammals, as a result of a report issued in September 2013 by an IWC independent scientific review panel (ISRP) linking the operation of a MBES to a mass stranding of melon-headed whales (*Peponocephala electra*; Southall et al. 2013) off Madagascar. During May–June 2008, ~100 melon-headed whales entered and stranded in the Loza Lagoon system in northwest Madagascar at the same time that a 12-kHz MBES survey was being conducted ~65 km away off the coast. In conducting a retrospective review of available information on the event, an independent scientific review panel concluded that the Kongsberg EM 120 MBES was the most plausible behavioral trigger for the animals initially entering the lagoon system and eventually stranding. The independent scientific review panel, however, identified that an unequivocal conclusion on causality of the event was not possible because of the lack of information about the event and a number of potentially contributing factors. Additionally, the independent review panel report indicated that this incident was likely the result of a complicated confluence of environmental, social, and other factors that have a very low probability of occurring again in the future, but recommended that the potential be considered in environmental planning. The proposed survey design and environmental context of the proposed survey are quite different from the mass melon-headed whale stranding described by the ISRP. It should be noted that this event is the first known marine mammal mass stranding closely associated with the operation of a MBES. It is noted that leading scientific experts knowledgeable about MBES have expressed concerns about the independent scientific review panel analyses and findings (Bernstein 2013).

There is no available information on marine mammal behavioral response to MBES sounds (Southall et al. 2013) or sea turtle responses to MBES systems. Much of the literature on marine mammal response to sonars relates to the types of sonars used in naval operations, including Low-Frequency Active (LFA) sonars (e.g., Miller et al. 2012; Sivle et al. 2012) and Mid-Frequency Active (MFA) sonars (e.g., Tyack et al. 2011; Melcón et al. 2012; Miller et al. 2012; DeRuiter et al. 2013a,b; Goldbogen et al. 2013). However, the MBES sounds are quite different from naval sonars. Ping duration of the MBES is very short relative to naval sonars. Also, at any given location, an individual marine mammal would be in the beam of the MBES for much less time given the generally downward orientation of the beam and its narrow fore-aft beamwidth; naval sonars often use near-horizontally-directed sound. In addition, naval sonars have higher duty cycles. These factors would all reduce the sound energy received from the MBES relative to that from naval sonars.

Risch et al. (2012) found a reduction in humpback whale song in the Stellwagen Bank National Marine Sanctuary during Ocean Acoustic Waveguide Remote Sensing (OAWRS) activities that were carried out approximately 200 km away. The OAWRS used three frequency-modulated (FM) pulses centered at frequencies of 415, 734, and 949 Hz with received levels in the sanctuary 88–110 dB re 1 µPa. Deng et al (2014) measured the spectral properties of pulses transmitted by three 200-kHz echo sounders, and found that they generated weaker sounds at frequencies below the center frequency (90–130 kHz). These sounds are within the hearing range of some marine mammals, and the authors suggested that they could be strong enough to elicit behavioural responses within close proximity to the sources, although they would be well below potentially harmful levels.

Despite the aforementioned information that has recently become available, this Draft Amended EA is in agreement with the assessment presented in § 3.4.7, 3.6.7, and 3.7.7 of the PEIS that operation of MBESs, SBPs, and pingers is not likely to impact mysticetes or odontocetes, and is not expected to affect sea turtles, (1) given the lower acoustic exposures relative to airguns and (2) because the intermittent and/or narrow downward-directed nature of these sounds would result in no more than one or two brief ping exposures of any individual marine mammal or sea turtle given the movement and speed of the vessel. Also, for sea turtles, the associated frequency ranges are above their known hearing range.

(c) Other Possible Effects of Seismic Surveys

Other possible effects of seismic surveys on marine mammals and/or sea turtles include masking by vessel noise, disturbance by vessel presence or noise, and injury or mortality from collisions with vessels or entanglement in seismic gear.

Vessel noise from the *Langseth* could affect marine animals in the proposed survey area. Sounds produced by large vessels generally dominate ambient noise at frequencies from 20 to 300 Hz (Richardson et al. 1995). Ship noise, through masking, can reduce the effective communication distance of a marine mammal if the frequency of the sound source is close to that used by the animal, and if the sound is present for a significant fraction of time (e.g., Richardson et al. 1995; Clark et al. 2009; Jensen et al. 2009; Hatch et al. 2012). In order to compensate for increased ambient noise, some cetaceans are known to increase the source levels of their calls in the presence of elevated noise levels from shipping, shift their peak frequencies, or otherwise change their vocal behavior (e.g., Parks et al. 2011; 2012; Castellote et al. 2012; Melcón et al. 2012: Tyack and Janik 2013).

Baleen whales are thought to be more sensitive to sound at these low frequencies than are toothed whales (e.g., MacGillivray et al. 2014), possibly causing localized avoidance of the proposed survey area during seismic operations. Reactions of gray and humpback whales to vessels have been studied, and there is limited information available about the reactions of right whales and rorquals (fin, blue, and minke whales). Reactions of humpback whales to boats are variable, ranging from approach to avoidance (Payne 1978; Salden 1993). Baker et al. (1982, 1983) and Baker and Herman (1989) found humpbacks often move away when vessels are within several kilometers. Humpbacks seem less likely to react overtly when actively feeding than when resting or engaged in other activities (Krieger and Wing 1984, 1986).

Many odontocetes show considerable tolerance of vessel traffic, although they sometimes react at long distances if confined by ice or shallow water, if previously harassed by vessels, or have had little or no recent exposure to ships (Richardson et al. 1995). Dolphins of many species tolerate and sometimes approach vessels. Some dolphin species approach moving vessels to ride the bow or stern waves (Williams et al. 1992). There are few data on the behavioral reactions of beaked whales to vessel noise, though they seem to avoid approaching vessels (e.g., Würsig et al. 1998) or dive for an extended period when approached by a vessel (e.g., Kasuya 1986). Based on a single observation, Aguilar-Soto et al. (2006) suggest foraging efficiency of Cuvier's beaked whales may be reduced by close approach of vessels.

The PEIS concluded that project vessel sounds would not be at levels expected to cause anything more than possible localized and temporary behavioral changes in marine mammals or sea turtles, and would not be expected to result in significant negative effects on individuals or at the population level. In addition, in all oceans of the world, large vessel traffic is currently so prevalent that it is commonly considered a usual source of ambient sound.

Another concern with vessel traffic is the potential for striking marine mammals or sea turtles. Information on vessel strikes is reviewed in § 3.4.4.4 and § 3.6.4.4 of the PEIS. The PEIS concluded that the risk of collision of seismic vessels or towed/deployed equipment with marine mammals or sea turtles exists but is extremely unlikely, because of the relatively slow operating speed (typically 7–9 km/h) of the vessel during seismic operations, and the generally straight-line movement of the seismic vessel. There has been no history of marine mammal vessel strikes with the *Langseth*, or its predecessor, R/V *Maurice Ewing* over the last ~23 years, including those conducted off NJ.

Entanglement of sea turtles in seismic gear is also a concern. There have been reports of turtles being trapped and killed between the gaps in tail-buoys offshore from West Africa (Weir 2007); however, these tailbuoys are significantly different than those used on the *Langseth*. In April 2011, a dead olive ridley turtle was found in a deflector foil of the seismic gear on the *Langseth* during equipment recovery at the conclusion of a survey off Costa Rica, where sea turtles were numerous. Such incidents are possible, but this is the first case of sea turtle entanglement in seismic gear for the *Langseth*, which has been conducting seismic surveys since 2008, or for R/V *Maurice Ewing*, during 2003–2007. Towing the hydrophone streamer or other equipment during the proposed survey is not expected to significantly interfere with sea turtle movements, including migration. Although sea turtles were observed during the 2014 survey, no such effects were detected nor were strandings reported during survey activities.

(d) Mitigation Measures

Several mitigation measures are built into the proposed seismic survey as an integral part of the planned activities. These measures include the following: ramp ups; typically two, however a minimum of one dedicated observer maintaining a visual watch during all daytime airgun operations; two observers for 30 min before and during ramp ups; PAM during the day and night to complement visual monitoring (unless the system and back-up systems are damaged during operations); and power downs (or if necessary shut downs) when mammals or turtles are detected in or about to enter designated EZ. These mitigation measures are described in § 2.4.4.1 of the PEIS and summarized earlier in this document, in § II(3). The fact that the 4-airgun subarray, because of its design, would direct the majority of the energy downward, and less energy laterally, is also an inherent mitigation measure.

Previous and subsequent analysis of the potential impacts takes account of these planned mitigation measures. It would not be meaningful to analyze the effects of the planned activities without mitigation, as the mitigation (and associated monitoring) measures are a basic part of the activities, and would be implemented under the Proposed Action or Alternative Action. The same monitoring and mitigation measures proposed for the 2014 survey are proposed for the 2015 survey.

(e) Potential Numbers of Cetaceans Exposed to Received Sound Levels ≥160 dB

All anticipated takes would be “takes by harassment” as described in § I, involving temporary changes in behavior. The mitigation measures to be applied would minimize the possibility of injurious takes. (However, as noted earlier and in the PEIS, there is no specific information demonstrating that injurious “takes” would occur even in the absence of the planned mitigation measures.) In the sections below, we describe methods to estimate the number of potential exposures to sound levels >160 dB re 1 μPa_{rms}, and present estimates of the numbers of marine mammals that could be affected during the proposed seismic

program. The estimates are based on consideration of the number of marine mammals that could be disturbed appreciably by ~4900 km of seismic surveys off the coast of New Jersey. The main sources of distributional and numerical data used in deriving the estimates are described in the next subsection.

Basis for Estimating Exposure.—The estimates are based on a consideration of the number of marine mammals that could be within the area around the operating airgun array where the received levels (RLs) of sound >160 dB re 1 μPa_{rms} are predicted to occur (see Table 1). The estimated numbers are based on the densities (numbers per unit area) of marine mammals expected to occur in the area in the absence of a seismic survey. To the extent that marine mammals tend to move away from seismic sources before the sound level reaches the criterion level and tend not to approach an operating airgun array, these estimates are likely to overestimate the numbers actually exposed to the specified level of sounds. The overestimation is expected to be particularly large when dealing with the higher sound-level criteria, e.g., 180 dB re 1 μPa_{rms}, as animals are more likely to move away before RL reaches 180 dB than they are to move away before it reaches (for example) 160 dB re 1 μPa_{rms}. Likewise, they are less likely to approach within the ≥180 dB re 1 μPa_{rms} radius than they are to approach within the considerably larger ≥160 dB radius.

We used densities calculated from the U.S. Navy's "OPAREA Density Estimates" (NODE) database (DoN 2007). The cetacean density estimates are based on the NMFS-NEFSC aerial surveys conducted between 1998 and 2004; all surveys from New Jersey to Maine were conducted in summer (June–August). Density estimates were derived using density surface modeling of the existing line-transect data, which uses sea surface temperature, chlorophyll *a*, depth, longitude, and latitude to allow extrapolation to areas/seasons where survey data were not collected. For some species, there were not enough sightings to be able to produce a density surface, so densities were estimated using traditional line-transect analysis. The models and analyses have been incorporated into a web-based Geographic Information System (GIS) developed by Duke University's Department of Defense Strategic Environmental Research and Development Program (SERDP) team in close collaboration with the NMFS SERDP team (Read et al. 2009). We used the GIS to obtain densities in a polygon the size of the survey area for the 19 cetacean species in the model. The GIS provides minimum, mean, and maximum estimates for four seasons, and we have used the mean estimates for summer (June–August). Mean densities were used because the minimum and maximum estimates are for points within the polygon, whereas the mean estimate is for the entire polygon.

The estimated numbers of individuals potentially exposed presented below are based on the 160-dB re 1 μPa_{rms} criterion for all cetaceans. It is assumed that marine mammals exposed to airgun sounds that strong could change their behavior sufficiently to be considered "taken by harassment". Table 7 shows the density estimates calculated as described above and the estimates of the number of different individual marine mammals that potentially could be exposed to ≥160 dB re 1 μPa_{rms} during the seismic survey if no animals moved away from the survey vessel. The *Requested Take Authorization* is given in the far right column of Table 7. For species for which densities were not available but for which there were sighting records near the survey area, we have included a *Requested Take Authorization* for the mean group size for the species from Palka (2012).

It should be noted that the following estimates of exposures to various sound levels assume that the proposed survey would be completed; in fact, the ensonified areas calculated using the planned number of line-kilometers ***have been increased by 25%*** to accommodate lines that may need to be repeated, equipment testing, etc. As is typical during offshore ship surveys, inclement weather and equipment malfunctions are likely to cause delays and may limit the number of useful line-kilometers of seismic operations that can be undertaken. Also, any marine mammal sightings within or near the designated EZ would result in the shut down of seismic operations as a mitigation measure. Thus, the following estimates of the numbers of marine mammals potentially exposed to 160-dB re 1 μPa_{rms} sounds are precautionary and

TABLE 7. Densities and estimates of the possible numbers of individuals that could be exposed to ≥160 dB re 1 μPa$_{rms}$ during the proposed seismic survey in the northwest Atlantic off New Jersey during June–August 2015. The proposed sound source consists of an 4-airgun subarray with a total discharge volume of ~700 in^3. Species in italics are listed under the ESA as endangered. The column of numbers in boldface shows the numbers of Level B "takes" for which authorization is requested.

Species	Reported Density (#/1000 km^2) Read et al. (2009)[1]	Correction Factor[2]	Estimated Density (#/1000 km^2)	Ensonified Area (km^2)	Calculated Take[3]	% of Regional Pop'n[4]	Requested Level B Take Authorization
Mysticetes							
North Atlantic right whale	*0*		*0*	*2037*	*0*	*0*	***0***
Humpback whale	*0*		*0*	*2037*	*0*	*0.01*	***1[5]***
Minke whale	0		0	2037	0	0	**0**
Sei whale	*0.161*		*0.161*	*2037*	*0*	*0.01*	***1[5]***
Fin whale	*0.002*		*0.002*	*2037*	*0*	*<0.01*	***1[5]***
Blue whale	*0*		*0*	*2037*	*0*	*0*	***0***
Odontocetes							
Sperm whale	*7.06*		*7.06*	*2037*	*14*	*0.11*	***14***
Pygmy/dwarf sperm whale	0.001		0.001	2037	0	0.05	**2[5]**
Beaked whales[6]	0.124		0.124	2037	0	0.02	**3[5]**
Rough-toothed dolphin	0		0	2037	0	0	**0**
Bottlenose dolphin	111.3		111.3	2037	227	0.26	**227**
Pantropical spotted dolphin	0		0	2037	0	0	**0**
Atlantic spotted dolphin	36.11		36.11	2037	74	0.16	**74**
Spinner dolphin[7]	0		0	2037	0	0	**0**
Striped dolphin	0		0	2037	0	0.08	**46[5]**
Short-beaked common dolphin	0		0	2037	0	0.01	**18[5]**
White-beaked dolphin[7]	0		0	2037	0	0	**0**
Atlantic white-sided dolphin	0		0	2037	0	0.03	**15[5]**
Risso's dolphin	13.60		13.60	2037	28	0.15	**28**
Pygmy killer whale[7]	0		0	2037	0	N/A	**0**
False killer whale[7]	0		0	2037	0	N/A	**0**
Killer whale [7]	0		0	2037	0	N/A	**0**
Pilot whale	0.184		0.184	2037	0	<0.01	**9[5]**
Harbor porpoise	0		0	2037	0	0	**0**

[1] Densities are the mean values for the survey area, calculated from the SERDP model of Read et al. (2009)
[2] No correction factors were applied for these calculations
[3] Calculated take is estimated density (reported density x correction factor) multiplied by the 160-dB ensonified area (including the 25% contingency)
[4] Requested takes expressed as percentages of the larger regional populations, where available, for species that are at least partly pelagic; where not available (most odontocetes–see Table 3), 2013 SAR population estimates were used; N/A means not available
[5] Requested take authorization was increased to group size from Palka (2012) for species for which densities were zero but that have been sighted near the proposed survey area
[6] May include Cuvier's, True's, Gervais', Sowerby's, or Blainville's beaked whales, or the northern bottlenose whale
[7] Atlantic waters not included in the SERDP model of Read et al. (2009)

probably overestimate the actual numbers of marine mammals that could be involved. These estimates assume that there would be no weather, equipment, or mitigation delays, which is highly unlikely. For the 2014 survey, NMFS added an additional 25% to the estimated take to account for the turnover of marine mammals in the survey area. NSF has traditionally not included this factor into take calculations and therefore has not included it here.

Consideration should be given to the hypothesis that delphinids are less responsive to airgun sounds than are mysticetes, as referenced in both the PEIS and "Summary of Potential Airgun Effects" of this document. The 160-dB (rms) criterion currently applied by NMFS, on which the following estimates are based, was developed based primarily on data from gray and bowhead whales. The estimates of "takes by harassment" of delphinids given below are thus considered precautionary. As noted previously, in December 2013, NOAA made available for public comment new draft guidance for assessing the effects of anthropogenic sound on marine mammals (NOAA 2013a), although at the time of preparation of this Draft Amended EA, the date of release of the final guidelines and how they would be implemented are unknown. Available data suggest that the current use of a 160-dB criterion may be improved upon, as behavioral response may not occur for some percentage of odontocetes and mysticetes exposed to received levels >160 dB, while other individuals or groups may respond in a manner considered as taken to sound levels <160 dB (NMFS 2013a). It has become evident that the context of an exposure of a marine mammal to sound can affect the animal's initial response to the sound (NMFS 2013a).

Potential Number of Marine Mammals Exposed.—The number of different individuals that could be exposed to airgun sounds with received levels ≥160 dB re 1 μPa_{rms} on one or more occasions can be estimated by considering the total marine area that would be within the 160-dB radius around the operating seismic source on at least one occasion, along with the expected density of animals in the area. The number of possible exposures (including repeated exposures of the same individuals) can be estimated by considering the total marine area that would be within the 160-dB radius around the operating airguns, including areas of overlap. During the proposed survey, the transect lines are closely spaced relative to the 160-dB distance. Thus, the area including overlap is 35.5 times the area excluding overlap, so a marine mammal that stayed in the survey area during the entire survey could be exposed ~36 times, on average. However, it is unlikely that a particular animal would stay in the area during the entire survey. The numbers of different individuals potentially exposed to ≥160 dB re 1 μPa_{rms} were calculated by multiplying the expected species density times the anticipated area to be ensonified to that level during airgun operations excluding overlap. The area expected to be ensonified was determined by entering the planned survey lines into a MapInfo GIS, using the GIS to identify the relevant areas by "drawing" the applicable 160-dB buffer (see Table 1) around each seismic line, and then calculating the total area within the buffers.

Applying the approach described above, ~1630 km^2 (~2037 km^2 including the 25% contingency) would be within the 160-dB isopleth on one or more occasions during the proposed survey. Because this approach does not allow for turnover in the mammal populations in the area during the course of the survey, the actual number of individuals exposed may be underestimated, although the conservative (i.e., probably overestimated) line-kilometer distances used to calculate the area may offset this. Also, the approach assumes that no cetaceans would move away or toward the trackline as the *Langseth* approaches in response to increasing sound levels before the levels reach 160 dB. Another way of interpreting the estimates that follow is that they represent the number of individuals that are expected (in the absence of a seismic program) to occur in the waters that would be exposed to ≥160 dB re 1 μPa_{rms}.

The estimate of the number of individual cetaceans that could be exposed to seismic sounds with received levels ≥160 dB re 1 μPa_{rms} during the proposed survey is 343 (Table 7). That total includes 14 cetaceans listed as ***Endangered*** under the ESA, all sperm whales (0.11% of the regional population). Most (96%) of the cetaceans potentially exposed are delphinids; the bottlenose dolphin, Atlantic spotted dolphin, and Risso's dolphin are estimated to be the most common delphinid species in the area, with estimates of 227 (0.26% of the regional population), 74 (0.16%), and 28 (0.15%) exposed to ≥160 dB re 1 μPa_{rms}, respectively.

As part of the IHA process in 2014, NMFS reviewed the take estimates presented in Table 7 of the July 2014 Final EA (Table 6 in the Draft EA), which were based on an 8-airgun subarray with a volume of ~1400 in^3. As part of NMFS's analyses process, however, they revised the take calculations for most species based upon the best available density information from SERDP SDSS and other sources and most recent population estimates from the 2013 SAR. These included some additional takes for blue, fin, humpback, minke, sei, and north Atlantic right whales; beaked whales; harbor porpoise; and gray, harbor, and harp seals, and other species. The IHA issued by NOAA on 1 July 2014 therefore included slightly different estimates of the possible numbers of marine mammals exposed to sound levels ≥160 dB re 1 mPa during the proposed seismic survey than those presented in Table 7. For all but two of the species for which take has been issued, the takes remain less than 1% of the species' regional population or stock. Additionally, in the 2014 Biological Opinion, a different methodology to analyze for multiple exposures of endangered species was presented. NMFS does not provide specific guidance or requirements for IHA Applicants or for Section 7 ESA consultation for the development of take estimates and multiple exposure analysis, therefore variation in methodologies and calculations are likely to occur. The analysis presented in this NSF Draft Amended EA and the Final EA dated 1 July 2014, however, is a methodology that has been used successfully for past NSF seismic surveys to generate take estimates and multiple exposures for the MMPA and ESA processes. Although NSF did not, and has not historically, estimated take for sea turtles, the Biological Opinion and ITS included analysis and take estimates for sea turtles (Appendix C of the 1 July 2014 Final EA). NSF and LDEO would adhere to the requirements of the Incidental Take Statement (ITS) and the IHA and associated take levels issued.

(f) Conclusions for Marine Mammals and Sea Turtles

The proposed seismic project would involve towing a 4-airgun subarray, with a total discharge volume of 700 in^3, that introduces pulsed sounds into the ocean. Routine vessel operations, other than the proposed seismic operations, are conventionally assumed not to affect marine mammals sufficiently to constitute "taking".

Cetaceans.—In § 3.6.7 and 3.7.7, the PEIS concluded that airgun operations with implementation of the proposed monitoring and mitigation measures could result in a small number of Level B behavioral effects in some mysticete and odontocete species in the NW Atlantic DAA; that Level A effects were highly unlikely; and that operations were unlikely to adversely affect ESA-listed species. The information from recent literature summarized in sections (a) to (c) above complements, and does not affect the outcome of the effects assessment as presented in the PEIS.

In this analysis, estimates of the numbers of marine mammals that could be exposed to airgun sounds during the proposed program have been presented, together with the requested "take authorization". The estimated numbers of animals potentially exposed to sound levels sufficient to cause appreciable disturbance are very low percentages of the regional population sizes (Table 7). The estimates are likely overestimates of the actual number of animals that would be exposed to and would react to the seismic sounds. The reasons for that conclusion are outlined above. The relatively short-term exposures are unlikely to result in any long-term negative consequences for the individuals or their populations. Therefore, no significant impacts on cetaceans would be anticipated from the proposed activities. In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, Protected Species Observers (PSOs) and other crew members have seen no seismic sound-related marine mammal injuries or mortality, including during 2014 survey activities. For the 2014 survey, NMFS issued a Final EA and a FONSI. NMFS also issued an IHA on 1 July 2014, therefore, the proposed activity meets the criteria that the proposed activities, "must not cause serious physical injury or death of marine mammals, must have negligible impacts on the species and stocks, must "take" no more than

small numbers of those species or stocks, and must not have an unmitigable adverse impact on the availability of the species or stocks for legitimate subsistence uses." In the Biological Opinion dated 1 July 2014, NMFS determined that the level of incidental take was not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat**.** The issuance of the Final EA, FONSI, IHA, and Biological Opinion by NMFS in July 2014 further verifies that significant impacts would not be anticipated from the proposed activities, especially given that the activities would be using the smaller 700-in^3 source, rather than the larger size source also analyzed and authorized by NMFS in 2014. Observations from the brief 2014 survey support this conclusion (Ingram et al. 2014).

***Sea Turtles.*—**In § 3.4.7, the PEIS concluded that with implementation of the proposed monitoring and mitigation measures, no significant impacts of airgun operations are likely to sea turtle populations in any of the analysis areas, and that any effects are likely to be limited to short-term behavioral disturbance and short-term localized avoidance of an area of unknown size near the active airguns. Five species of sea turtle**—**the leatherback, loggerhead, green, hawksbill, and Kemp's ridley**—**could be encountered in the proposed survey area. Only foraging or migrating individuals would occur. Given the proposed activities, no significant impacts on sea turtles would be anticipated. In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, Protected Species Observers (PSOs) and other crew members have seen no seismic sound-related sea turtle injuries or mortality, including during 2014 survey activities. In their July 2014 Final EA, FONSI, and Biological Opinion, NMFS determined that the level of incidental take was not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat**.** The Biological Opinion further verifies that significant impacts would not be anticipated from the proposed activities. Observations from the brief 2014 survey support this conclusion (Ingram et al. 2014).

(2) Direct Effects on Invertebrates, Fish, Fisheries, and EFH and Their Significance

Effects of seismic sound on marine invertebrates (crustaceans and cephalopods), marine fish, and their fisheries are discussed in § 3.2.4 and § 3.3.4 and Appendix D of the PEIS. Relevant new studies on the effects of sound on marine invertebrates, fish, and fisheries that have been published since the release of the PEIS are summarized below.

(a) Effects of Sound on Fish and Invertebrates

Morley et al. (2013) considered invertebrates important when examining the impacts of anthropogenic noise. Although their review focused on terrestrial invertebrates, they noted that invertebrates, because of their short life cycle, can provide model systems for evaluating the effects of noise on individual fitness and physiology, thereby providing data that can be used to draw stronger, ecologically valid conclusions.

Solé et al. (2013) exposed four cephalopod species to low-frequency sound (50–400 Hz sweeps) with received levels of 157 ± 5 dB re 1 μPa, and peak levels up to 175 dB re 1 μPa. Besides exhibiting startle responses, all four species examined received damage to the statocyst, which is the organ responsible for equilibrium and movement. The animals showed stressed behavior, decreased activity, and loss of muscle tone. When the shore crab *Carcinus maenas* was initially exposed to ship-noise playbacks, it consumed more oxygen, indicating a higher metabolic rate and potentially more stress; however, there were no changes in physiological responses to repeated exposure (Wale et al. 2013). Heavier crabs were more responsive than lighter crab (Wale et al. 2013). Celi et al. (2013) exposed red swamp crayfish (*Procambarus clarkia*) to linear sweeps with a frequency range of 0.1 to 25 kHz and a

peak amplitude of 148 dB re 1 μPa rms at 12 kHz for 30 min. They found that the noise exposure caused changes in the haemato-immunological parameters (indicating stress) and reduced agonistic behaviors.

Fewtrell and McCauley (2012) exposed squid (*Sepioteuthis australis*), pink snapper (*Pagrus auratus*), and trevally (*Pseudocaranx dentex*) to pulses from a single airgun. The received sound levels ranged from 120 to 184 dB re 1 dB re 1 $\mu Pa^2 \cdot s$ SEL. Increases in alarm responses were seen in the squid and fish at SELs >147–151 dB re 1 $\mu Pa^2 \cdot s$; the fish swam faster and formed more cohesive groups in response to the airgun sounds, and squid were seen to discharge ink or change their swimming pattern or vertical position in the water column.

Significant developmental delays and body abnormalities in scallop larvae exposed to seismic pulses were reported by de Soto et al. (2013). Their experiment used larvae enclosed in 60-ml flasks suspended in a 2-m diameter by 1.3-m water depth tank and exposed to a playback of seismic sound at a distance of 5–10 cm. Other studies conducted in the field have shown no effects on Dungeness crab larvae or snow crab embryos (Pearson et al. 1994; DFOC 2004 *in* NSF PEIS). Moreover, a major annual scallop-spawning period occurs in the Mid-Atlantic Bight during late summer to fall (August–October), although MacDonald and Thompson (1988 in NMFS 2004) reported scallop spawning off New Jersey during September–November. The timing of the proposed survey would not coincide with the time when scallops are spawning.

Bui et al. (2013) examined the behavioral responses of Atlantic salmon (*Salmo salar L*.) to light, sound, and surface disturbance events. They reported that the fish showed short-term avoidance responses to the three stimuli. Salmon that were exposed to 12 Hz sounds and/or surface disturbances increased their swimming speeds.

Peña et al. (2013) used an omnidirectional fisheries sonar to determine the effects of a 3D seismic survey off Vesterålen, northern Norway, on feeding herring (*Clupea harengus*). They reported that herring schools did not react to the seismic survey; no significant changes were detected in swimming speed, swim direction, or school size when the drifting seismic vessel approached the fish from a distance of 27 km to 2 km over a 6 h period. Peña et al. (2013) attributed the lack of response to strong motivation for feeding, the slow approach of the seismic vessel, and an increased tolerance to airgun sounds.

Miller and Cripps (2013) used underwater visual census to examine the effect of a seismic survey on a shallow-water coral reef fish community in Australia. The census took place at six sites on the reef prior to and after the survey. When the census data collected during the seismic program were combined with historical data, the analyses showed that the seismic survey had no significant effect on the overall abundance or species richness of reef fish. This was in part attributed to the design of the seismic survey, which reduced the impacts of seismic sounds on the fish communities by exposing them to relatively low SELs (<187 dB re 1 $\mu Pa^2 \cdot s$).

Hastings and Miksis-Olds (2012) measured the hearing sensitivity of caged reef fish following exposure to a seismic survey in Australia. When the auditory evoked potentials (AEP) were examined for fish that had been in cages as close as 45 m from the pass of the seismic vessel and at water depth of 5 m, there was no evidence of temporary threshold shift (TTS) in any of the fish examined, even though the cumulative SELs had reached 190 dB re 1 $\mu Pa^2 \cdot s$.

Two spawning stocks that migrate inshore/offshore off New Jersey are the summer flounder and black sea bass. Summer flounder normally inhabit shallow coastal and estuarine waters in summer and move offshore in 60–150 m depth in fall and winter. They spawn in fall and winter (September–December) (MAFMC 1988), after the proposed seismic survey period. Black sea bass normally inhabit shallow waters in summer and move offshore and south in 75–165 m depth in fall and winter (MAFMC 1996). Spawning in the Middle Atlantic Bight population occurs primarily on the inner continental shelf

from May to July during inshore migrations (NMFS 1999), largely before the survey's proposed timing. Therefore, spawning of at least two important species would not be affected to any great degree.

(b) Effects of Sound on Fisheries

Handegard et al. (2013) examined different exposure metrics to explain the disturbance of seismic surveys on fish. They applied metrics to two experiments in Norwegian waters, during which fish distribution and fisheries were affected by airguns. Even though the disturbance for one experiment was greater, the other appeared to have the stronger SEL, based on a relatively complex propagation model. Handegard et al. (2013) recommended that simple sound propagation models should be avoided and that the use of sound energy metrics like SEL to interpret disturbance effects should be done with caution. In this case, the simplest model (exposures per area) best explained the disturbance effect.

Hovem et al. (2012) used a model to predict the effects of airgun sounds on fish populations. Modeled SELs were compared with empirical data and were then compared with startle response levels for cod. Their preliminary analyses indicated that seismic surveys should occur at a distance of 5–10 km from fishing areas, in order to minimize potential effects on fishing.

In their introduction, Løkkeborg et al. (2012) described three studies in the 1990s that showed effects on fisheries. Results of their study off Norway in 2009 indicated that fishes reacted to airgun sound based on observed changes in catch rates during seismic shooting; gillnet catches increased during the seismic shooting, likely a result of increased fish activity, whereas longline catches decreased overall (Løkkeborg et al. 2012).

(c) Conclusions for Invertebrates, Fish, and Fisheries

This newly available information does not affect the outcome of the effects assessment as presented in the PEIS. The PEIS concluded that there could be changes in behavior and other non-lethal, short-term, temporary impacts, and injurious or mortal impacts on a small number of individuals within a few meters of a high-energy acoustic source, but that there would be no significant impacts of NSF-funded marine seismic research on populations and associated EFH. The PEIS also concluded that seismic surveys could cause temporary, localized reduced fish catch to some species, but that effects on commercial and recreation fisheries were not significant.

Most commercial fish catches by weight (almost all menhaden) and most recreational fishing trips off the coast of New Jersey (87% in 2013 occur in waters within 5.6 km from shore, although the highest-value fish (e.g., flounder and tuna) are caught farther offshore. The closest distance between the proposed survey and shore is >25 km, so interactions between the proposed survey and recreational and some commercial fisheries would be relatively limited. Also, most of the recreational fishery "hotspots" described in § III are to the north or south of the proposed survey area; however, there are several hotspots located within or very near the northwestern corner of the survey area. Two possible conflicts are the *Langseth*'s streamer entangling with fixed fishing gear and temporary displacement of fishers within the survey area, although the survey area is relatively small (12 x 50 km). Fishing activities could occur within the survey area; however, a safe distance would need to be kept from the *Langseth* and the towed seismic equipment. Conflicts would be avoided and, therefore, impacts would be negligible, through communication with the fishing community and publication of a Notice to Mariners about operations in the area. No fisheries activities except vessels in transit were observed in the survey area during the 13 days that the Langseth was there in July 2014.

Survey activities are proposed to take place ~25–85 km off the coast of New Jersey. The area of the proposed survey is relatively small, ~600 km^2. If we were to make a comparison of that survey area to blocks in New York City, it would essentially be equivalent to an area of 8 by 22 city blocks. The overall

area of NJ marine waters from shore to the EEZ encompasses ~210,768 km^2. Thus the proposed survey area represents less than one half percent (0.28%) of the area of waters from the NJ shore to the EEZ (600 km^2/210,768 km^2). The survey area plus the largest mitigation zone (8.15 km) would represent less than one percent (0.88%) of the area of waters from the NJ shore to the EEZ (1159 km^2/210,768 km^2). The seismic survey is proposed to take place for ~30 days within the June to August timeframe in 2015, not over the entire time that would be allowable under the IHA. As noted previously, fishing activities would not be precluded from operating in the proposed survey area. Any impacts to fish species would occur very close to the survey vessel and would be temporary. No fish kills or injuries were observed during 2014 survey activities (Ingram et al. 2014).

Given the proposed activities, no significant impacts on marine invertebrates, marine fish, their EFH, and their fisheries would be anticipated. In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, Protected Species Observers (PSOs) and other crew members have seen no seismic sound-related fish or invertebrate injuries or mortality. Furthermore, past seismic surveys in the proposed survey area (2002, 1998, 1995, 1990) did not result in noticeable effects on commercial or recreational fish catches, based on a review of multi-year NMFS fish catch data in the months when seismic surveys were undertaken. The issuance of the Final EA, FONSI, IHA, and Biological Opinion by NMFS in July 2014 further verifies that significant impacts would not be anticipated from the proposed activities. Observations from the brief 2014 survey support this conclusion (Ingram et al. 2014).

NSF consulted in 2014, and will do so again in 2015, with the NMFS Greater Atlantic Regional Fisheries Office under the Magnuson-Stevens Act for EFH (see below "Coordination with Other Agencies and Processes" for further details). The NMFS Greater Atlantic Regional Fisheries Office concluded that the proposed activities may at some level adversely affect EFH, however, no specific conservation measures were identified for the proposed activities.

(3) Direct Effects on Seabirds and Their Significance

Effects of seismic sound and other aspects of seismic operations (collisions, entanglement, and ingestion) on seabirds are discussed in § 3.5.4 of the PEIS. The PEIS concluded that there could be transitory disturbance, but that there would be no significant impacts of NSF-funded marine seismic research on seabirds or their populations. Given the proposed activities, no significant impacts on seabirds would be anticipated. In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, Protected Species Observers (PSOs) and other crew members have seen no seismic sound-related seabird injuries or mortality. Furthermore, NSF received concurrence from USFWS in 2014 (Appendix F of the 1 July 2014 Final EA), and will seek concurrence again in 2015, that the proposed activities "may affect" but "are not likely to adversely affect" species under their jurisdiction (Appendix F of the 1 July 2014 Final EA). Observations from the July 2014 survey support this conclusion (Ingram et al. 2014).

(4) Indirect Effects on Marine Mammals, Sea Turtles, and Their Significance

The proposed seismic operations would not result in any permanent impact on habitats used by marine mammals or sea turtles, or to the food sources they use. The main impact issue associated with the proposed activities would be temporarily elevated noise levels and the associated direct effects on marine mammals and sea turtles, as discussed above.

During the proposed seismic survey, only a small fraction of the available habitat would be ensonified at any given time. Disturbance to fish species and invertebrates would be short-term, and fish would return to their pre-disturbance behavior once the seismic activity ceased. Thus, the proposed

survey would have little impact on the abilities of marine mammals or sea turtles to feed in the area where seismic work is planned. No other indirect effects on other species would be anticipated.

(5) Direct Effects on Recreational SCUBA Divers and Dive Sites and Their Significance

No significant impacts on dive sites, including shipwrecks, would be anticipated. Airgun sounds would have no effects on solid structures. The only potential effects could be temporary displacement of fish and invertebrates from the structures.

Significant impacts on, or conflicts with, divers or diving activities would be avoided through communication with the diving community before and during the survey and publication of a Notice to Mariners about operations in the area. In particular, dive operators with dives scheduled on the shipwreck *Lillian* during the survey would be contacted directly. That dive site represents only a very small percentage of the recreational dive sites in New Jersey waters. No dive vessels were observed in the survey area during the ~14 days that the Langseth was there in July 2014.

(6) Cumulative Effects

The results of the cumulative impacts analysis in the PEIS indicated that there would not be any significant cumulative effects to marine resources from the proposed NSF-funded marine seismic research. However, the PEIS also stated that, “A more detailed, cruise-specific cumulative effects analysis would be conducted at the time of the preparation of the cruise-specific EAs, allowing for the identification of other potential activities in the area of the proposed seismic survey that may result in cumulative impacts to environmental resources.” Here we focus on activities that could impact animals specifically in the proposed survey area (research activities, vessel traffic, and commercial fisheries). Additionally, the 2014 NMFS EA Cumulative Effects Section on Climate Change is incorporated into this Draft Amended EA by reference as if fully set forth herein.

(a) Past and future research activities in the area

Most recently, as part of the Integrated Ocean Drilling Program (IODP), the liftboat *Kayd* conducted scientific research and drilling on Expedition 313, New Jersey Shallow Shelf, at several sites off New Jersey during 30 April–17 July 2008. In the more distant past, there have been other scientific drilling activities in the vicinity. There have also been numerous prior seismic surveys, all of which were 2-D, ranging from poor quality, low resolution data collected in 1978 to the most recent, excellent quality, high resolution but shallow penetration data from 2002. These include surveys with a 6-airgun, 1350-in^3 array in 1990; with a single, 45-in^3 GI Gun in 1995 and 1998; and with two 45-in^3 GI Guns in 2002. No seismic sound-related marine mammal, fish, or seabird injuries or mortality were observed by crew or scientists during these past seismic surveys in the proposed survey area. Other scientific research activities may be conducted in this region in the future; however, no other marine geophysical surveys are proposed at this specific site using the *Langseth* in the foreseeable future. At the present time, the proponents of the survey are not aware of other similar research activities planned to occur in the proposed survey area during the June–August 2015 timeframe, but research activities planned by other entities are possible, although unlikely.

In 2014, the *Langseth* also supported an NSF-proposed 2-D seismic survey off the coast of North Carolina to study the U.S. mid-Atlantic margin. That cruise lasted ~34 days and collected ~5000 km of track lines in September/October 2014. Additionally, the *Langseth* conducted a 2-D seismic survey (~2700 km) for ~3 weeks in August/September 2014, and may conduct a similar survey in 2015, for the USGS in support of the delineation of the U.S. Extended Continental Shelf (ECS) along the east coast. Separate EAs were prepared for those activities, and neither project would overlap with the proposed survey area.

(b) Vessel traffic

Based on data available through the Automated Mutual-Assistance Vessel Rescue (AMVER) system managed by the U.S. Coast Guard, 15–49 commercial vessels per month travelled through the proposed survey area during the months of June and July from 2008 to 2013, and for each month in 2012 and 2013 (2013 data are available for January–June, the most recent data available as of October 2014). Over 50 commercial vessels per month were recorded during this time closer to shore (particularly around New York City), to the immediate west and northwest of the proposed survey area (USCG 2013).

Live vessel traffic information is available from MarineTraffic (2014), including vessel names, types, flags, positions, and destinations. Various types of vessels were in the general vicinity of the proposed survey area when MarineTraffic (2014) was accessed on 10 and 15 October and 14 November 2014, including fishing vessels (22), pleasure craft (11), tug/towing vessels (9), cargo vessels (16), tankers (7), and research/survey, military, and dredger vessels (1 of each). There was also one unidentified ship type, with a U.S.A. flag. All but the majority of cargo vessels, the military vessel, the tankers, and two pleasure craft were U.S.A.-flagged. During the 13 days in July 2014 that the *Langseth* was in the survey area, there was limited merchant vessel activity; most merchant traffic was lining up for "safety fairway" to the west of the survey area.

The total transit distance (~5200 km) by L-DEO's vessel *Langseth* would be minimal relative to total transit length for vessels operating in the proposed survey area during June–August 2015. Thus, the projected increases in vessel traffic attributable to implementation of the proposed activities would constitute only a negligible portion of the total existing vessel traffic in the analysis area, and only a negligible increase in overall ship disturbance effects on marine mammals.

(c) Marine Mammal Disease

As discussed in § III, since July 2013, an unusually high number of dead or dying bottlenose dolphins have washed up on the mid-Atlantic coast from New York to Florida. NOAA noted that the triggers for disease outbreaks are unknown, but that contaminants and injuries may reduce the fitness of dolphin populations by stressing the immune system. Morbillivirus outbreaks can also be triggered by a drop in the immunity of bottlenose dolphin populations if they have not been exposed to the disease over time, and natural immunity wanes (NOAA 2013b). The last morbillivirus mortality event occurred in 1987–1988, when more than 740 bottlenose dolphins died along the mid-Atlantic coast from New Jersey to Florida (NOAA 2013b). During that mortality event, fungal, bacterial, and mixed bacterial and fungal pneumonias were common in the lungs of 79 dolphins that were examined, and the frequent occurrence of the fungal and bacterial infections in dolphins that also were infected by morbillivirus was consistent with morbillivirus-induced immunosuppression resulting in secondary infections (Lipscomb et al. 1994). Dr. Teri Knowles of NOAA noted that if the current outbreak evolves like the one in 1987–1988, "we're looking at mortality being higher and morbillivirus traveling southwards and continuing until May 2014." In fact, as of mid October 2014 it is still continuing, although recently, the number of strandings appear to be decreasing, especially in the northern states; between 17 August and 19 October, there were 2, 3, 4, and 0 strandings in NY, NJ, DE, and MD, respectively. Dr. Knowles also speculated that environmental factors, such as heavy metal pollution and sea surface temperature changes, could also play a role in the current outbreak (National Geographic Daily News 2013). It seems unlikely that the short-term behavioral disturbance that could be caused by the proposed seismic survey, especially for dolphins, would contribute to the development or continuation of a morbillivirus outbreak. Although NSF has contacted the NMFS Greater Atlantic Regional Fisheries Office Marine Mammal Response Coordinator, strandings from the proposed activities would not be anticipated. Therefore, the proposed activities would not be anticipated to increase the level of coordination necessary for stranding networks and

associated budgets or impact the NJ Animal Health Diagnostic Laboratory budget, which has been involved with funding efforts related to the recent bottlenose dolphin morbillivirus mortality event.

(d) Fisheries

The commercial and recreational fisheries in the general area of the proposed survey are described in § III. No fisheries activities except vessels in transit were observed in the survey area during the 13 days that the Langseth was there in July 2014. The primary contributions of fishing to potential cumulative impacts on marine mammals and sea turtles involve direct removal of prey items, noise, potential entanglement (Reeves et al. 2003), and the direct and indirect removal of prey items. In U.S. waters, numerous cetaceans (mostly delphinids) and pinnipeds suffer serious injury or mortality each year from fisheries; for example, for the species assessed by Waring et al. (2013), average annual fishery-related mortality during 2006–2010 in U.S. Atlantic waters included 164 common dolphins, 212 Atlantic white-sided dolphins, 791 harbor porpoises, and 1466 harbor, gray, and harp seals. There may be some localized avoidance by marine mammals of fishing vessels near the proposed seismic survey area. L-DEO's operations in the proposed survey area are also limited (duration of ~1 month), and the combination of L-DEO's operations with the existing commercial and recreational fishing operations in the region is expected to produce only a negligible increase in overall disturbance effects on marine mammals and sea turtles.

(e) Military Activity

The proposed survey is located within the U.S. Navy's Atlantic City Range Complex (ACRC). The Boston, Narragansett Bay, and Atlantic City range complexes are collectively referred to as the Northeast Range Complexes. The types of activities that could occur in the ACRC would include the use of active sonar, gunnery events with both inert and explosive rounds, bombing events with both inert and explosive bombs, and other similar events. The ACRC includes special use airspace, Warning Area W-107. The ACRC is an active area, but there is typically relatively limited activity that occurs there. There has only been limited activity in the past, and there were no conflicts during the 2014 survey. L-DEO and NSF are coordinating, and would continue to coordinate, with the U.S. Navy to ensure there would be no conflicts in 2015.

(f) Oil and Gas Activities

Oil and gas activities are managed by BOEM. If BOEM were interested in oil and gas development activities in the survey area, BOEM would need to prepare the appropriate analyses under NEPA, followed by other consultation processes under such federal statutes as the MMPA, ESA, EFH, and CZMA. The proposed survey site is outside of the BOEM Atlantic Outer Continental Shelf Proposed Geological and Geophysical (G&G) Activities in the Mid-Atlantic and South Atlantic Planning Areas (BOEM 2014). The current BOEM mid-Atlantic and South Atlantic activities would be the preliminary surveys that are necessary for BOEM and industry to determine resource potential, and to provide siting information for renewable energy and marine minerals activities; lease sales in those areas have not yet been considered. The final BOEM Record of Decision for the proposed action was issued in July 2014.

Whereas it is theoretically possible that the oil and gas industry may be interested in the architecture of the passive margin area in the survey region for application to other locations (see Appendix B, page C-15, of the 1 July 2014 Final EA), there are no known interests for G&G activities, including oil and gas exploration, in or around the proposed survey site. The proposed seismic survey is not related to nor would it lead to offshore drilling; the proposed activities would evaluate sea level change as described here and in the 2014 Final EA and there are no additional activities proposed beyond those by the PIs or NSF (i.e., there are no proposed oil and gas exploration activities associated with the proposed activities).

Seismic surveys in support of research activities have occurred in the survey area in the recent past (2002, 1998, 1995, 1990). Additionally, NJDEP conducted a seismic survey (boomer/sparker source) in 1985 off the coast of New Jersey (Waldner and Hall 1991). Oil and gas activities in the proposed survey area have not resulted from these similar research seismic surveys. Therefore, it would not be logical to assume that the proposed research seismic survey would result in oil and gas development.

Given the potential distance from any future BOEM G&G activities in the region and separation in time with the proposed activities, no cumulative effects would be anticipated.

(7) Unavoidable Impacts

Unavoidable impacts to the species of marine mammals, sea turtles, seabirds, fish, and invertebrates occurring in the proposed survey area would be limited to short-term, localized changes in behavior of individuals. For cetaceans, some of the changes in behavior may be sufficient to fall within the MMPA definition of "Level B Harassment" (behavioral disturbance; no serious injury or mortality). TTS, if it occurs, would be limited to a few individuals, would be a temporary phenomenon that does not involve injury, and would be unlikely to have long-term consequences for the few individuals involved. No long-term or significant impacts would be expected on any of these individual marine mammals, sea turtles, seabirds, fish, and invertebrates or on the populations to which they belong. Effects on recruitment or survival would be expected to be (at most) negligible.

(8) Public Involvement and Coordination with Other Agencies and Processes

For the 2014 survey, NSF posted the Draft Environmental Assessment (Draft EA) on the NSF website for a 30 day public comment period from 3 February to 3 March 3, 2014, but received no comments during the open comment period. As noted below, public comments were received during the NMFS IHA process in June 2014, and although not received as part of the NSF NEPA process, NSF considered the responses with respect to the information included in the Draft EA and refinements were made and additional information included in the Final EA. The new information included in the 2014 Final EA and in this NSF Draft Amended EA remain consistent with the conclusions in the PEIS. This Draft Amended EA will also be posted on the NSF website for a 30 day public comment period.

This Draft Amended EA was prepared by LGL on behalf of L-DEO and NSF pursuant to NEPA. Potential impacts to endangered species and critical habitat were also assessed in the document; therefore, it will be used to coordinate and support other consultations with federal agencies as required and noted below.

Endangered Species Act (ESA)

For 2014 survey activities, NSF engaged in formal consultation with NMFS and informal consultation with USFWS pursuant to Section 7 of the ESA. NSF received concurrence from USFWS that the proposed activities "may affect" but "are not likely to adversely affect" species under their jurisdiction (Appendix F of the 1 July 2014 Final EA). Mitigation measures would include power-downs/shut-downs for foraging endangered or threatened seabirds. NMFS issued a Biological Opinion and an Incidental Take Statement (Appendix C of the 1 July 2014 Final EA) on 1 July 2014 for the proposed activities and consultation was concluded. For operational purposes and coordination with monitoring and mitigation measures required under the IHA, the Exclusion Zone for sea turtles and foraging seabirds was expanded to the 177db isopleth.

NSF will consult under ESA Section 7 again with NMFS and USFWS for proposed 2015 activities.

Marine Mammal Protection Act (MMPA)

For 2014 survey activities, L-DEO submitted to NMFS an IHA pursuant to the MMPA. On 17 March 2014, NMFS issued in the Federal Register a Notice of Intent to issue an IHA for the survey and 30-day public comment period. In response to public comment request, NMFS extended the public comment period an additional 30 days, for a total of 60 days. As noted above, public comments were received as part of the IHA process (Appendix G of the 1 July 2014 Final EA) and, although not received as part of the NSF NEPA process, NSF considered the responses with respect to the information included in the Draft EA. NMFS prepared a separate EA for its federal action of issuing an IHA; NMFS's EA (Appendix E of the 1 July 2014 Final EA) is hereby incorporated by reference in this NSF Draft Amended EA as appropriate and where indicated. NMFS issued an IHA on 1 July 2014 (Appendix D of the 1 July 2014 Final EA). The IHA stipulated monitoring and mitigation measures, including additional mitigation measures beyond those proposed in the NSF Draft EA and IHA Application, such as an expanded Exclusion Zone (177-dB isopleth) and a one minute shot interval for the 40-in^3 mitigation airgun.

As required by NMFS, L-DEO will submit a new IHA application to NMFS for the proposed 2015 activities. NSF and LDEO would adhere to the IHA requirements for the proposed action.

NMFS Marine Mammal Stranding Program

Although marine mammal strandings were not anticipated as a result of the 2014 survey activities, during ESA Section 7 and MMPA consultation with NMFS it was recommended that the NMFS Greater Atlantic Regional Fisheries Office Marine Mammal Response Coordinator be contacted regarding the proposed activity. Both NMFS and NSF made contact with that coordinator. NSF and NMFS will contact the NMFS Greater Atlantic Regional Fisheries Office Marine Mammal Response Coordinator again regarding proposed 2015 activities. Should any marine mammal strandings occur during the survey, NMFS and the NMFS Greater Atlantic Regional Fisheries Office Marine Mammal Response Coordinator would be contacted. No strandings associated with seismic activities were reported during 2014 survey operations.

Magnuson Stevens Act - Essential Fish Habitat (EFH)

The Magnuson Stevens Act requires that a federal action agency consult with NMFS for actions that "may adversely affect" EFH. Although adverse effects on EFH, including a reduction in quantity or quality of EFH, were not anticipated by the 2014 survey activities, NSF contacted the EFH Regional Coordinator of the NOAA Greater Atlantic Regional Fisheries Office regarding the proposed activities. The EFH Regional Coordinator concluded in a letter dated 18 June 2014, however, that some level of adverse effects to EFH may occur as a result of the proposed activities (Appendix H of the 1 July 2014 Final EA). Additional research and monitoring to gain a better understanding of the potential effects that seismic surveys may have on EFH, federal managed species, their prey, and other NOAA trust resources was recommended for future NSF activities. No project-specific EFH conservation recommendations were provided, however, and consultation was concluded.

NSF will consult again with the Regional Coordinator of the NOAA Greater Atlantic Regional Fisheries Office regarding the proposed 2015 survey activities.

Coastal Zone Management Act (CZMA)

For the 2014 survey, per the requirements of the CZMA, NSF reviewed the New Jersey Coastal Management Program (CMP) Federal Consistency Listings and determined that the proposed activity was unlisted. NSF contacted NOAA's Office of Ocean and Coastal Resource Management (OCRM) to

discuss CZMA implications regarding the proposed project. NSF, OCRM, and the New Jersey Department of Environmental Protection (NJDEP) engaged in several conversations regarding the proposed activity. On 20 May, OCRM received by email NJDEP's request for approval to review the NSF assistance to Rutgers as an unlisted activity under Subpart F and for OCRM to concur that the operation of the vessel was subject to Subpart C (Appendix I of the 1 July 2014 Final EA). OCRM submitted a letter to NSF requesting information about the proposed project (Appendix J of the 1 July 2014 Final EA). NSF provided a response to OCRM per request, also noting NSF's position that the proposed activities were applicable to Subpart F and that the NJDEP request to review was untimely (Appendix K of the 1 July 2014 Final EA). NSF further set forth its position that the operation of the vessel was pursuant to a cooperative agreement that had been approved years ago, and, thus, the time for consistency review had passed. In response to the NJDEP request, OCRM concluded in its letter dated 18 June 2014 that the proposed project falls under Subpart F, not Subpart C, of the regulations implementing CZMA and determined that the NJDEP request to review the project under Subpart F was untimely (Appendix L of the 1 July 2014 Final EA). No further action was required by NSF or the PIs under CZMA for 2014 activities.

NSF has contacted the NJDEP and OCRM regarding CZMA obligations for proposed 2015 survey activities and will comply as appropriate.

Alternative Action: Another Time

An alternative to issuing the IHA for the period requested, and to conducting the Project then, is to issue the IHA for another time, and to conduct the project at that alternative time. The proposed dates for the cruise (~34 days in June–August) are the dates when the personnel and equipment essential to meet the overall project objectives are available; if the date of the cruise were changed, for example to late spring or early fall, it is likely that the *Langseth* would not be available and, thus, the purpose and need of the proposed activities could not be met. If the IHA is issued for another period, it could result in significant delay and disruption not only of this cruise, but also of additional studies that are planned on the *Langseth* for 2015 and beyond.

The weather in the mid-Atlantic Ocean was taken into consideration when planning the proposed activities. The mid-Atlantic Ocean off New Jersey can be challenging to operate during certain times of year, precluding the ability to safely tow seismic gear. Whereas conducting the survey at an alternative time is a viable alternative if the *Langseth*, personnel, and essential equipment are available, because of the weather conditions, it would not be viable to conduct a seismic survey in winter months off the coast of New Jersey.

Marine mammals and sea turtles are expected to be found throughout the proposed survey area and throughout the time during which the project would occur. Some marine mammal species are expected to occur in the area year-round, so altering the timing of the proposed project likely would result in no net benefits for those species. Some migratory species are expected to be farther north at the time of the survey, so the survey timing is beneficial for those species (see § III, above). In particular, migration of the North Atlantic right whale occurs mostly between November and April, and the survey is timed to avoid those months. Accordingly, the alternative action would likely result in either a failure to meet the purpose and need of the proposed activities or it would raise the risk of causing impacts to species such as the North Atlantic right whale.

No Action Alternative

An alternative to conducting the proposed activities is the "No Action" alternative, i.e. do not issue an IHA and do not conduct the operations. If the research were not conducted, the "No Action" alternative would result in no disturbance to marine mammals or sea turtles attributable to the proposed activities, however valuable data about the marine environment would be lost. Research that would contribute to the understanding of the response of nearshore environments to changes in elevation of global sea level would be lost and greater understanding of Earth processes would not be gained. The "No Action" alternative could also, in some circumstances, result in significant delay of other studies that would be planned on the *Langseth* for 2015 and beyond, depending on the timing of the decision. Not conducting this cruise (no action) would result in less data and support for the academic institutions involved. Data collection would be an essential first step for a much greater effort to analyze and report information for the significant topics indicated. The field effort would provide material for years of analyses involving multiple professors, students, and technicians. The lost opportunity to collect valuable scientific information would be compounded by lost opportunities for support of research infrastructure, training, and professional career growth. The research goals and objectives cannot be achieved using existing scientific data. Existing seismic profiles occur at intervals too coarse to achieve the proposed scientific goals of this project. Both the larger spacing and the limitations inherent in processing 2-D seismic data preclude identification of key features of the past margin such as river or delta channels and shoreline adjustments. Only dense and 3-D seismic acquisition and processing can provide continuity of imaging to enable confident identification of these features, whose distributions are expected to evolve throughout the time period recorded in the sediments targeted. The no Action Alternative would not meet the purpose and need for the proposed activities.

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APPENDIX A:

ACOUSTIC MODELING OF SEISMIC ACOUSTIC SOURCES AND SCALING FACTORS FOR SHALLOW WATER[4]

For the proposed survey off New Jersey, a smaller energy source than the full airgun array available on the R/V *Langseth* would be sufficient to collect the desired geophysical data. Previously conducted calibration studies of the *Langseth*'s airgun arrays, however, can still inform the modeling process used to develop mitigation radii for the currently proposed survey.

Acoustic Source Description

This 3-D seismic data acquisition project would use two airgun subarrays that would be fired alternately as the ship progresses along track (one subarray would be towed on the port side and the other on the starboard side). Each airgun subarray would consist of four airguns (total volume 700 in^3). The subarrays would use subsets of the linear arrays or "strings" composed of Bolt 1500LL and Bolt 1900LLX airguns that are carried by the R/V *Langseth* (Figure A1): four airguns in one string would be fired simultaneously, and the other six airguns on the string would be inactive. The subarray tow depth would be either 4.5 m (desired tow depth) or 6 m (in case of weather degradation). The subarray would be fired roughly every 5.4 s. At each shot, a brief (~0.1 s) pulse of sound would be emitted, with silence in the intervening periods. This signal attenuates as it moves away from the source, decreasing in amplitude and increasing in signal duration.

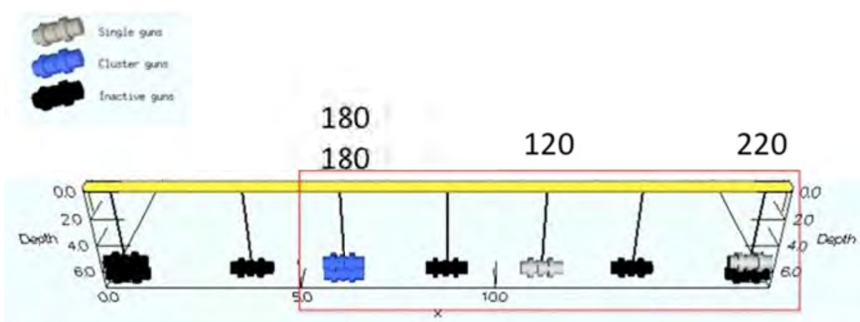

FIGURE A1. Four-airgun subset of one string that would be used as a 700-in^3 subarray for the proposed survey (individual volumes are indicated).

Four-Airgun Subarray Specifications

Energy Source	1950-psi Bolt airguns with volumes 120–220 in^3, arranged in one string of four operating airguns
Towing depth of energy source	4.5 m or 6 m
Source output (downward), 4.5 m	0-pk is 240.4 dB re 1 μPa · m; pk-pk is 246.3 dB re 1 μPa · m
Source output (downward), 6 m	0-pk is 240.4 dB re 1 μPa · m; pk-pk is 246.7 dB re 1 μPa · m
Air discharge volume	~700 in^3
Dominant frequency components	0–188 Hz

Because the actual source originates from 4 airguns rather than a single point source, the highest sound levels measurable at any location in the water is less than the nominal source level. In addition, the

[4] Helene Carton, Ph.D., L-DEO.

effective source level for sound propagating in near-horizontal directions would be substantially lower than the nominal source level applicable to downward propagation because of the directional nature of the sound from the airgun array.

Modeling and Scaling Factors

Propagation measurements were obtained in shallow water for the *Langseth*'s 18-gun, 3300-in^3 (2-string) array towed at 6 m depth, in both crossline (athwartship) and inline (fore and aft) directions. Results were presented in Diebold et al. (2010), and part of their Figures 5 and 8 are reproduced here (Figure A2). The crossline measurements, which were obtained at ranges ~2 km to ~14.5 km, are shown along with the 95th percentile fit (Figure A1, top panel). This allows extrapolation for ranges <2 km and >14.5 km, providing 150 dB SEL, 170 dB SEL and 180 dB SEL distances of 15.28 km, 1097 m, and 294 m, respectively. Note that the short ranges were better sampled in inline direction including by the 6-km long MCS streamer (Figure A2, bottom panel). The measured 170-dB SEL level is at 370-m distance in inline direction, well under the extrapolated value of 1097 m in crossline direction, and the measured 180-dB SEL level is at 140-m distance in inline direction, also less than the extrapolated value of 294 m in crossline direction. Overall, received levels are ~5 dB lower inline than they are crossline, which results from the directivity of the array (the 2-string array being spatially more extended in fore and aft than athwartship directions). Mitigation radii based on the crossline measurements are thus the more conservative ones and are therefore proposed to be used as the basis for the mitigation zone for the proposed activity.

The empirically derived crossline measurements obtained for the 18-gun, 3300-in^3 array in shallow water in the Gulf of Mexico, described above, are used to derive the mitigation radii for the proposed New Jersey margin 3-D survey that would take place in June–August 2015 (Figure A3). The entire survey area would be located in shallow water (<100 m). The source for this survey would be a 4-gun, 700-in^3 subset of 1 string at 4.5- or 6-m tow depth. The differences in array volumes, airgun configuration and tow depth are accounted for by scaling factors calculated based on the deep-water L-DEO model results (shown in Figures A4 to A6).

The scaling procedure uses radii obtained from L-DEO models. Specifically, from L-DEO modeling, 150-, 170-, and 180-dB SEL isopleths for the 18-gun, 3300-in^3 array towed at 6-m depth have radii of 4500, 450, and 142 m, respectively, in deep water (Figure A3). Similarly, the 150-, 170-, and 180-dB SEL isopleths for the 4-gun, 700-in^3 subset of 2 strings array towed at 4.5 m depth have radii of 1544, 155, and 49 m, respectively, in deep water (Figure A4). Taking the ratios between both sets of deep-water radii yields scaling factors of 0.3431–0.3451. These scaling factors are then applied to the empirically derived shallow water radii for the 3300-in^3 array at 6-m tow depth, to derive radii for the suite of proposed airgun subsets. For example, when applying the scaling ratios for the 4-gun, 700-in^3 array at 4.5-m tow depth, the distances obtained are 5.24 km for 150 dB SEL (proxy for SPL 160 dB rms), 378 m for 170 dB SEL (SPL 180 dB rms), and 101 m for 180 dB SEL (SPL 190 dB rms).

The same procedure is applied for the suite of arrays:

(1) 4-gun 700 in^3 array, subset of 1 string at 4.5 m tow depth (Figure A4)

(2) 4-gun 700 in^3 array, subset of 1 string at 6 m tow depth (Figure A5)

(3) Single 40 in^3 mitigation gun at 6 m tow depth (Figure A6)

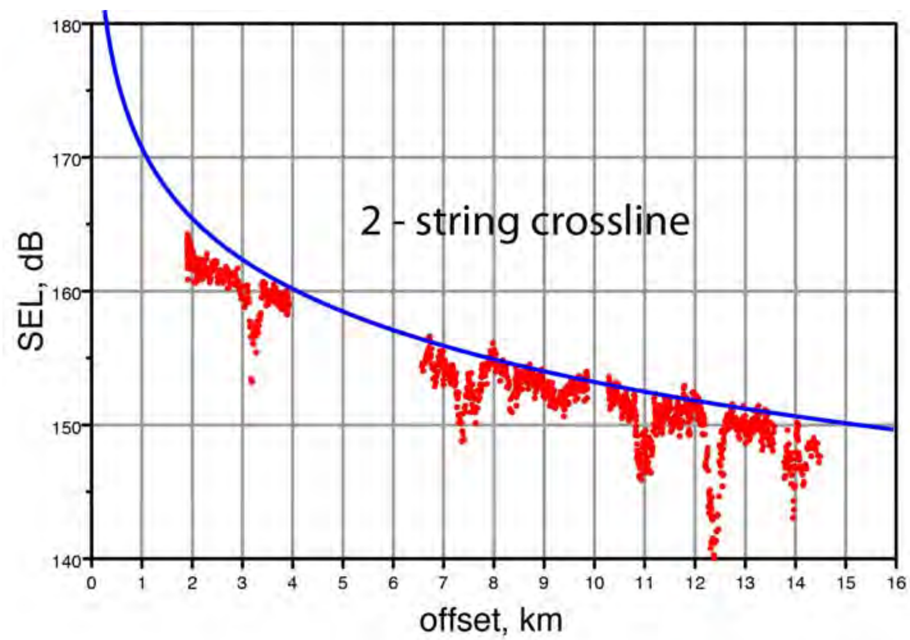

Figure 5a. Sound Exposure Levels for the crossline (side aspect) arrivals recorded along the spiral track at the shallow water calibration site, with a 95th percentile fit (using the methods described by Tolstoy et al., 2009).

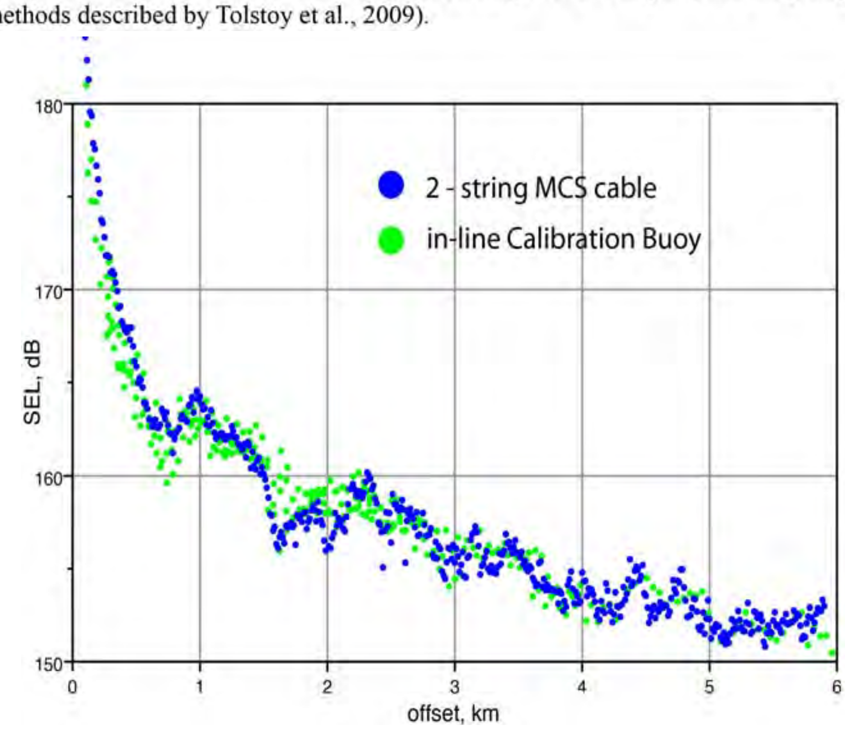

FIGURE A2. R/V *Langseth* Gulf of Mexico calibration results for the 18-gun, 3300-in^3, 2-string array at 6-m depth obtained at the shallow site (Diebold et al. 2010).

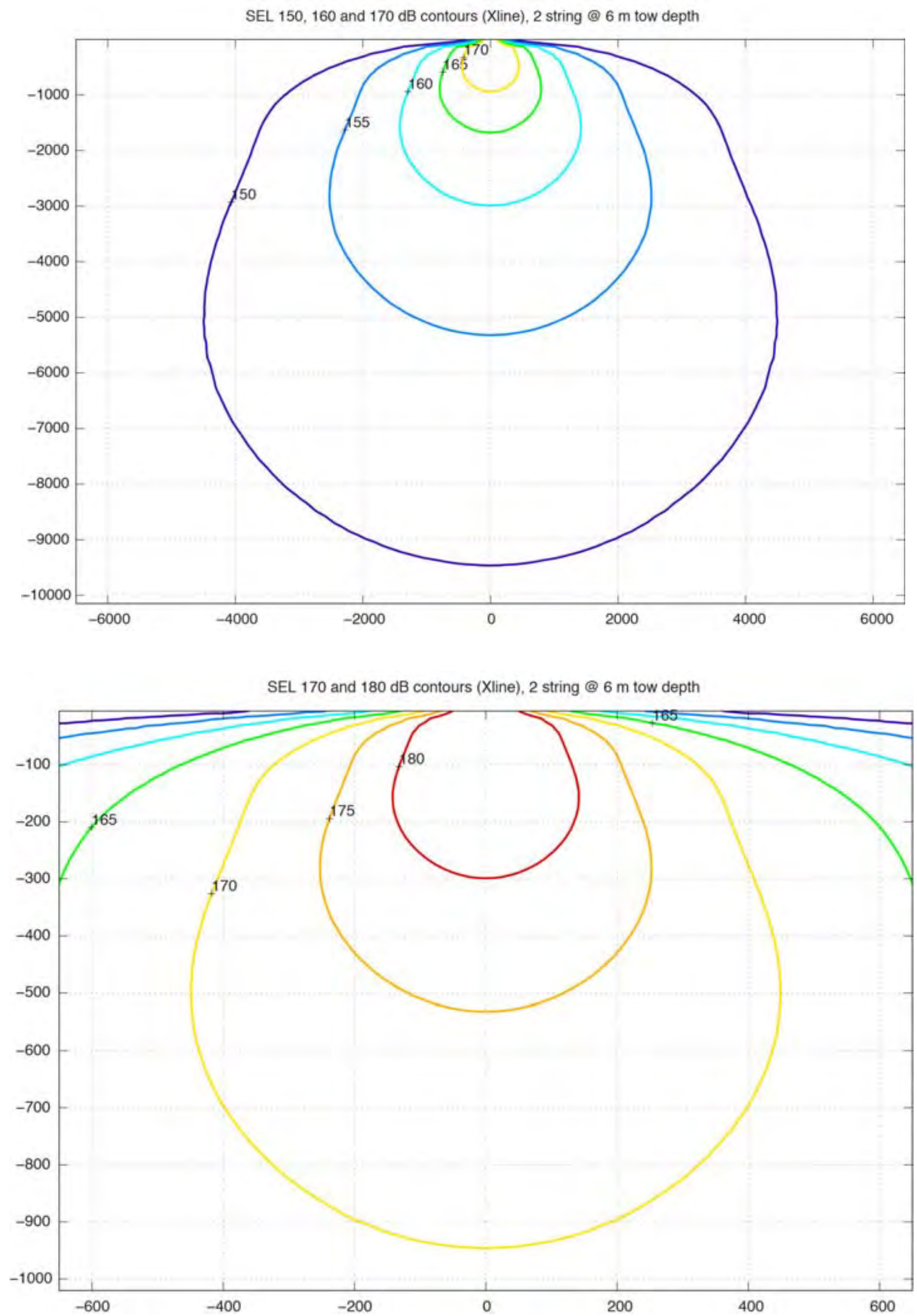

FIGURE A3. Deep-water model results for the 18-gun, 3300-in^3, 2-string array at 6-m tow depth, the configuration that was used to collect calibration measurements presented in Figure 2. The 150-dB SEL, 170-dB SEL, and 180-dB SEL (proxies for SPLs of 160, 180, and 190 dB rms[5]) distances can be read at 4500 m, 450 m, and 142 m.

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[5] Sound sources are primarily described in sound pressure level (SPL) units. SPL is often referred to as rms or "root mean square" pressure, averaged over the pulse duration. Sound exposure level (SEL) is a measure of the received energy in a pulse and represents the SPL that would be measured if the pulse energy were spread evenly across a 1-s period.

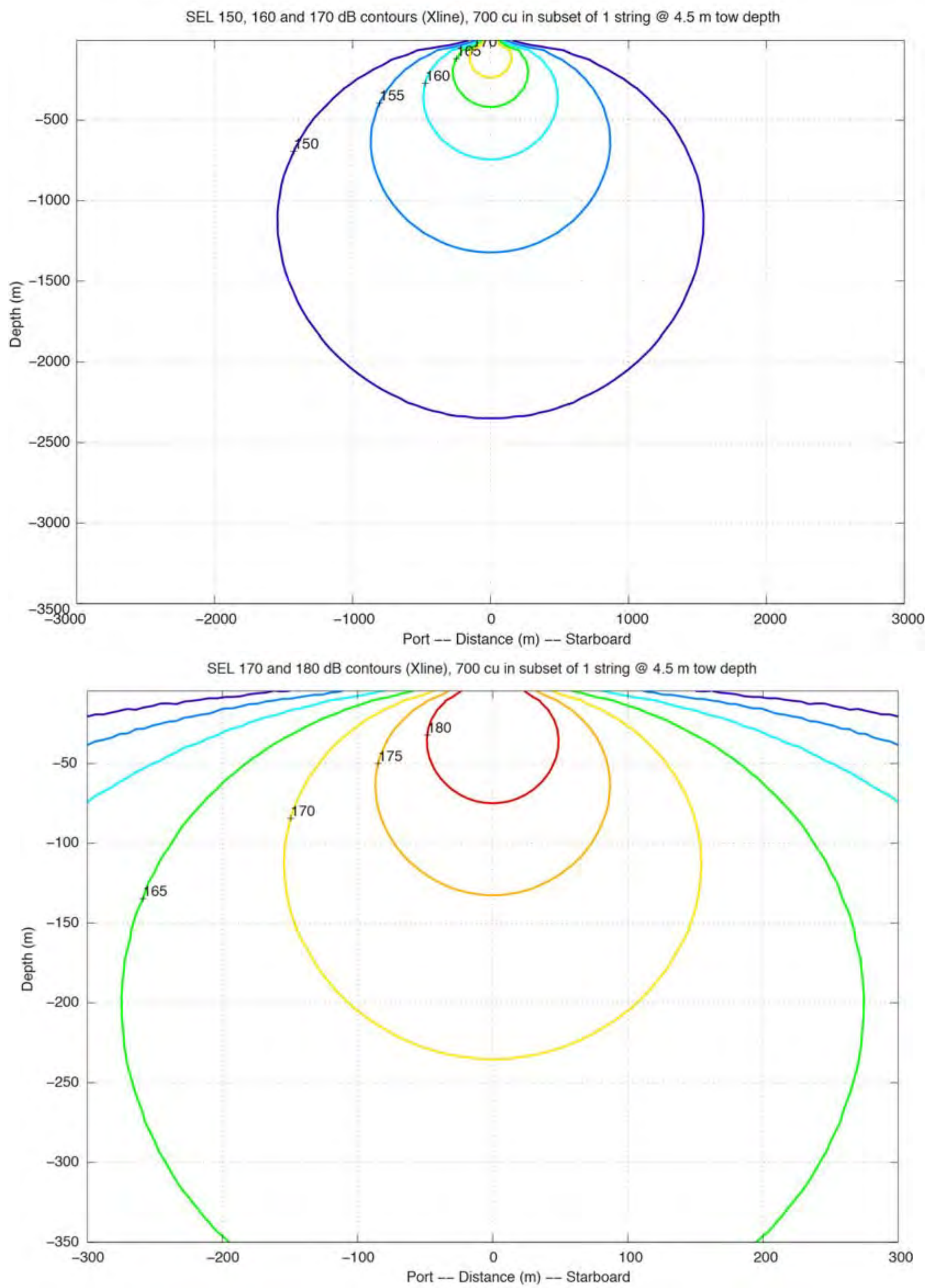

FIGURE A4. Deep-water model results for the 4-gun, 700-in^3 subset of 1-string array at 4.5-m tow depth that could be used for the NJ margin 3D survey. The 150-dB SEL, 170-dB SEL, and 180-dB SEL distances can be read at 1544 m, 155 m, and 49 m, respectively.

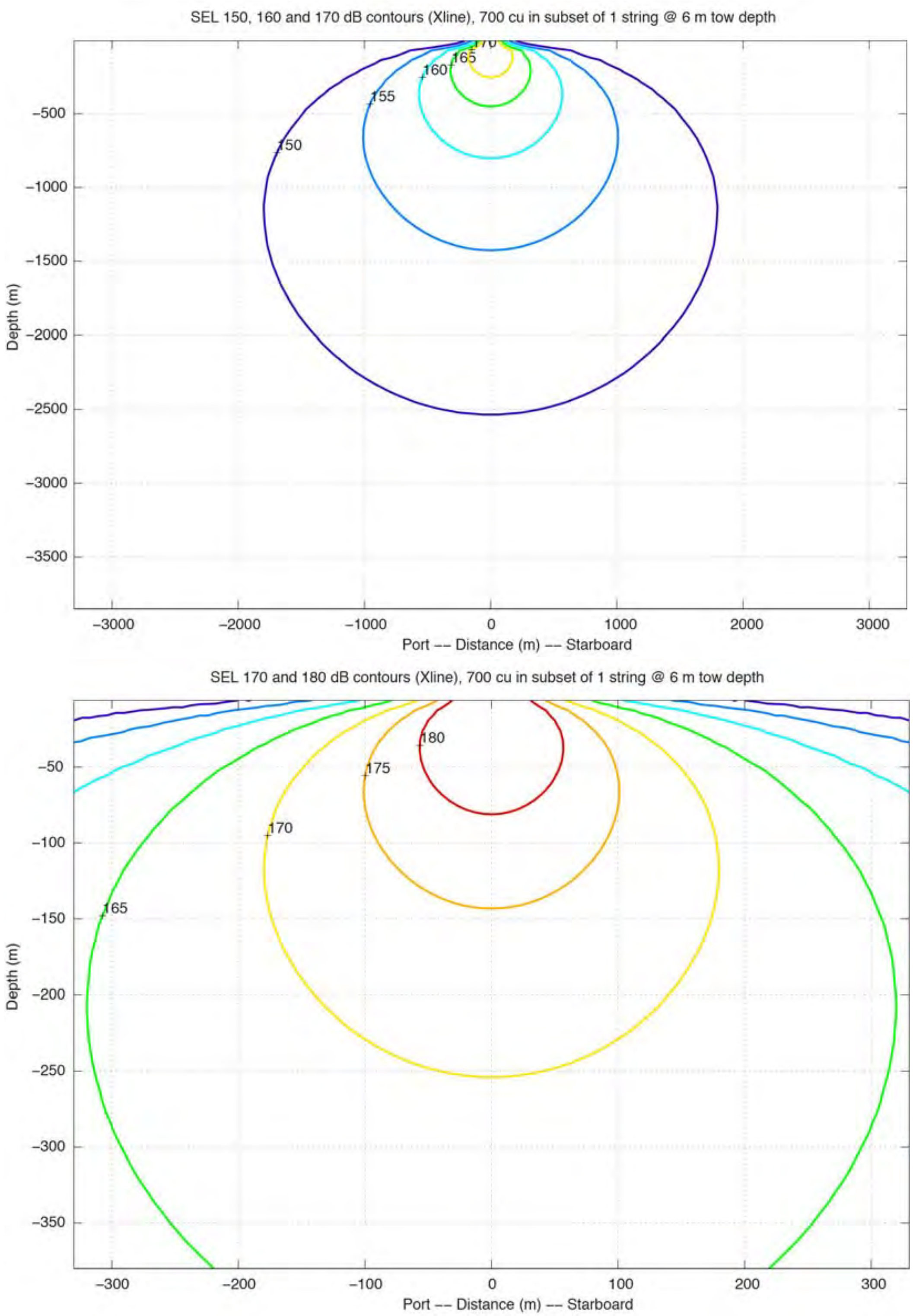

FIGURE A5. Deep-water model results for the 4-gun, 700-in^3 subset of 1-string array at 6m tow depth that could be used for the NJ margin 3-D survey. The 150-dB SEL, 170-dB SEL, and 180-dB SEL distances can be read at 1797 m, 180 m, and 57 m, respectively.

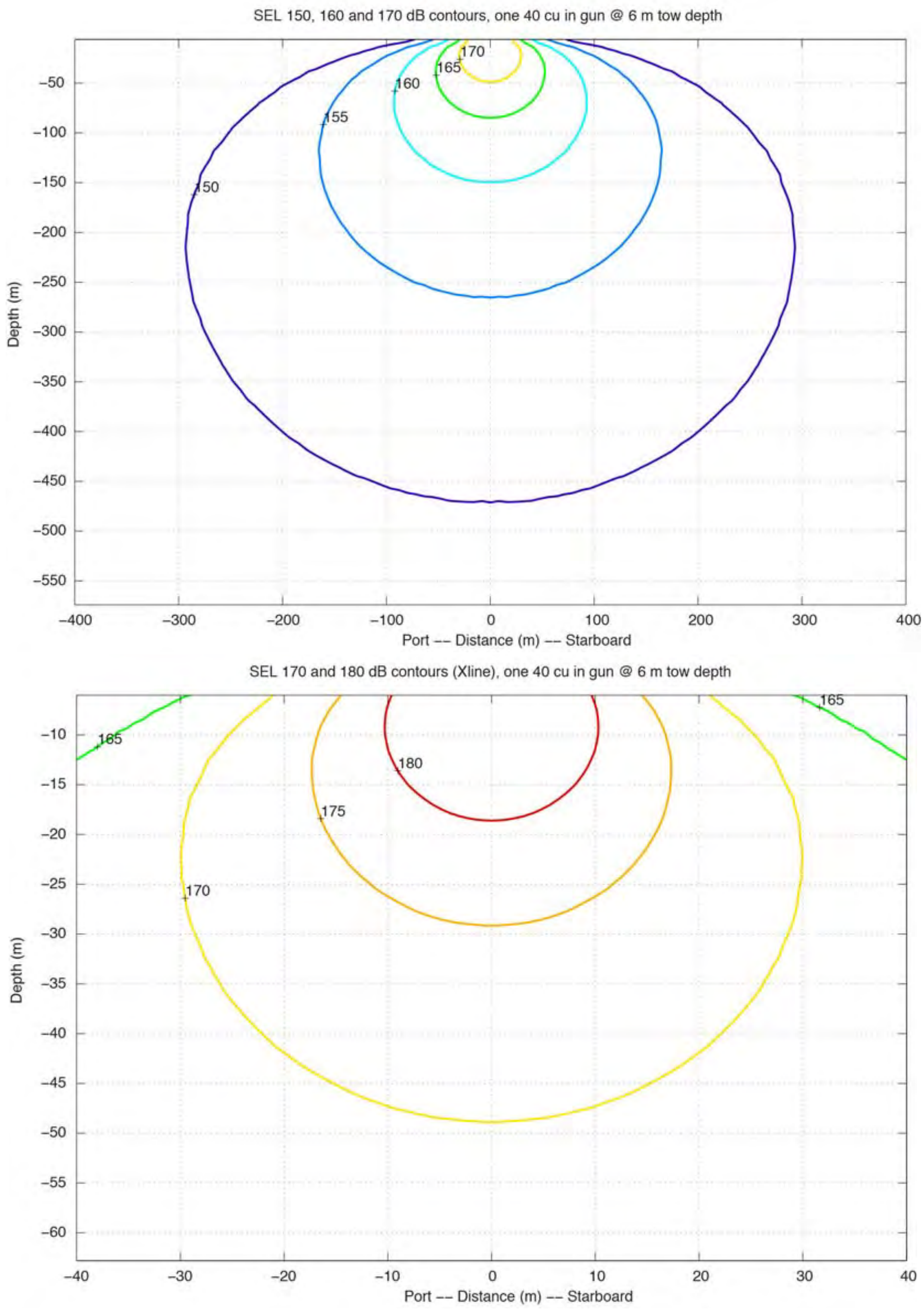

FIGURE A6. Deep-water model results for the single 40-in^3 Bolt airgun at 6-m tow depth. The 150-dB SEL, 170-dB SEL, and 180-dB SEL distances can be read at 293 m, 30 m, and 10 m, respectively.

The derived shallow water radii are presented in Table A1. The final values are reported in Table A2.

TABLE A1. Table summarizing scaling procedure applied to empirically derived shallow-water radii to derive shallow-water radii for various array subsets that could be used during the New Jersey margin 3D survey.

Calibration Study: 18-gun, 3300-in^3 @ 6-m depth	**Deep water radii (m)** (from L-DEO model results)			**Shallow Water Radii (m)** (Based on empirically-derived crossline Measurements)
	150 dB SEL:	4500		15280
	170 dB SEL:	450		1097
	180 dB SEL:	142		294
Proposed Airgun sources	**Deep water radii** (from L-DEO model results)		**Scaling factor** *[Deep-water radii for 18-gun 3300-in^3 array @ 6 m depth]*	**Shallow water radii (m)** *[Scaling factor **x** shallow water radii for 18-gun 3300 in^3 array @ 6 m depth]*
Source #1: 4-gun, 700-in^3 @ 4.5-m depth	150 dB SEL:	1544 m	0.3431	5240
	170 dB SEL:	155 m	0.3444	378
	180 dB SEL:	49 m	0.3451	101
Source #2: 4-gun, 700-in^3 @ 6-m depth	150 dB SEL:	1797 m	0.3993	6100
	170 dB SEL:	180 m	0.4000	439
	180 dB SEL:	57 m	0.4014	118
Source #3: Single 40-in^3 @ 6-m depth	150 dB SEL:	293 m	0.0651	995
	170 dB SEL:	30 m	0.0667	73
	180 dB SEL:	10 m	0.0704	21

TABLE A2. Predicted distances in meters to which sound levels ≥ 180 and 160 dB re 1 μPa$_{rms}$ would be received during the proposed 3-D survey off New Jersey, using a 4-gun, 700-in^3 subset of 1 string at 4.5- or 6-m tow depth and the 40-in^3 airgun during power-downs. Radii are based on Figures A2 to A6 and scaling described in the text and Table A1, assuming that received levels on an rms basis are, numerically, 10 dB higher than the SEL values.

		Predicted RMS Radii (m)	
Source and Volume	Water Depth	180 dB	160 dB
4-airgun subarray (700 in^3) @ 4.5 m	<100 m	378	5240
4-airgun subarray (700 in^3) @ 6 m	<100 m	439	6100
Single Bolt airgun (40 in^3) @ 6 m	<100 m	73	995

CD

State of New Jersey

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Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

February 11, 2015

Holly Smith
National Science Foundation
4201 Wilson Boulevard, Room 725
Arlington, VA 22230

RE: Federal Consistency Determination for Marine Geophysical Survey by the R/V *Marcus G. Langseth* in Atlantic Ocean off New Jersey, Summer 2015
DLUR File No. 0000-14-0030.1 CDT 150001

Dear Ms. Smith:

Pursuant to section 15 CFR 930.41 of the Federal Consistency Regulations, this office hereby requests that the review period to determine consistency with the New Jersey Coastal Management Program-Bay and Ocean Shore Segment for the above project, be extended 15 days, to March 6, 2015, in order for the Department to complete its review.

If you have any questions regarding the above please contact me in writing at the above address or by phone at (609) 633-2289.

Sincerely,

Jessica Cobb

Jessica Cobb, Environmental Specialist 3
Bureau of Coastal Regulation
Division of Land Use Regulation

NATIONAL SCIENCE FOUNDATION
4201 WILSON BOULEVARD
ARLINGTON, VIRGINIA 22230

February 24, 2015

Jessica Cobb
State of New Jersey
Department of Environmental Protection
Division of Land Use Regulation
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Mail Code 5010-02A
P.O. Box 420
Trenton, NJ 08625-0420

RE: Federal Consistency Determination for Marine Geophysical Survey by the R/V Marcus G. Langseth in Atlantic Ocean off New Jersey, Summer 2015
DLUR File No. 0000-14-0030.1 CDT 150001

Dear Ms. Cobb:

The National Science Foundation (NSF) is in receipt of a letter from the New Jersey Department of Environmental Protections (NJDEP) requesting a 15 day extension pursuant to 15 C.F.R. 930.41(b) of the Coastal Zone Management Act. The letter, which was dated February 11, 2015, was mailed via U.S postal service and postmarked February 12, 2015. Although the NJDEP identified in a previous letter submitted via email to NSF on February 9, 2015, that a final determination on NSF's Consistency Determination, or request to extend, would be provided to NSF by February 19, 2015, the letter requesting an extension was not received by NSF until February 20, 2015, and did not reach my office until February 23, 2015. To facilitate timely communication between our offices in the future, we would greatly appreciate receiving copies of all correspondence by email, regardless of whether a hard copy is also mailed via U.S. mail; NSF will, of course, extend the same courtesy to NJDEP.

NSF acknowledges that the state wishes the additional 15 days to complete its review of the proposed project that was originally scheduled to be completed during the summer of 2014. Based on your letter, we understand that your office intends to respond to NSF's Consistency Determination by March 6, 2015. NSF welcomes, however, earlier notification so that our offices can maximize the time available within the 90 day notice period to resolve any potential differences. Finally, as NSF has noted since October 2014, we are open to a dialogue about the proposed project with NJDEP and encourage your office to contact us if you have any questions regarding the Consistency Determination.

Thank you for your assistance on this matter and we look forward to receiving NJDEP's response.

Sincerely,

Holly Smith
Environmental Compliance Officer

cc:
Virginia KopKash, NJDEP
Elizabeth Semple, NJDEP
John Gray, NJDEP
Megan Brunatti, NJDEP
Kerry Kehoe, National Oceanic Atmospheric Administration Office of Ocean and Coastal Resource Management

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RE: Federal Consistency Determination for Marine Geophysical Survey by the R/V *Marcus G. Langseth* in Atlantic Ocean off New Jersey, Summer 2015 - Inconsistent
DLUR File No. 0000-14-0030.1 CDT 150001

Dear Ms. Smith:

The New Jersey Department of Environmental Protection (Department) Division of Land Use Regulation (Division), acting pursuant to Section 307 of the Federal Coastal Zone Management Act (CZMA) of 1972 (P.L. 92-583) as amended, finds the above referenced request to be inconsistent with enforceable policies of the New Jersey Coastal Management Program (NJCMP).

Project Description

The National Science Foundation (NSF) is funding a research project proposed by lead Principle Investigator Dr. Gregory Mountain of Rutgers University and collaborators Drs. J. Austin, C. Fulthorpe, and M. Nedimovic of University of Texas Austin to study sea level rise in the Atlantic Ocean off of the coast of New Jersey, which includes a marine geophysical survey. The project includes the use of a 3-D seismic reflection survey to map sequences around existing drill sites and analyze their spatial/temporal evolution. Objectives include establishing the impact of known Ice House base-level changes on the stratigraphic record; providing greater understanding of the response of nearshore environments to changes in elevation of global sea-level; and determining amplitudes and timing of global sea-level changes during the mid-Cenozoic era.

Administrative History

On March 17, 2014, the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NFMS) published a Federal Register Notice (79 FR 14779, March 17, 2014) announcing the proposed issuance of an Incidental Harassment Authorization to the Lamont Doherty Earth Observatory in collaboration with NSF to take marine mammals by harassment incidental to conducting a marine geophysical (seismic) survey in the northwest Atlantic Ocean from May through August 2014.

On April 22, 2014, a conference call was held between NJCMP, NOAA's Office of Ocean and Coastal Resource Management (OCRM) and NSF staff to discuss the proposed activity. During that conference call, it was determined that Rutgers University will be the recipient of the NSF funding as the Principal Investigator for the scientific research related to the surveys that require the proposed incidental harassment authorization.

On May 7, 2014 another conference call was held between NJCMP, OCRM, and NSF to discuss alternate arrangements to assuage the NJCMP's concerns over potential impacts to New Jersey's resources. On this call, OCRM also provided NJCMP with the details necessary for the Department to appropriately request NSF submit a Consistency Determination request to the Department. While the conference call was beneficial to lay the foundation for an alternative resolution to this matter, the NJCMP made clear that the State of New Jersey would pursue this request since a final resolution was not agreed upon and the NJCMP is required to timely submit this request.

On May 16, 2014 the Department notified OCRM, NSF, and Rutgers University of the Department's intent to review the project for consistency with the enforceable policies of the NJCMP. The Department contended that the project would have both direct and indirect reasonably foreseeable effects on the uses and resources of New Jersey's coastal zone relating to commercial fishing, recreational fishing and boating; marine fish, sea turtles and marine mammals; shipwrecks and historical and archeological resources.

On June 18, 2014, the Department was advised of OCRM's concurrence that the project is considered federally funded assistance to a state entity and is therefore, subject to Subpart F requirements of the CZMA Federal Consistency regulations. However, OCRM ultimately denied the Department's review request due to untimeliness and OCRM did not address the Department's analysis of the project's reasonably foreseeable effects.

On June 25, 2014 the Department provided OCRM with information demonstrating that the request was timely and requested a reconsideration of the denial decision.

On July 1, 2014 the project commenced.

On July 3, 2014, the Department filed a complaint in federal District Court seeking injunctive and declaratory relief. On July 10, 2014 the District CourtCourt denied the Department's complaint, but issued a temporary injunction to afford the Department an opportunity to appeal.. The Department subsequently filed an appeal to U.S. Court of Appeals for the Third Circuit (Third Circuit). On July 14 2014, the Third Circuit denied the Department's appeal. On August 12,12, 2014 the matter was dismissed from District Court without prejudice.

In August 2014, the project was ultimately cancelled due to mechanical issues with the survey vessel, R/V *Marcus G. Langseth.*

On December 22, 2014, the Division received NSF's request for consistency concurrence for a similar project during the period of June to August 2015. The request included a report entitled,

"Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015" prepared for Lamont-Doherty Earth Observatory and the National Science Foundation's Division of Ocean Sciences, prepared by LGL Ltd., environmental research associates, and dated December 18, 2014 (Amended EA). Pursuant to 15 CFR Section 930.41, the Division has 60 days to provide a determination and may request an extension period of 15 days or less.

On February 11, 2015 the Department issued a 15 day extension request extending the Department's decision deadline to March 6, 2015.

Analysis

The following analysis is based on New Jersey's Rules on Coastal Zone Management, N.J.A.C. 7:7E-1.1 et seq., as amended July 15, 2013. The Department relied on the study's Programmatic Environmental Impact Statement, dated June 2011 (PEIS), site-specific draft Environmental Assessment dated, December 2013 (EA), and the Amended EA. The Department also considered numerous and significant comments received as part of the Department's public comment period for this determination.

For purposes of CZMA review, the Department must determine whether an activity will affect a coastal use or resource. This Department's analysis is embodied in Department published guidance.[1] Coastal effects are defined under National Oceanic and Atmospheric Administration (NOAA) regulations as any reasonably foreseeable effect on any coastal use or resource resulting from a Federal agency activity, Federal license, or permit activity. Effects are not just environmental effects, but also include effects on coastal uses. Effects include both direct effects, which result from the activity and occur at the same time and place as the activity, and indirect (cumulative and secondary) effects that result from the activity and are later in time or farther removed in distance, but are still reasonably foreseeable. The Department's foreseeability test applies to activities and uses or resources that occur outside a State's coastal zone, so long as the uses or resources impacted are uses or resources of a State's coastal zone.

The Department relied on the study's Programmatic Environmental Impact Statement, dated June 2011 (PEIS), sitespecific draft Environmental Assessment dated, December 2013 (EA), and the draft Amended EA,dated December 2014(Amended EA). The Department also considered numerous and significant comments received as part of the Department's public comment period for this determination.

In evaluating this project, the Department also looked to other sources to define "foreseeability." Black's Law Dictionary (5th Ed.) defines foreseeability as "the reasonable anticipation that harm or injury is a likely result of acts or omissions." Thus, the test is whether the impact is reasonably related to the activity, not whether an impact is more likely than not to occur.

[1] Federal Consistency in New Jersey, dated September 8, 2010. *Available at* http://www.state.nj.us/dep/cmp/fc_guidance.pdf

N.J.A.C. 7:7E-3.4 Prime Fishing AreasAreas

Both the project location and the timeframe will foreseeably adversely affect New Jersey's prime fishing areas. The project area will see high commercial and recreational activity off the coast of New Jersey during the study period.. The project's timeframe coincides with a period of high to peak population abundance of several commercially and recreationally important fish species at identified prime fishing areas.

Prime fishing areas include tidal water areas and water's edge areas, which have a demonstrable history of supporting a significant local intensity of recreational or commercial fishing activity. These areas include all coastal jetties, groins, public fishing piers or docks, and artificial reefs. Prime fishing areas also include features such as rock outcroppings, sand ridges or lumps, rough bottoms, aggregates such as cobblestones, coral, shell and tubeworms, slough areas and offshore canyons. Prime fishing areas also include areas identified in "New Jersey's Recreational and Commercial Fishing Grounds of Raritan Bay, Sandy Hook Bay and Delaware Bay and The Shellfish Resources of Raritan Bay and Sandy Hook Bay," Figley and McCloy (1988), and those areas identified on the map titled, "New Jersey's Specific Sport Ocean Fishing Grounds."

The project is located off the coast of New Jersey, ingextending from Barnegat Ridge to the 35 fathom line, and runs in a northwest to southeast direction intersecting fathom curves at a general perpendicular nature along its extent. This location is offshore from some of New Jersey's most important fishing ports, including: Barnegat Light, Atlantic City, and Point Pleasant. Pursuant to the aforementioned "New Jersey's Specific Sport Ocean Fishing Grounds" map, a portion of the proposed survey area is a State-recognized productive and historical fishing area known as "The Fingers." Contrary to the portrayal in the Amended EA, areas beyond State waters areheavily utilized by New Jersey's commercial and recreational fishing industry. It should also be noted that according to National Marine Fisheries Service data, New Jersey's commercial and recreation fisheries are some of the most productive, highest grossing and employ more people than other states in the Mid-Atlantic and along the Atlantic Coast. Lastly, there is at least one known shipwreck, *Lillian,* within the project area that is popular with scuba diving and spearfishing enthusiasts.

Data analysis of commercial and recreational landings from 1996 to 2013 indicate that this entire area is not only used by multiple commercial fisheries including gillnetters, otter trawl vessels, scallop boats, and long liners, but is also heavily utilized by recreational fishermen. In combination, both commercial and recreational sectors pursue over 35 species of fish in this area including but not limited to: albacore, bluefish, big eye tuna, Bluefin tuna, bonita, black sea bass, butter fish, cobia, cod, smooth dogfish, spiny dogfish, summer flounder, Atlantic menhaden, monkfish, red hake, skate, tilefish, swordfish, yellow fin tuna, and skipjack tuna.

Offshore waters also serve as essential habitat for invertebrate species during various stages of their lifecycles. Studies have provided "evidence that noise exposure during larval development produces body malformations in marine invertebrates. Scallop larvae exposed to playbacks of seismic pulses showed significant developmental delays and 46% developed body abnormalities. Similar effects were observed in all independent samples exposed to noise while no

malformations were found in the control groups."[2] A reduction in harvestable stock would result in further impacts to New Jersey's commercial fisheries.

While seismic surveys are not expressly prohibited pursuant to the N.J.A.C. 7:7E-3.4(b)2, based on studies examining seismic survey impacts, it is reasonably foreseeable that the project would affect fishery distribution, movement, migration and spawning at identified prime fishing areas. This also foreseeably results in adverse impacts to the high productivity of New Jersey's commercial and recreational fishing industry. In conclusion, the project is found to be inconsistent with prime fishing areas rule, N.J.A.C. 7:7E-3.4, due to the foreseeable effect on utilization of prime fishing areas.

N.J.A.C. 7:7E-8.2 Marine Fish and Fisheries

Both the project location and the timeframe will foreseeably affect New Jersey's fisheries. The project area and timeframe sees consistently high commercial and recreational activity based out of New Jersey. The Department finds the study inconsistent with the NJCMP for the following reasons: research indicates adverse impacts to fisheries are likely and New Jersey's rules discourage activities that adversely impact the natural functioning of marine fish; NSF's failure to minimize or mitigate for adverse impacts to a commercially important fishery, which is inconsistent with NSF's own guidance; National Marine Fisheries Service (NMFS) findings and guidance; and the significant concerns raised by the Department's stakeholders, including members of New Jersey's commercial and recreational fishing industry.

Numerous studies identify responses of fish to high energy sound. Studies have shown that noise produced from this activity can cause physical impacts such as short and long term damage to the ears of fish and in some cases, mortality. Research has also documented behavioral impacts that show a clear change in "normal" activity and an increase in "alarm" response behavior that results in changes to schooling behavior, swimming speeds, water column location and sound avoidance. Studies have also demonstrated declining catch rates for a number of commercial fisheries during seismic testing activities. For example, Arill Engas, et al., found that catch rates fell within the seismic shooting region and surrounding areas immediately after shooting started and continued after shooting ended.[3] More recently, Svein Løkkeborg, et al., highlighted that "reduced catches on fishing grounds exposed to seismic survey activities have been demonstrated."[4] The conclusions reached by the Løkkeborg study are further supported by other recent studies concluding that catch rates reduced in the presence of seismic studies.[5] Based on this information, it is reasonably foreseeable that the project will adversely impact New Jersey's marine fish and fisheries resources.

[2] de Soto, N.; Delorme, N.; Atkins, J.; Howard, S.; Williams, J. & Johnson, M. 2013. Anthropogenic noise causes body malformations and delays development in marine larvae. Scientific Reports. 3. Article No. 2831.

[3] A. Engas, S. Lokkeborg, E. Ona and A.V. Soldad, 1996. Effects of Seismic Shooting on Local Abundance and Catch Rates of Cod (Gadus morhua) and Haddock (Melanogrammus aeglefinus). Can. J. Aquat. Sci. 53: 2238-2249.

[4] Løkkeborg, S.; Ona, E.; Vold, A.; & Salthaug, A., 2012. Effects of Sounds from Seismic Air Guns on Fish Behavior and Catch Rates. Advances in Experimental Medicine and Biology, 730, 415-419.

[5] Fewtrell, J.L. & McCauley R.D., 2012, Impact of Air Gun Noise on Behavior of Marine Fish and Squid. Marine Pollution Bulletin, 64, 984-993.

Department rules define marine fisheries as one or more stocks of marine fish that can be treated as a unit for the purposes of conservation and management, and which are identified on the basis of geographical, scientific, technical, recreational and economic characteristics. Any activity that would adversely impact the natural functioning of marine fish, including the reproductive, spawning and migratory patterns or species abundance or diversity of marine fish, is discouraged.[6] In addition, any activity that would adversely impact any New Jersey based marine fisheries or access thereto is discouraged. Based on the above cited research and lack of appropriate mitigation and threat reduction strategies, the Department concludes that any benefits for the study's research are outweighed by the risk posed to New Jersey's coastal resources.

The time of year and project duration (30 consecutive days) are considered significant negative factors that may adversely affect normal fisheries movement, migration and availability. The project's timeframe is a period of high to peak population abundance of several commercially and recreationally important fish species and commercial and recreational activity off the coast of New Jersey. These impacts could lead to direct and indirect consequences to New Jersey's important commercial and recreational fishing industries. The results of a harvest analysis from May through August 2013 showed that 20% of the commercial black sea bass harvest and 22% of the commercial summer flounder harvest occurred within an area that includes the study area. This represents $250,000 worth of black sea bass and $1,360,000 of potential loss of summer flounder. This period generates 21% of commercial harvest revenue for New Jersey fishermen and represents 60% to 100% of the entire recreational season for the species listed above. Generally during any given year from May through August, 67% of the annual black sea bass and 89% of summer flounder are recreationally harvested. Local businesses including restaurants, hotels, bait and tackle shops, and other coastal related trades are dependent on this time period for generating income.

The NSF established guidance for surveys occurring in areas with commercially important fisheries. The PEIS states that "pre-survey planning *would be conducted*...to minimize adverse impacts to the associated populations."[7] From March 2014 to March 2015, the Department and many other stakeholders, including members of the commercial and recreational fishing industries, made known that the study area and period coincide with commercially important fisheries. Yet, the Amended EA offers no plan, and simply reasserts that impacts are unlikely, or at most temporary. Under the terms of NSF's own guidance, the NSF is obligated to work with the Department and other stakeholders to minimize harms when commercially important fisheries are present. The Department has repeatedly raised concerns that NSF's tack of refuting the likelihood of harm is inconsistent with NSF's own guidance that instructs NSF to work collaboratively with stakeholders on the study's scope and mitigation strategies when commercially important fisheries are present. Since commercially important fisheries are present during the proposed study period and area, and the NSF has failed to provide any appropriate mitigation or risk reduction strategies in a pre-survey plan, the Department finds the study poses a foreseeable impact to New Jersey's coastal resources.

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[6] N.J.A.C. 7:7E-8.2(b)

[7] PEIS, 3-49 (June 2011) (emphasis added).

Even though studies identify impacts to fish from high energy sound, the Department recognizes the science is variable, with research documenting a variety of impacts. Both the Department and NSF have explored peer-reviewed literature regarding seismic activities' various impacts on fish. Quantifying impacts to New Jersey's marine fish and fisheries impacts is difficult because of the various findings and quality of research. However, the difficulty to quantify impacts is a poor excuse not to take necessary steps to more appropriately address the issue. The National Marine Fisheries Service concluded as such in a letter to NSF, dated June 18, 2014. The letter states that because of the lack of scientific consensus within current research, future seismic studies should include additional monitoring and planning to mitigate for potential impacts. The Department has steadfastly held that NSF is obligated to incorporate fisheries monitoring and mitigation as part of the study's current scope because of the lack of scientific consensus.

Various new studies concerning effects of sound on marine fish and fisheries are summarized in the Amended EA. According to the Amended EA, the information presented in the studies did not affect the conclusion that the project would not result in significant impacts on populations despite possible changes in behavior and other non-lethal, short-term, temporary impacts, and injurious or mortal impacts on a small number of individuals within a few meters of high-energy acoustic source. In reviewing this information, the Department has determined there is insufficient evidence to support the conclusion that impacts on New Jersey's coastal fishery resources are insignificant and unlikely to occur.

Despite the Amended EA's consideration of impacts to New Jersey's marine fish and fisheries, the Department contends that there is insufficient information to conclude that there will be insignificant impacts to New Jersey's marine fish and fisheries. Moreover, the NSF's own failure to provide appropriate mitigation violates NSF's own agency guidelines embodied in the PEIS. Therefore, the project is found to be inconsistent with the Marine fish and fisheries rule, N.J.A.C. 7:7E-8.2.

N.J.A.C. 7:7E-3.38 Endangered or Threatened Wildlife or Plant SHSpecies Habitats

Despite the Amended EA's consideration of impacts to sea turtles and marine mammals and the proposed monitoring and mitigation measures, the Department contends that there is insufficient information to conclude that there will be insignificant impacts to the habitat of New Jersey's endangered and threatened wildlife species.

Endangered or threatened wildlife or plant species habitats are terrestrial and aquatic, including marine, estuarine, or freshwater,, areas known to be inhabited on a seasonal or permanent basis by, or to be critical at any stage in the life cycle of, any wildlife or plant identified as "endangered" or "threatened" species on official Federal or State lists of endangered or threatened species, or under active consideration for State or Federal listing. Development of endangered or threatened wildlife or plant species habitat is prohibited unless it can be demonstrated, through an Endangered or Threatened Wildlife or Plant Species Impact Assessment as described at N.J.A.C. 7:7E-3C.2, that endangered or threatened wildlife or plant

species habitat would not directly, or through secondary impacts on the relevant site or in the surrounding area, be adversely affected.

New Jersey's Atlantic Ocean waters act as a migration corridor for several endangered sea turtle species which transit between habitats farther north and south. More specifically, the marine waters off New Jersey shore provide critical migration and feeding areas for sea turtle species such as Kemp's Ridley, Green, Atlantic Loggerhead and Leatherback turtles. Sea turtles likely use sound for navigation, predator avoiding, locating prey, and other activities (Piniak et al. 2012). Although information regarding the impacts of anthropogenic noise on sea turtles is conclusively lacking, there is evidence to suggest that observed effects due to airguns may include behavioral changes, as well as temporary or even permanent hearing loss (Moein et al. 1995).

Numerous sea turtle sightings have been reported from June through September in and around Barnegat Bay. It is believed that the sea turtles are utilizing the area as feeding grounds. It is believed that sea turtles are using the areas as feeding grounds. Therefore, sea turtles may be migrating through the project area during the critical June to July period, making them susceptible not only to impacts (e.g. behavior changes, hearing loss) from seismic activity, but to entanglement in the seismic array gear, and injury or mortality due to ship strikes. Although the Amended EA states that "recent monitoring studies show that some sea turtles do show localized movement away from approaching airguns," the extent to which sea turtles will exhibit avoidance behavior, along with the impacts to airgun exposure, remains unclear. Many of the sea turtles migrating near New Jersey during the project period are juveniles. Effects from air gun noise to smaller turtles will undoubtedly be greater than those observed in monitoring studies, while their ability to swim away or avoid the array due to their size will be reduced.

In addition to several turtle species, New Jersey's Atlantic Ocean waters act as a migration corridor for several endangered marine mammals which transit between habitats farther north and south. Listed marine mammals found year round off of New Jersey include humpback and fin whales (GMI, Inc. 2010). Acoustic detections of whale calls by Geo-Marine, Inc. confirmed the presence of North Atlantic right whales within 37 km of the shoreline, approximately between Seaside Park and Stone Harbor, during all seasons, concluding that some individual North Atlantic right whales occur in the nearshore waters off New Jersey either transiently or regularly. Similarly, the Department's Endangered and Nongame Species Program has records of harbor porpoise occurring in the project vicinity and during the project period. Despite the time of year and 30 day duration, the project would still impact individual whales and other marine mammals remaining in the area.

Marine mammals, especially cetaceans, would be adversely affected by noise created during seismic testing activities. Cetaceans' primary means of communication, navigation, locating food and mates, and avoiding predators and other threats is through their sense of hearing. Cetaceans' sense of hearing is much more highly developed than that of humans and can detect sounds within a much wider range of frequency. Noise pollution, in the form of repeated or prolonged sounds would adversely impact marine mammals by disrupting otherwise normal behaviors associated with migration, feeding, alluding predators, resting, and breeding, etc. Any

alterations to these behaviors would jeopardize the survival of an individual simply by increasing efforts directed at avoidance of the noise and the perceived threat. In addition, animals distressed by noise generated from survey activities may become more susceptible to disease or predation by species which are not directly affected themselves. Furthermore, the project will add to an existing and increasing cacophony of anthropogenic noise pollution which may already be negatively impacting species.

The Endangered or threatened wildlife or vegetation species habitats rule, N.J.A.C. 7:7E-3.38, seeks to protect endangered and threatened species which are facing possible extinction in the State in the immediate future due to loss of suitable habitat, and past overexploitation through human activities or natural causes. Extinction represents a loss of biodiversity, which would adversely affect education, research and the interrelationship of all living creatures within the coastal ecosystem. Despite the Amended EA's consideration of impacts to sea turtles and marine mammals and the proposed monitoring and mitigation measures, the Department contends that there is insufficient information to conclude that there will be insignificant impacts to the habitat of New Jersey's endangered and threatened wildlife species. Therefore, the project is found to be inconsistent with the Endangered or threatened wildlife or plant species habitats rule, N.J.A.C. 7:7E-3.38.

Considerations

The New Jersey Department of Environmental Protection opposes this study as currently proposed. We respectfully request that if NSF proceeds with the study, the NSF consider the following recommendations to be included in the study.

The Department proposes a September to October timeframe. This timeframe would most likely reduce adverse impacts to New Jersey's prime fishing areas, marine fish and fisheries, and endangered or threatened wildlife habitats. In addition, this timeframe would likely avoid hazardous weather conditions and take place outside of the migration of the North Atlantic right whale which occurs mostly between November and April. Some marine mammal species are expected to occur in the area year-round therefore, altering the project during September to October would likely result in no net difference for those species. Furthermore, the geologic formations which this project proposes to map are static and not likely to change if this project is rescheduled to September to October in a year in which the personnel and equipment essential to meet the overall project objectives are available.

If the project cannot be postponed to this year's September to October period, the Department recommends the study be rescheduled to September to October of another year. According to the Amended EA, alternative timeframes for the project were considered but deemed unworkable due to personnel and equipment needs, as well as weather conditions. The Amended EA proffers that the survey vessel is booked into the foreseeable future, however documentation demonstrating such was not provided. Following the cancelled 2014 survey, the Department finds it remarkable and expresses regret that the vessel is being rescheduled for the identical time period in 2015.

If the project is to take place during the proposed June to August timeframe, the Department recommends the inclusion of a field study focused on assessing the project's impacts on fisheries and marine mammals. More specifically, the Department recommends that the study include monitoring of fish behavior, abundance and catch rates. The monitoring should start a minimum of one month prior to project commencement, continue through the duration of the project, and last a minimum of one month after project cessation.

The Department also recommends that an aerial survey be performed over the project area just prior to the vessel leaving its home port to facilitate marine species protection. The flyover would determine if there is a feeding, static, or migrating population of sea turtles or marine mammals. This is especially important for North Atlantic right whales and harbor porpoise in the vicinity of the project area, which these species have a lower recommended PTS threshold level, according to new National Marine Fisheries Service guidelines, currently undergoing public comment. If marine mammals or sea turtles are not observed during the flyover, then the survey could be performed as scheduled. If marine mammals or sea turtles are found within or near the project area during the flyover, then delaying the survey for 3-4 days would be prudent.

In addition to the flyover, the Department recommends the incorporation of a QA/QC plan that would designate one independent person as responsible for ensuring the cessation of sound producing activities if sea turtles or marine mammals are observed during transect runs. The vessel should stop all noise for at least 30 minutes after the animal is no longer observable in the area. The designee would document any observations of sea turtles and send all relevant occurrence information to the Department's Endangered and Nongame Species Program for inclusion into the Biotics database.

The Department is disappointed this proposed seismic study takes a myopic view on research needs. While the study's focus is on climatology and geology, several important issues touch on other areas of research needs, including aquatic biology and fisheries management. The Department views this as contrary to NSF's mission to promote collaborative work on novel, complex issues. In addition, because of the significant concerns raised by multiple states and stakeholders throughout the United States, the Department sees this as an opportunity for NSF to develop scientifically valid consensus on seismic studies' impacts to marine life.

Conclusion

As discussed herein, the Department finds the project inconsistent with the N.J.A.C. 7:7E-3.4 Prime fishing areas, N.J.A.C. 7:7E-8.2 Marine fish and fisheries, and N.J.A.C. 7:7E-3.38 Endangered or threatened wildlife or plant species habitats, due to anticipated, foreseeable adverse impacts to New Jersey's coastal resources. In conclusion, the Department has determined that the project is inconsistent with the Rules on Coastal Zone Management.

The Department views this project as an opportunity to address issues surrounding the impacts of seismic activities on marine life. These issues are consistently raised by a number of stakeholders, including state agencies, members of the commercial and recreational fishing industry, as well as other environmental advocates across various seismic studies. On March 5,

2015, a group of 75 world leading ocean scientists urged President Obama to halt seismic studies for oil and gas exploration because of the "significant, long-lasting and widespread impacts on the reproduction and survival" of threatened whales and commercial fish populations. While this group of prominent scientists focused on seismic studies around oil and gas exploration, it is reflective of the need for further assessments for any study using high-energy sound. If the project proceeds, we urge the NSF to use this study as an opportunity to build scientific consensus on the impacts of high-energy sound on marine life.

Thank you for your attention to and your cooperation with New Jersey's Coastal Zone Management Program. If you have any questions with regard to this determination, please contact Jessica Cobb of my staff at Jessica.Cobb@dep.nj.gov, at the above address, or at (609) 633-2289. Be sure to indicate the Division's file number in all communication.

Sincerely,

David B. Fanz

David B. Fanz, Assistant Director
Division of Land Use Regulation

3/6/15
Date

cc: John Gray, Deputy Chief of Staff
Virginia Kopkash, Assistant Commissioner, Land Use Management
Elizabeth Semple, Division of Coastal and Land Use Planning
Brandon Muffley, Marine Fisheries Administration
Kelly Davis, Division of Fish & Wildlife
Megan Brunatti, Office of Permit Coordination and Environmental Review

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
OFFICE OF PERMIT COORDINATION AND ENVIRONMENTAL REVIEW
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CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

Kerry Kehoe, Federal Consistency Specialist
Stewardship Division, OCRM/CSC
National Oceanic and Atmospheric Administration
1305 East-West Hwy., 10th Floor (N/ORM3)
Silver Spring, MD 20910

April 21, 2015

RE: Request for mediation assistance with National Science Foundation on the Inconsistent Federal Consistency Determination for Marine Geophysical Survey by the R/V *Marcus G. Langseth* in Atlantic Ocean off New Jersey, Summary 2015.

Dear Mr. Kehoe:

On March 6, 2015, the New Jersey Department of Environmental Protection (Department) Division of Land Use Regulation, acting pursuant to Section 307 of the Federal Coastal Zone Management Act (CZMA) of 1972 (P.L. 92-583) as amended, found the above referenced project to be inconsistent with the enforceable policy of the New Jersey Coastal Management Program (NJCMP). The Department is now seeking informal mediation assistance from OCRM, NOAA in seeking resolution to issues identified in our March 6, 2015 letter to Holly Smith, National Science Foundation (NSF).

The Department and NSF seek to work with OCRM through informal mediation to resolve issues identified in the attached findings related to the impacts of seismic activities on marine life. The Department will work with NSF and OCRM to identify a facilitator for the mediation; establish jointly agreed upon ground rules of the mediation; including process, desired outcome, and schedule.

Please contact Megan Brunatti, of the Office of Permit Coordination & Environmental Review, at (609)292-3600 or Megan.Brunatti@dep.nj.gov, to confirm OCRM's willingness to provide mediation services for the above referenced state agency determination.

Sincerely,

John Gray, Deputy Chief of Staff
New Jersey Department of Environmental Protection

w/Attachment

Cc: Holly Smith, National Science Foundation
Virginia Kopkash, Asst. Commissioner NJDEP

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Division of Land Use Regulation
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CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

MAR - 6 2015

Holly Smith
National Science Foundation
4201 Wilson Boulevard, Room 725
Arlington, VA 22230

RE: Federal Consistency Determination for Marine Geophysical Survey by the R/V *Marcus G. Langseth* in Atlantic Ocean off New Jersey, Summer 2015 - Inconsistent
DLUR File No. 0000-14-0030.1 CDT 150001

Dear Ms. Smith:

The New Jersey Department of Environmental Protection (Department) Division of Land Use Regulation (Division), acting pursuant to Section 307 of the Federal Coastal Zone Management Act (CZMA) of 1972 (P.L. 92-583) as amended, finds the above referenced request to be inconsistent with enforceable policies of the New Jersey Coastal Management Program (NJCMP).

Project Description

The National Science Foundation (NSF) is funding a research project proposed by lead Principle Investigator Dr. Gregory Mountain of Rutgers University and collaborators Drs. J. Austin, C. Fulthorpe, and M. Nedimovic of University of Texas Austin to study sea level rise in the Atlantic Ocean off of the coast of New Jersey, which includes a marine geophysical survey. The project includes the use of a 3-D seismic reflection survey to map sequences around existing drill sites and analyze their spatial/temporal evolution. Objectives include establishing the impact of known Ice House base-level changes on the stratigraphic record; providing greater understanding of the response of nearshore environments to changes in elevation of global sea-level; and determining amplitudes and timing of global sea-level changes during the mid-Cenozoic era.

Administrative History

On March 17, 2014, the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NFMS) published a Federal Register Notice (79 FR 14779, March 17, 2014) announcing the proposed issuance of an Incidental Harassment Authorization to the Lamont Doherty Earth Observatory in collaboration with NSF to take marine mammals by harassment incidental to conducting a marine geophysical (seismic) survey in the northwest Atlantic Ocean from May through August 2014.

On April 22, 2014, a conference call was held between NJCMP, NOAA's Office of Ocean and Coastal Resource Management (OCRM) and NSF staff to discuss the proposed activity. During that conference call, it was determined that Rutgers University will be the recipient of the NSF funding as the Principal Investigator for the scientific research related to the surveys that require the proposed incidental harassment authorization.

On May 7, 2014 another conference call was held between NJCMP, OCRM, and NSF to discuss alternate arrangements to assuage the NJCMP's concerns over potential impacts to New Jersey's resources. On this call, OCRM also provided NJCMP with the details necessary for the Department to appropriately request NSF submit a Consistency Determination request to the Department. While the conference call was beneficial to lay the foundation for an alternative resolution to this matter, the NJCMP made clear that the State of New Jersey would pursue this request since a final resolution was not agreed upon and the NJCMP is required to timely submit this request.

On May 16, 2014 the Department notified OCRM, NSF, and Rutgers University of the Department's intent to review the project for consistency with the enforceable policies of the NJCMP. The Department contended that the project would have both direct and indirect reasonably foreseeable effects on the uses and resources of New Jersey's coastal zone relating to commercial fishing, recreational fishing and boating; marine fish, sea turtles and marine mammals; shipwrecks and historical and archeological resources.

On June 18, 2014, the Department was advised of OCRM's concurrence that the project is considered federally funded assistance to a state entity and is therefore, subject to Subpart F requirements of the CZMA Federal Consistency regulations. However, OCRM ultimately denied the Department's review request due to untimeliness and OCRM did not address the Department's analysis of the project's reasonably foreseeable effects.

On June 25, 2014 the Department provided OCRM with information demonstrating that the request was timely and requested a reconsideration of the denial decision.

On July 1, 2014 the project commenced.

On July 3, 2014, the Department filed a complaint in federal District Court seeking injunctive and declaratory relief. On July 10, 2014 the District CourtCourt denied the Department's complaint, but issued a temporary injunction to afford the Department an opportunity to appeal.. The Department subsequently filed an appeal to U.S. Court of Appeals for the Third Circuit (Third Circuit). On July 14 2014, the Third Circuit denied the Department's appeal. On August 12,12, 2014 the matter was dismissed from District Court without prejudice.

In August 2014, the project was ultimately cancelled due to mechanical issues with the survey vessel, R/V *Marcus G. Langseth.*

On December 22, 2014, the Division received NSF's request for consistency concurrence for a similar project during the period of June to August 2015. The request included a report entitled,

"Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015" prepared for Lamont-Doherty Earth Observatory and the National Science Foundation's Division of Ocean Sciences, prepared by LGL Ltd., environmental research associates, and dated December 18, 2014 (Amended EA). Pursuant to 15 CFR Section 930.41, the Division has 60 days to provide a determination and may request an extension period of 15 days or less.

On February 11, 2015 the Department issued a 15 day extension request extending the Department's decision deadline to March 6, 2015.

Analysis

The following analysis is based on New Jersey's Rules on Coastal Zone Management, N.J.A.C. 7:7E-1.1 et seq., as amended July 15, 2013. The Department relied on the study's Programmatic Environmental Impact Statement, dated June 2011 (PEIS), site-specific draft Environmental Assessment dated, December 2013 (EA), and the Amended EA. The Department also considered numerous and significant comments received as part of the Department's public comment period for this determination.

For purposes of CZMA review, the Department must determine whether an activity will affect a coastal use or resource. This Department's analysis is embodied in Department published guidance.[1] Coastal effects are defined under National Oceanic and Atmospheric Administration (NOAA) regulations as any reasonably foreseeable effect on any coastal use or resource resulting from a Federal agency activity, Federal license, or permit activity. Effects are not just environmental effects, but also include effects on coastal uses. Effects include both direct effects, which result from the activity and occur at the same time and place as the activity, and indirect (cumulative and secondary) effects that result from the activity and are later in time or farther removed in distance, but are still reasonably foreseeable. The Department's foreseeability test applies to activities and uses or resources that occur outside a State's coastal zone, so long as the uses or resources impacted are uses or resources of a State's coastal zone.

The Department relied on the study's Programmatic Environmental Impact Statement, dated June 2011 (PEIS), sitespecific draft Environmental Assessment dated, December 2013 (EA), and the draft Amended EA,dated December 2014(Amended EA). The Department also considered numerous and significant comments received as part of the Department's public comment period for this determination.

In evaluating this project, the Department also looked to other sources to define "foreseeability." Black's Law Dictionary (5th Ed.) defines foreseeability as "the reasonable anticipation that harm or injury is a likely result of acts or omissions." Thus, the test is whether the impact is reasonably related to the activity, not whether an impact is more likely than not to occur.

[1] Federal Consistency in New Jersey, dated September 8, 2010. *Available at* http://www.state.nj.us/dep/cmp/fc_guidance.pdf

N.J.A.C. 7:7E-3.4 Prime Fishing AreasAreas

Both the project location and the timeframe will foreseeably adversely affect New Jersey's prime fishing areas. The project area will see high commercial and recreational activity off the coast of New Jersey during the study period.. The project's timeframe coincides with a period of high to peak population abundance of several commercially and recreationally important fish species at identified prime fishing areas.

Prime fishing areas include tidal water areas and water's edge areas, which have a demonstrable history of supporting a significant local intensity of recreational or commercial fishing activity. These areas include all coastal jetties, groins, public fishing piers or docks, and artificial reefs. Prime fishing areas also include features such as rock outcroppings, sand ridges or lumps, rough bottoms, aggregates such as cobblestones, coral, shell and tubeworms, slough areas and offshore canyons. Prime fishing areas also include areas identified in "New Jersey's Recreational and Commercial Fishing Grounds of Raritan Bay, Sandy Hook Bay and Delaware Bay and The Shellfish Resources of Raritan Bay and Sandy Hook Bay," Figley and McCloy (1988), and those areas identified on the map titled, "New Jersey's Specific Sport Ocean Fishing Grounds."

The project is located off the coast of New Jersey, ingextending from Barnegat Ridge to the 35 fathom line, and runs in a northwest to southeast direction intersecting fathom curves at a general perpendicular nature along its extent. This location is offshore from some of New Jersey's most important fishing ports, including: Barnegat Light, Atlantic City, and Point Pleasant. Pursuant to the aforementioned "New Jersey's Specific Sport Ocean Fishing Grounds" map, a portion of the proposed survey area is a State-recognized productive and historical fishing area known as "The Fingers." Contrary to the portrayal in the Amended EA, areas beyond State waters areheavily utilized by New Jersey's commercial and recreational fishing industry. It should also be noted that according to National Marine Fisheries Service data, New Jersey's commercial and recreation fisheries are some of the most productive, highest grossing and employ more people than other states in the Mid-Atlantic and along the Atlantic Coast. Lastly, there is at least one known shipwreck, *Lillian,* within the project area that is popular with scuba diving and spearfishing enthusiasts.

Data analysis of commercial and recreational landings from 1996 to 2013 indicate that this entire area is not only used by multiple commercial fisheries including gillnetters, otter trawl vessels, scallop boats, and long liners, but is also heavily utilized by recreational fishermen. In combination, both commercial and recreational sectors pursue over 35 species of fish in this area including but not limited to: albacore, bluefish, big eye tuna, Bluefin tuna, bonita, black sea bass, butter fish, cobia, cod, smooth dogfish, spiny dogfish, summer flounder, Atlantic menhaden, monkfish, red hake, skate, tilefish, swordfish, yellow fin tuna, and skipjack tuna.

Offshore waters also serve as essential habitat for invertebrate species during various stages of their lifecycles. Studies have provided "evidence that noise exposure during larval development produces body malformations in marine invertebrates. Scallop larvae exposed to playbacks of seismic pulses showed significant developmental delays and 46% developed body abnormalities. Similar effects were observed in all independent samples exposed to noise while no

malformations were found in the control groups."[2] A reduction in harvestable stock would result in further impacts to New Jersey's commercial fisheries.

While seismic surveys are not expressly prohibited pursuant to the N.J.A.C. 7:7E-3.4(b)2, based on studies examining seismic survey impacts, it is reasonably foreseeable that the project would affect fishery distribution, movement, migration and spawning at identified prime fishing areas. This also foreseeably results in adverse impacts to the high productivity of New Jersey's commercial and recreational fishing industry. In conclusion, the project is found to be inconsistent with prime fishing areas rule, N.J.A.C. 7:7E-3.4, due to the foreseeable effect on utilization of prime fishing areas.

N.J.A.C. 7:7E-8.2 Marine Fish and Fisheries

Both the project location and the timeframe will foreseeably affect New Jersey's fisheries. The project area and timeframe sees consistently high commercial and recreational activity based out of New Jersey. The Department finds the study inconsistent with the NJCMP for the following reasons: research indicates adverse impacts to fisheries are likely and New Jersey's rules discourage activities that adversely impact the natural functioning of marine fish; NSF's failure to minimize or mitigate for adverse impacts to a commercially important fishery, which is inconsistent with NSF's own guidance; National Marine Fisheries Service (NMFS) findings and guidance; and the significant concerns raised by the Department's stakeholders, including members of New Jersey's commercial and recreational fishing industry.

Numerous studies identify responses of fish to high energy sound. Studies have shown that noise produced from this activity can cause physical impacts such as short and long term damage to the ears of fish and in some cases, mortality. Research has also documented behavioral impacts that show a clear change in "normal" activity and an increase in "alarm" response behavior that results in changes to schooling behavior, swimming speeds, water column location and sound avoidance. Studies have also demonstrated declining catch rates for a number of commercial fisheries during seismic testing activities. For example, Arill Engas, et al., found that catch rates fell within the seismic shooting region and surrounding areas immediately after shooting started and continued after shooting ended.[3] More recently, Svein Løkkeborg, et al., highlighted that "reduced catches on fishing grounds exposed to seismic survey activities have been demonstrated."[4] The conclusions reached by the Løkkeborg study are further supported by other recent studies concluding that catch rates reduced in the presence of seismic studies.[5] Based on this information, it is reasonably foreseeable that the project will adversely impact New Jersey's marine fish and fisheries resources.

[2] de Soto, N.; Delorme, N.; Atkins, J.; Howard, S.; Williams, J. & Johnson, M. 2013. Anthropogenic noise causes body malformations and delays development in marine larvae. Scientific Reports. 3. Article No. 2831.
[3] A. Engas, S. Lokkeborg, E. Ona and A.V. Soldad, 1996. Effects of Seismic Shooting on Local Abundance and Catch Rates of Cod (Gadus morhua) and Haddock (Melanogrammus aeglefinus). Can. J. Aquat. Sci. 53: 2238-2249.
[4] Løkkeborg, S.; Ona, E.; Vold, A.; & Salthaug, A., 2012. Effects of Sounds from Seismic Air Guns on Fish Behavior and Catch Rates. Advances in Experimental Medicine and Biology, 730, 415-419.
[5] Fewtrell, J.L. & McCauley R.D., 2012, Impact of Air Gun Noise on Behavior of Marine Fish and Squid. Marine Pollution Bulletin, 64, 984-993.

Department rules define marine fisheries as one or more stocks of marine fish that can be treated as a unit for the purposes of conservation and management, and which are identified on the basis of geographical, scientific, technical, recreational and economic characteristics. Any activity that would adversely impact the natural functioning of marine fish, including the reproductive, spawning and migratory patterns or species abundance or diversity of marine fish, is discouraged.[6] In addition, any activity that would adversely impact any New Jersey based marine fisheries or access thereto is discouraged. Based on the above cited research and lack of appropriate mitigation and threat reduction strategies, the Department concludes that any benefits for the study's research are outweighed by the risk posed to New Jersey's coastal resources.

The time of year and project duration (30 consecutive days) are considered significant negative factors that may adversely affect normal fisheries movement, migration and availability. The project's timeframe is a period of high to peak population abundance of several commercially and recreationally important fish species and commercial and recreational activity off the coast of New Jersey. These impacts could lead to direct and indirect consequences to New Jersey's important commercial and recreational fishing industries. The results of a harvest analysis from May through August 2013 showed that 20% of the commercial black sea bass harvest and 22% of the commercial summer flounder harvest occurred within an area that includes the study area. This represents \$250,000 worth of black sea bass and \$1,360,000 of potential loss of summer flounder. This period generates 21% of commercial harvest revenue for New Jersey fishermen and represents 60% to 100% of the entire recreational season for the species listed above. Generally during any given year from May through August, 67% of the annual black sea bass and 89% of summer flounder are recreationally harvested. Local businesses including restaurants, hotels, bait and tackle shops, and other coastal related trades are dependent on this time period for generating income.

The NSF established guidance for surveys occurring in areas with commercially important fisheries. The PEIS states that "pre-survey planning *would be conducted*...to minimize adverse impacts to the associated populations."[7] From March 2014 to March 2015, the Department and many other stakeholders, including members of the commercial and recreational fishing industries, made known that the study area and period coincide with commercially important fisheries. Yet, the Amended EA offers no plan, and simply reasserts that impacts are unlikely, or at most temporary. Under the terms of NSF's own guidance, the NSF is obligated to work with the Department and other stakeholders to minimize harms when commercially important fisheries are present. The Department has repeatedly raised concerns that NSF's tack of refuting the likelihood of harm is inconsistent with NSF's own guidance that instructs NSF to work collaboratively with stakeholders on the study's scope and mitigation strategies when commercially important fisheries are present. Since commercially important fisheries are present during the proposed study period and area, and the NSF has failed to provide any appropriate mitigation or risk reduction strategies in a pre-survey plan, the Department finds the study poses a foreseeable impact to New Jersey's coastal resources.

[6] N.J.A.C. 7:7E-8.2(b)
[7] PEIS, 3-49 (June 2011) (emphasis added).

Even though studies identify impacts to fish from high energy sound, the Department recognizes the science is variable, with research documenting a variety of impacts. Both the Department and NSF have explored peer-reviewed literature regarding seismic activities' various impacts on fish. Quantifying impacts to New Jersey's marine fish and fisheries impacts is difficult because of the various findings and quality of research. However, the difficulty to quantify impacts is a poor excuse not to take necessary steps to more appropriately address the issue. The National Marine Fisheries Service concluded as such in a letter to NSF, dated June 18, 2014. The letter states that because of the lack of scientific consensus within current research, future seismic studies should include additional monitoring and planning to mitigate for potential impacts. The Department has steadfastly held that NSF is obligated to incorporate fisheries monitoring and mitigation as part of the study's current scope because of the lack of scientific consensus.

Various new studies concerning effects of sound on marine fish and fisheries are summarized in the Amended EA. According to the Amended EA, the information presented in the studies did not affect the conclusion that the project would not result in significant impacts on populations despite possible changes in behavior and other non-lethal, short-term, temporary impacts, and injurious or mortal impacts on a small number of individuals within a few meters of high-energy acoustic source. In reviewing this information, the Department has determined there is insufficient evidence to support the conclusion that impacts on New Jersey's coastal fishery resources are insignificant and unlikely to occur.

Despite the Amended EA's consideration of impacts to New Jersey's marine fish and fisheries, the Department contends that there is insufficient information to conclude that there will be insignificant impacts to New Jersey's marine fish and fisheries. Moreover, the NSF's own failure to provide appropriate mitigation violates NSF's own agency guidelines embodied in the PEIS. Therefore, the project is found to be inconsistent with the Marine fish and fisheries rule, N.J.A.C. 7:7E-8.2.

N.J.A.C. 7:7E-3.38 Endangered or Threatened Wildlife or Plant SHSpecies Habitats

Despite the Amended EA's consideration of impacts to sea turtles and marine mammals and the proposed monitoring and mitigation measures, the Department contends that there is insufficient information to conclude that there will be insignificant impacts to the habitat of New Jersey's endangered and threatened wildlife species.

Endangered or threatened wildlife or plant species habitats are terrestrial and aquatic, including marine, estuarine, or freshwater,, areas known to be inhabited on a seasonal or permanent basis by, or to be critical at any stage in the life cycle of, any wildlife or plant identified as "endangered" or "threatened" species on official Federal or State lists of endangered or threatened species, or under active consideration for State or Federal listing. Development of endangered or threatened wildlife or plant species habitat is prohibited unless it can be demonstrated, through an Endangered or Threatened Wildlife or Plant Species Impact Assessment as described at N.J.A.C. 7:7E-3C.2, that endangered or threatened wildlife or plant

species habitat would not directly, or through secondary impacts on the relevant site or in the surrounding area, be adversely affected.

New Jersey's Atlantic Ocean waters act as a migration corridor for several endangered sea turtle species which transit between habitats farther north and south. More specifically, the marine waters off New Jersey shore provide critical migration and feeding areas for sea turtle species such as Kemp's Ridley, Green, Atlantic Loggerhead and Leatherback turtles. Sea turtles likely use sound for navigation, predator avoiding, locating prey, and other activities (Piniak et al. 2012). Although information regarding the impacts of anthropogenic noise on sea turtles is conclusively lacking, there is evidence to suggest that observed effects due to airguns may include behavioral changes, as well as temporary or even permanent hearing loss (Moein et al. 1995).

Numerous sea turtle sightings have been reported from June through September in and around Barnegat Bay. It is believed that the sea turtles are utilizing the area as feeding grounds. It is believed that sea turtles are using the areas as feeding grounds. Therefore, sea turtles may be migrating through the project area during the critical June to July period, making them susceptible not only to impacts (e.g. behavior changes, hearing loss) from seismic activity, but to entanglement in the seismic array gear, and injury or mortality due to ship strikes. Although the Amended EA states that "recent monitoring studies show that some sea turtles do show localized movement away from approaching airguns," the extent to which sea turtles will exhibit avoidance behavior, along with the impacts to airgun exposure, remains unclear. Many of the sea turtles migrating near New Jersey during the project period are juveniles. Effects from air gun noise to smaller turtles will undoubtedly be greater than those observed in monitoring studies, while their ability to swim away or avoid the array due to their size will be reduced.

In addition to several turtle species, New Jersey's Atlantic Ocean waters act as a migration corridor for several endangered marine mammals which transit between habitats farther north and south. Listed marine mammals found year round off of New Jersey include humpback and fin whales (GMI, Inc. 2010). Acoustic detections of whale calls by Geo-Marine, Inc. confirmed the presence of North Atlantic right whales within 37 km of the shoreline, approximately between Seaside Park and Stone Harbor, during all seasons, concluding that some individual North Atlantic right whales occur in the nearshore waters off New Jersey either transiently or regularly. Similarly, the Department's Endangered and Nongame Species Program has records of harbor porpoise occurring in the project vicinity and during the project period. Despite the time of year and 30 day duration, the project would still impact individual whales and other marine mammals remaining in the area.

Marine mammals, especially cetaceans, would be adversely affected by noise created during seismic testing activities. Cetaceans' primary means of communication, navigation, locating food and mates, and avoiding predators and other threats is through their sense of hearing. Cetaceans' sense of hearing is much more highly developed than that of humans and can detect sounds within a much wider range of frequency. Noise pollution, in the form of repeated or prolonged sounds would adversely impact marine mammals by disrupting otherwise normal behaviors associated with migration, feeding, alluding predators, resting, and breeding, etc. Any

alterations to these behaviors would jeopardize the survival of an individual simply by increasing efforts directed at avoidance of the noise and the perceived threat. In addition, animals distressed by noise generated from survey activities may become more susceptible to disease or predation by species which are not directly affected themselves. Furthermore, the project will add to an existing and increasing cacophony of anthropogenic noise pollution which may already be negatively impacting species.

The Endangered or threatened wildlife or vegetation species habitats rule, N.J.A.C. 7:7E-3.38, seeks to protect endangered and threatened species which are facing possible extinction in the State in the immediate future due to loss of suitable habitat, and past overexploitation through human activities or natural causes. Extinction represents a loss of biodiversity, which would adversely affect education, research and the interrelationship of all living creatures within the coastal ecosystem. Despite the Amended EA's consideration of impacts to sea turtles and marine mammals and the proposed monitoring and mitigation measures, the Department contends that there is insufficient information to conclude that there will be insignificant impacts to the habitat of New Jersey's endangered and threatened wildlife species. Therefore, the project is found to be inconsistent with the Endangered or threatened wildlife or plant species habitats rule, N.J.A.C. 7:7E-3.38.

Considerations

The Department recognizes that NSF can ultimately find this Federal Consistency determination as non-binding and advisory, or disagree with the Department's findings. In such cases, the Department submits the following considerations, if NSF proceeds with the proposed study.

The Department proposes a September to October timeframe. This timeframe would most likely reduce adverse impacts to New Jersey's prime fishing areas, marine fish and fisheries, and endangered or threatened wildlife habitats. In addition, this timeframe would likely avoid hazardous weather conditions and take place outside of the migration of the North Atlantic right whale which occurs mostly between November and April. Some marine mammal species are expected to occur in the area year-round therefore, altering the project during September to October would likely result in no net difference for those species. Furthermore, the geologic formations which this project proposes to map are static and not likely to change if this project is rescheduled to September to October in a year in which the personnel and equipment essential to meet the overall project objectives are available.

If the project cannot be postponed to this year's September to October period, the Department recommends the study be rescheduled to September to October of another year. According to the Amended EA, alternative timeframes for the project were considered but deemed unworkable due to personnel and equipment needs, as well as weather conditions. The Amended EA proffers that the survey vessel is booked into the foreseeable future, however documentation demonstrating such was not provided. Following the cancelled 2014 survey, the Department finds it remarkable and expresses regret that the vessel is being rescheduled for the identical time period in 2015.

If the project is to take place during the proposed June to August timeframe, the Department recommends the inclusion of a field study focused on assessing the project's impacts on fisheries and marine mammals. More specifically, the Department recommends that the study include monitoring of fish behavior, abundance and catch rates. The monitoring should start a minimum of one month prior to project commencement, continue through the duration of the project, and last a minimum of one month after project cessation.

The Department also recommends that an aerial survey be performed over the project area just prior to the vessel leaving its home port to facilitate marine species protection. The flyover would determine if there is a feeding, static, or migrating population of sea turtles or marine mammals. This is especially important for North Atlantic right whales and harbor porpoise in the vicinity of the project area, which these species have a lower recommended PTS threshold level, according to new National Marine Fisheries Service guidelines, currently undergoing public comment. If marine mammals or sea turtles are not observed during the flyover, then the survey could be performed as scheduled. If marine mammals or sea turtles are found within or near the project area during the flyover, then delaying the survey for 3-4 days would be prudent.

In addition to the flyover, the Department recommends the incorporation of a QA/QC plan that would designate one independent person as responsible for ensuring the cessation of sound producing activities if sea turtles or marine mammals are observed during transect runs. The vessel should stop all noise for at least 30 minutes after the animal is no longer observable in the area. The designee would document any observations of sea turtles and send all relevant occurrence information to the Department's Endangered and Nongame Species Program for inclusion into the Biotics database.

The Department is disappointed this proposed seismic study takes a myopic view on research needs. While the study's focus is on climatology and geology, several important issues touch on other areas of research needs, including aquatic biology and fisheries management. The Department views this as contrary to NSF's mission to promote collaborative work on novel, complex issues. In addition, because of the significant concerns raised by multiple states and stakeholders throughout the United States, the Department sees this as an opportunity for NSF to develop scientifically valid consensus on seismic studies' impacts to marine life.

Conclusion

As discussed herein, the Department finds the project inconsistent with the N.J.A.C. 7:7E-3.4 Prime fishing areas, N.J.A.C. 7:7E-8.2 Marine fish and fisheries, and N.J.A.C. 7:7E-3.38 Endangered or threatened wildlife or plant species habitats, due to anticipated, foreseeable adverse impacts to New Jersey's coastal resources. In conclusion, the Department has determined that the project is inconsistent with the Rules on Coastal Zone Management.

The Department views this project as an opportunity to address issues surrounding the impacts of seismic activities on marine life. These issues are consistently raised by a number of stakeholders, including state agencies, members of the commercial and recreational fishing industry, as well as other environmental advocates across various seismic studies. On March 5,

2015, a group of 75 world leading ocean scientists urged President Obama to halt seismic studies for oil and gas exploration because of the "significant, long-lasting and widespread impacts on the reproduction and survival" of threatened whales and commercial fish populations. While this group of prominent scientists focused on seismic studies around oil and gas exploration, it is reflective of the need for further assessments for any study using high-energy sound. If the project proceeds, we urge the NSF to use this study as an opportunity to build scientific consensus on the impacts of high-energy sound on marine life.

Thank you for your attention to and your cooperation with New Jersey's Coastal Zone Management Program. If you have any questions with regard to this determination, please contact Jessica Cobb of my staff at Jessica.Cobb@dep.nj.gov, at the above address, or at (609) 633-2289. Be sure to indicate the Division's file number in all communication.

Sincerely,

David B. Fanz

David B. Fanz, Assistant Director
Division of Land Use Regulation

3/6/15
Date

cc: John Gray, Deputy Chief of Staff
Virginia Kopkash, Assistant Commissioner, Land Use Management
Elizabeth Semple, Division of Coastal and Land Use Planning
Brandon Muffley, Marine Fisheries Administration
Kelly Davis, Division of Fish & Wildlife
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State of New Jersey

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April 21, 2015

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RE: Notice of Stage Agency Review of the proposed Marine Geophysical Survey by the *R/V Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015

Dear Sirs:

I am writing concerning the proposed Marine Geophysical Survey by the R/V Marcus G. Langseth in the Atlantic Ocean off New Jersey, Summer 2015 ("the Project"). The Coastal Zone Management Act and its implementing regulations grant States with an approved Coastal Management Program, including New Jersey, the right to review unlisted activities beyond the coastal zone that the State determines will have reasonably foreseeable coastal effects.

Pursuant to these rights, this letter serves as notice that the proposed Project requires review by the New Jersey Department of Environmental Protection (the "Department") pursuant to 15 C.F.R. 930.54 within Subpart D (Unlisted federal license or permit activities) and 15 C.F.R. 930.98 within Subpart F (Federally assisted activities outside of the coastal zone) of the federal coastal management regulations.

I. Background and Discussion

On December 22, 2014, the National Science Foundation ("NSF") sent to the Department a Consistency Determination for the Project. The Consistency Determination directed the Department to concur or object to the Consistency Determination in accordance with Subpart C (Consistency for Federal Agency Activities) of the federal coastal management regulations.

Pursuant to the federal coastal management regulations, a federal agency is only required to prepare a Consistency Determination when it is engaging in a federal agency activity. See 15 C.F.R. 930.36. Moreover, the regulations make clear that an activity cannot be both a federal agency activity under Subpart C and an activity under Subpart D (Unlisted federal license or permit activities) or F (Federally assisted activities outside of the coastal zone).[1] Thus, by preparing a Consistency Determination, NSF apparently determined the Project is a federal agency activity under Subpart C and is not subject to Subparts D and F of the federal coastal management regulations.

At the behest of NSF, the Department proceeded to review the Project under the provisions of Subpart C, and did not review the project under Subparts D or F. Subpart C provided the Department with a 60-day review period with an optional extension. 15 C.F.R. 930.41. After obtaining an extension, on March 6, 2015, the Department submitted to NSF an Inconsistency Determination (attached) for the proposed Project.[2]

The Department's Inconsistency Determination is attached to this letter. In that determination, the Department found the Project to be inconsistent with New Jersey's coastal management program due to anticipated, foreseeable adverse impacts to fishing areas, fish and fisheries, and threatened or endangered species and their habitats.

The Department stands by its Inconsistency Determination and expects NSF to comply with its duties and obligations pursuant to 15 C.F.R. 930.43. However, it has recently come to the Department's attention that NSF may have erred in characterizing the Project as a federal agency activity subject to Subpart C.

[1] The definition of "Federal agency activity" provides that "'Federal agency activity' does not include the issuance of a federal license or permit to and applicant [under Subpart D]. . . or the granting of federal assistance to an applicant agency [under Subpart F]."

[2] The Department also sent a copy of the Inconsistency Determination to the Director of the Office of Ocean and Coastal Resource Management on April 10, 2015.

Therefore, to preserve New Jersey's rights under the Coastal Zone Management Act and its implementing regulations in spite of NSF's possible mischaracterization of the Project, this letter serves to clarify the Department's position and to ensure all interested parties are on notice of the Department's determination that the proposed Project requires review pursuant to Subparts D and F of the coastal management regulations.

II. The Project requires review as an activity requiring a federal license or permit (Subpart D).

Subpart D of the federal coastal management regulations governs "Consistency for Activities Requiring a Federal License of Permit." A "federal license or permit" is defined, in pertinent part, as "any authorization that an applicant is required by law to obtain in order to conduct activities affecting any land or water use or natural resource of the coastal zone and that any Federal agency is empowered to issue to an applicant." 15 C.F.R. 930.51(a).

On March 17, 2015, the National Oceanic and Atmospheric Administration issued Notice of a proposed Incidental Harassment Authorization ("IHA Notice") for harassment incidental to the Project. Harassment of marine mammals is illegal under the Marine Mammal Protection Act without an Incidental Harassment Authorization. 16 U.S.C. 1371. According to the "IHA Notice," the Project is expected to result in the harassment of marine mammals. Thus, the Project constitutes an activity requiring a federal license or permit.

Pursuant to 15 C.F.R. 930.54(a), the Department hereby notifies the requisite parties that the Project requires State review as an unlisted activity affecting coastal uses and resources. The Department also hereby requests the approval of the Director of the Office of Ocean and Coastal Resource Management to review the unlisted activity. 15 C.F.R. 930.54(b). Please refer to the Department's attached Inconsistency Determination as the Department's analysis in support of its determination that coastal effects are reasonably foreseeable. 15 C.F.R. 930.54(b).

The Department anticipates any decision by the Director concerning the Department's review will be made in accordance with 15 C.F.R. 930.54(c). If the Director approves the Department's decision to review, the applicant must comply with the requirements contained in 15 C.F.R. 930.54(e).

III. The Department intends to review the Project due to the federal assistance being provided to a State entity (Subpart F).

Subpart F of the federal coastal management regulations governs "Consistency for Federal Assistance to State and Local Governments." "Federal assistance" is defined as "assistance provided under a federal program to an applicant agency through grant or contractual arrangements, loans, subsidies, guarantees, or other form of financial aid." 15 C.F.R. 930.91. "Applicant agency," in turn, "means any unit of State or local government, or any related public entity . . . submits an application for federal assistance." 15 C.F.R. 930.92 (emphasis added).

On approximately December 18, 2014, NSF issued a Draft Environmental Assessment ("Draft EA") of the Project. The Draft EA states that the State University of New Jersey at Rutgers ("Rutgers") is proposing to conduct the Project "with funding from the U.S. National Science Foundation[.]" Thus, the Project constitutes an activity subject to Subpart F because of the federal assistance NSF is providing to Rutgers.

Pursuant to 15 C.F.R. 930.98, the Department hereby notifies the requisite parties that the Project will have reasonably foreseeable coastal effects and the Department is reviewing for consistency with New Jersey's coastal management programs. Please refer to the Department's attached Inconsistency Determination for the Department's analysis in support of its determination that coastal effects are reasonably foreseeable.

The Department anticipates any decision by the Director concerning the Department's review will be made in accordance with 15 C.F.R. 930.98 and 930.54(c). If the Director decides not to review the Department's decision, or if the Director approves the Department's decision, the Department will inform the parties of any objections in accordance with 15 C.F.R. 930.98.

IV. Conclusion

This letter serves as notice that the Department is reviewing the Project for consistency with its approved coastal management program pursuant to Subparts D and F of the federal coastal management regulations. The Department also preserves its Inconsistency Determination submitted in response to NSF's Consistency Determination pursuant to Subpart C. Should you have any questions about this letter, please feel free to contact Megan Brunatti at (609)984-2462 or Megan.Brunatti@dep.nj.gov.

Sincerely yours,

By: ______________________

John Gray, Deputy Chief of Staff
New Jersey Department of Environmental Protection

W/attachment

c: Holly Smith, NSF
Gregory Mountain, Rutgers University
Ginger Kopkash, NJDEP LUM
David Apy, AAG
Lewin Weyl, DAG
John Doyle, DAG
Timothy Malone, DAG

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Lt. Governor

BOB MARTIN
Commissioner

MAR - 6 2015

Holly Smith
National Science Foundation
4201 Wilson Boulevard, Room 725
Arlington, VA 22230

RE: Federal Consistency Determination for Marine Geophysical Survey by the R/V *Marcus G. Langseth* in Atlantic Ocean off New Jersey, Summer 2015 - Inconsistent
DLUR File No. 0000-14-0030.1 CDT 150001

Dear Ms. Smith:

The New Jersey Department of Environmental Protection (Department) Division of Land Use Regulation (Division), acting pursuant to Section 307 of the Federal Coastal Zone Management Act (CZMA) of 1972 (P.L. 92-583) as amended, finds the above referenced request to be inconsistent with enforceable policies of the New Jersey Coastal Management Program (NJCMP).

Project Description

The National Science Foundation (NSF) is funding a research project proposed by lead Principle Investigator Dr. Gregory Mountain of Rutgers University and collaborators Drs. J. Austin, C. Fulthorpe, and M. Nedimovic of University of Texas Austin to study sea level rise in the Atlantic Ocean off of the coast of New Jersey, which includes a marine geophysical survey. The project includes the use of a 3-D seismic reflection survey to map sequences around existing drill sites and analyze their spatial/temporal evolution. Objectives include establishing the impact of known Ice House base-level changes on the stratigraphic record; providing greater understanding of the response of nearshore environments to changes in elevation of global sea-level; and determining amplitudes and timing of global sea-level changes during the mid-Cenozoic era.

Administrative History

On March 17, 2014, the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NFMS) published a Federal Register Notice (79 FR 14779, March 17, 2014) announcing the proposed issuance of an Incidental Harassment Authorization to the Lamont Doherty Earth Observatory in collaboration with NSF to take marine mammals by harassment incidental to conducting a marine geophysical (seismic) survey in the northwest Atlantic Ocean from May through August 2014.

On April 22, 2014, a conference call was held between NJCMP, NOAA's Office of Ocean and Coastal Resource Management (OCRM) and NSF staff to discuss the proposed activity. During that conference call, it was determined that Rutgers University will be the recipient of the NSF funding as the Principal Investigator for the scientific research related to the surveys that require the proposed incidental harassment authorization.

On May 7, 2014 another conference call was held between NJCMP, OCRM, and NSF to discuss alternate arrangements to assuage the NJCMP's concerns over potential impacts to New Jersey's resources. On this call, OCRM also provided NJCMP with the details necessary for the Department to appropriately request NSF submit a Consistency Determination request to the Department. While the conference call was beneficial to lay the foundation for an alternative resolution to this matter, the NJCMP made clear that the State of New Jersey would pursue this request since a final resolution was not agreed upon and the NJCMP is required to timely submit this request.

On May 16, 2014 the Department notified OCRM, NSF, and Rutgers University of the Department's intent to review the project for consistency with the enforceable policies of the NJCMP. The Department contended that the project would have both direct and indirect reasonably foreseeable effects on the uses and resources of New Jersey's coastal zone relating to commercial fishing, recreational fishing and boating; marine fish, sea turtles and marine mammals; shipwrecks and historical and archeological resources.

On June 18, 2014, the Department was advised of OCRM's concurrence that the project is considered federally funded assistance to a state entity and is therefore, subject to Subpart F requirements of the CZMA Federal Consistency regulations. However, OCRM ultimately denied the Department's review request due to untimeliness and OCRM did not address the Department's analysis of the project's reasonably foreseeable effects.

On June 25, 2014 the Department provided OCRM with information demonstrating that the request was timely and requested a reconsideration of the denial decision.

On July 1, 2014 the projeet commenced.

On July 3, 2014, the Department filed a complaint in federal District Court seeking injunctive and declaratory relief. On July 10, 2014 the District CourtCourt denied the Department's complaint, but issued a temporary injunction to afford the Department an opportunity to appeal.. The Department subsequently filed an appeal to U.S. Court of Appeals for the Third Circuit (Third Circuit). On July 14 2014, the Third Circuit denied the Department's appeal. On August 12,12, 2014 the matter was dismissed from District Court without prejudice.

In August 2014, the project was ultimately cancelled due to mechanical issues with the survey vessel, R/V *Marcus G. Langseth*.

On December 22, 2014, the Division received NSF's request for consistency concurrence for a similar project during the period of June to August 2015. The request included a report entitled,

"Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015" prepared for Lamont-Doherty Earth Observatory and the National Science Foundation's Division of Ocean Sciences, prepared by LGL Ltd., environmental research associates, and dated December 18, 2014 (Amended EA). Pursuant to 15 CFR Section 930.41, the Division has 60 days to provide a determination and may request an extension period of 15 days or less.

On February 11, 2015 the Department issued a 15 day extension request extending the Department's decision deadline to March 6, 2015.

Analysis

The following analysis is based on New Jersey's Rules on Coastal Zone Management, N.J.A.C. 7:7E-1.1 et seq., as amended July 15, 2013. The Department relied on the study's Programmatic Environmental Impact Statement, dated June 2011 (PEIS), site-specific draft Environmental Assessment dated, December 2013 (EA), and the Amended EA. The Department also considered numerous and significant comments received as part of the Department's public comment period for this determination.

For purposes of CZMA review, the Department must determine whether an activity will affect a coastal use or resource. This Department's analysis is embodied in Department published guidance.[1] Coastal effects are defined under National Oceanic and Atmospheric Administration (NOAA) regulations as any reasonably foreseeable effect on any coastal use or resource resulting from a Federal agency activity, Federal license, or permit activity. Effects are not just environmental effects, but also include effects on coastal uses. Effects include both direct effects, which result from the activity and occur at the same time and place as the activity, and indirect (cumulative and secondary) effects that result from the activity and are later in time or farther removed in distance, but are still reasonably foreseeable. The Department's foreseeability test applies to activities and uses or resources that occur outside a State's coastal zone, so long as the uses or resources impacted are uses or resources of a State's coastal zone.

The Department relied on the study's Programmatic Environmental Impact Statement, dated June 2011 (PEIS), sitespecific draft Environmental Assessment dated, December 2013 (EA), and the draft Amended EA,dated December 2014(Amended EA). The Department also considered numerous and significant comments received as part of the Department's public comment period for this determination.

In evaluating this project, the Department also looked to other sources to define "foreseeability." Black's Law Dictionary (5th Ed.) defines foreseeability as "the reasonable anticipation that harm or injury is a likely result of acts or omissions." Thus, the test is whether the impact is reasonably related to the activity, not whether an impact is more likely than not to occur.

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[1] Federal Consistency in New Jersey, dated September 8, 2010. *Available at* http://www.state.nj.us/dep/cmp/fc_guidance.pdf

N.J.A.C. 7:7E-3.4 Prime Fishing AreasAreas

Both the project location and the timeframe will foreseeably adversely affect New Jersey's prime fishing areas. The project area will see high commercial and recreational activity off the coast of New Jersey during the study period.. The project's timeframe coincides with a period of high to peak population abundance of several commercially and recreationally important fish species at identified prime fishing areas.

Prime fishing areas include tidal water areas and water's edge areas, which have a demonstrable history of supporting a significant local intensity of recreational or commercial fishing activity. These areas include all coastal jetties, groins, public fishing piers or docks, and artificial reefs. Prime fishing areas also include features such as rock outcroppings, sand ridges or lumps, rough bottoms, aggregates such as cobblestones, coral, shell and tubeworms, slough areas and offshore canyons. Prime fishing areas also include areas identified in "New Jersey's Recreational and Commercial Fishing Grounds of Raritan Bay, Sandy Hook Bay and Delaware Bay and The Shellfish Resources of Raritan Bay and Sandy Hook Bay," Figley and McCloy (1988), and those areas identified on the map titled, "New Jersey's Specific Sport Ocean Fishing Grounds."

The project is located off the coast of New Jersey, ingextending from Barnegat Ridge to the 35 fathom line, and runs in a northwest to southeast direction intersecting fathom curves at a general perpendicular nature along its extent. This location is offshore from some of New Jersey's most important fishing ports, including: Barnegat Light, Atlantic City, and Point Pleasant. Pursuant to the aforementioned "New Jersey's Specific Sport Ocean Fishing Grounds" map, a portion of the proposed survey area is a State-recognized productive and historical fishing area known as "The Fingers." Contrary to the portrayal in the Amended EA, areas beyond State waters areheavily utilized by New Jersey's commercial and recreational fishing industry. It should also be noted that according to National Marine Fisheries Service data, New Jersey's commercial and recreation fisheries are some of the most productive, highest grossing and employ more people than other states in the Mid-Atlantic and along the Atlantic Coast. Lastly, there is at least one known shipwreck, *Lillian,* within the project area that is popular with scuba diving and spearfishing enthusiasts.

Data analysis of commercial and recreational landings from 1996 to 2013 indicate that this entire area is not only used by multiple commercial fisheries including gillnetters, otter trawl vessels, scallop boats, and long liners, but is also heavily utilized by recreational fishermen. In combination, both commercial and recreational sectors pursue over 35 species of fish in this area including but not limited to: albacore, bluefish, big eye tuna, Bluefin tuna, bonita, black sea bass, butter fish, cobia, cod, smooth dogfish, spiny dogfish, summer flounder, Atlantic menhaden, monkfish, red hake, skate, tilefish, swordfish, yellow fin tuna, and skipjack tuna.

Offshore waters also serve as essential habitat for invertebrate species during various stages of their lifecycles. Studies have provided "evidence that noise exposure during larval development produces body malformations in marine invertebrates. Scallop larvae exposed to playbacks of seismic pulses showed significant developmental delays and 46% developed body abnormalities. Similar effects were observed in all independent samples exposed to noise while no

malformations were found in the control groups."[2] A reduction in harvestable stock would result in further impacts to New Jersey's commercial fisheries.

While seismic surveys are not expressly prohibited pursuant to the N.J.A.C. 7:7E-3.4(b)2, based on studies examining seismic survey impacts, it is reasonably foreseeable that the project would affect fishery distribution, movement, migration and spawning at identified prime fishing areas. This also foreseeably results in adverse impacts to the high productivity of New Jersey's commercial and recreational fishing industry. In conclusion, the project is found to be inconsistent with prime fishing areas rule, N.J.A.C. 7:7E-3.4, due to the foreseeable effect on utilization of prime fishing areas.

N.J.A.C. 7:7E-8.2 Marine Fish and Fisheries

Both the project location and the timeframe will foreseeably affect New Jersey's fisheries. The project area and timeframe sees consistently high commercial and recreational activity based out of New Jersey. The Department finds the study inconsistent with the NJCMP for the following reasons: research indicates adverse impacts to fisheries are likely and New Jersey's rules discourage activities that adversely impact the natural functioning of marine fish; NSF's failure to minimize or mitigate for adverse impacts to a commercially important fishery, which is inconsistent with NSF's own guidance; National Marine Fisheries Service (NMFS) findings and guidance; and the significant concerns raised by the Department's stakeholders, including members of New Jersey's commercial and recreational fishing industry.

Numerous studies identify responses of fish to high energy sound. Studies have shown that noise produced from this activity can cause physical impacts such as short and long term damage to the ears of fish and in some cases, mortality. Research has also documented behavioral impacts that show a clear change in "normal" activity and an increase in "alarm" response behavior that results in changes to schooling behavior, swimming speeds, water column location and sound avoidance. Studies have also demonstrated declining catch rates for a number of commercial fisheries during seismic testing activities. For example, Arill Engas, et al., found that catch rates fell within the seismic shooting region and surrounding areas immediately after shooting started and continued after shooting ended.[3] More recently, Svein Løkkeborg, et al., highlighted that "reduced catches on fishing grounds exposed to seismic survey activities have been demonstrated."[4] The conclusions reached by the Løkkeborg study are further supported by other recent studies concluding that catch rates reduced in the presence of seismic studies.[5] Based on this information, it is reasonably foreseeable that the project will adversely impact New Jersey's marine fish and fisheries resources.

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[2] de Soto, N.; Delorme, N.; Atkins, J.; Howard, S.; Williams, J. & Johnson, M. 2013. Anthropogenic noise causes body malformations and delays development in marine larvae. Scientific Reports. 3. Article No. 2831.
[3] A. Engas, S. Lokkeborg, E. Ona and A.V. Soldad, 1996. Effects of Seismic Shooting on Local Abundance and Catch Rates of Cod (Gadus morhua) and Haddock (Melanogrammus aeglefinus). Can. J. Aquat. Sci. 53: 2238-2249.
[4] Løkkeborg, S.; Ona, E.; Vold, A.; & Salthaug, A., 2012. Effects of Sounds from Seismic Air Guns on Fish Behavior and Catch Rates. Advances in Experimental Medicine and Biology, 730, 415-419.
[5] Fewtrell, J.L. & McCauley R.D., 2012, Impact of Air Gun Noise on Behavior of Marine Fish and Squid. Marine Pollution Bulletin, 64, 984-993.

Department rules define marine fisheries as one or more stocks of marine fish that can be treated as a unit for the purposes of conservation and management, and which are identified on the basis of geographical, scientific, technical, recreational and economic characteristics. Any activity that would adversely impact the natural functioning of marine fish, including the reproductive, spawning and migratory patterns or species abundance or diversity of marine fish, is discouraged.[6] In addition, any activity that would adversely impact any New Jersey based marine fisheries or access thereto is discouraged. Based on the above cited research and lack of appropriate mitigation and threat reduction strategies, the Department concludes that any benefits for the study's research are outweighed by the risk posed to New Jersey's coastal resources.

The time of year and project duration (30 consecutive days) are considered significant negative factors that may adversely affect normal fisheries movement, migration and availability. The project's timeframe is a period of high to peak population abundance of several commercially and recreationally important fish species and commercial and recreational activity off the coast of New Jersey. These impacts could lead to direct and indirect consequences to New Jersey's important commercial and recreational fishing industries. The results of a harvest analysis from May through August 2013 showed that 20% of the commercial black sea bass harvest and 22% of the commercial summer flounder harvest occurred within an area that includes the study area. This represents $250,000 worth of black sea bass and $1,360,000 of potential loss of summer flounder. This period generates 21% of commercial harvest revenue for New Jersey fishermen and represents 60% to 100% of the entire recreational season for the species listed above. Generally during any given year from May through August, 67% of the annual black sea bass and 89% of summer flounder are recreationally harvested. Local businesses including restaurants, hotels, bait and tackle shops, and other coastal related trades are dependent on this time period for generating income.

The NSF established guidance for surveys occurring in areas with commercially important fisheries. The PEIS states that "pre-survey planning *would be conducted*...to minimize adverse impacts to the associated populations."[7] From March 2014 to March 2015, the Department and many other stakeholders, including members of the commercial and recreational fishing industries, made known that the study area and period coincide with commercially important fisheries. Yet, the Amended EA offers no plan, and simply reasserts that impacts are unlikely, or at most temporary. Under the terms of NSF's own guidance, the NSF is obligated to work with the Department and other stakeholders to minimize harms when commercially important fisheries are present. The Department has repeatedly raised concerns that NSF's tack of refuting the likelihood of harm is inconsistent with NSF's own guidance that instructs NSF to work collaboratively with stakeholders on the study's scope and mitigation strategies when commercially important fisheries are present. Since commercially important fisheries are present during the proposed study period and area, and the NSF has failed to provide any appropriate mitigation or risk reduction strategies in a pre-survey plan, the Department finds the study poses a foreseeable impact to New Jersey's coastal resources.

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[6] N.J.A.C. 7:7E-8.2(b)

[7] PEIS, 3-49 (June 2011) (emphasis added).

Even though studies identify impacts to fish from high energy sound, the Department recognizes the science is variable, with research documenting a variety of impacts. Both the Department and NSF have explored peer-reviewed literature regarding seismic activities' various impacts on fish. Quantifying impacts to New Jersey's marine fish and fisheries impacts is difficult because of the various findings and quality of research. However, the difficulty to quantify impacts is a poor excuse not to take necessary steps to more appropriately address the issue. The National Marine Fisheries Service concluded as such in a letter to NSF, dated June 18, 2014. The letter states that because of the lack of scientific consensus within current research, future seismic studies should include additional monitoring and planning to mitigate for potential impacts. The Department has steadfastly held that NSF is obligated to incorporate fisheries monitoring and mitigation as part of the study's current scope because of the lack of scientific consensus.

Various new studies concerning effects of sound on marine fish and fisheries are summarized in the Amended EA. According to the Amended EA, the information presented in the studies did not affect the conclusion that the project would not result in significant impacts on populations despite possible changes in behavior and other non-lethal, short-term, temporary impacts, and injurious or mortal impacts on a small number of individuals within a few meters of high-energy acoustic source. In reviewing this information, the Department has determined there is insufficient evidence to support the conclusion that impacts on New Jersey's coastal fishery resources are insignificant and unlikely to occur.

Despite the Amended EA's consideration of impacts to New Jersey's marine fish and fisheries, the Department contends that there is insufficient information to conclude that there will be insignificant impacts to New Jersey's marine fish and fisheries. Moreover, the NSF's own failure to provide appropriate mitigation violates NSF's own agency guidelines embodied in the PEIS. Therefore, the project is found to be inconsistent with the Marine fish and fisheries rule, N.J.A.C. 7:7E-8.2.

N.J.A.C. 7:7E-3.38 Endangered or Threatened Wildlife or Plant SHSpecies Habitats

Despite the Amended EA's consideration of impacts to sea turtles and marine mammals and the proposed monitoring and mitigation measures, the Department contends that there is insufficient information to conclude that there will be insignificant impacts to the habitat of New Jersey's endangered and threatened wildlife species.

Endangered or threatened wildlife or plant species habitats are terrestrial and aquatic, including marine, estuarine, or freshwater,, areas known to be inhabited on a seasonal or permanent basis by, or to be critical at any stage in the life cycle of, any wildlife or plant identified as "endangered" or "threatened" species on official Federal or State lists of endangered or threatened species, or under active consideration for State or Federal listing. Development of endangered or threatened wildlife or plant species habitat is prohibited unless it can be demonstrated, through an Endangered or Threatened Wildlife or Plant Species Impact Assessment as described at N.J.A.C. 7:7E-3C.2, that endangered or threatened wildlife or plant

species habitat would not directly, or through secondary impacts on the relevant site or in the surrounding area, be adversely affected.

New Jersey's Atlantic Ocean waters act as a migration corridor for several endangered sea turtle species which transit between habitats farther north and south. More specifically, the marine waters off New Jersey shore provide critical migration and feeding areas for sea turtle species such as Kemp's Ridley, Green, Atlantic Loggerhead and Leatherback turtles. Sea turtles likely use sound for navigation, predator avoiding, locating prey, and other activities (Piniak et al. 2012). Although information regarding the impacts of anthropogenic noise on sea turtles is conclusively lacking, there is evidence to suggest that observed effects due to airguns may include behavioral changes, as well as temporary or even permanent hearing loss (Moein et al. 1995).

Numerous sea turtle sightings have been reported from June through September in and around Barnegat Bay. It is believed that the sea turtles are utilizing the area as feeding grounds. It is believed that sea turtles are using the areas as feeding grounds. Therefore, sea turtles may be migrating through the project area during the critical June to July period, making them susceptible not only to impacts (e.g. behavior changes, hearing loss) from seismic activity, but to entanglement in the seismic array gear, and injury or mortality due to ship strikes. Although the Amended EA states that "recent monitoring studies show that some sea turtles do show localized movement away from approaching airguns," the extent to which sea turtles will exhibit avoidance behavior, along with the impacts to airgun exposure, remains unclear. Many of the sea turtles migrating near New Jersey during the project period are juveniles. Effects from air gun noise to smaller turtles will undoubtedly be greater than those observed in monitoring studies, while their ability to swim away or avoid the array due to their size will be reduced.

In addition to several turtle species, New Jersey's Atlantic Ocean waters act as a migration corridor for several endangered marine mammals which transit between habitats farther north and south. Listed marine mammals found year round off of New Jersey include humpback and fin whales (GMI, Inc. 2010). Acoustic detections of whale calls by Geo-Marine, Inc. confirmed the presence of North Atlantic right whales within 37 km of the shoreline, approximately between Seaside Park and Stone Harbor, during all seasons, concluding that some individual North Atlantic right whales occur in the nearshore waters off New Jersey either transiently or regularly. Similarly, the Department's Endangered and Nongame Species Program has records of harbor porpoise occurring in the project vicinity and during the project period. Despite the time of year and 30 day duration, the project would still impact individual whales and other marine mammals remaining in the area.

Marine mammals, especially cetaceans, would be adversely affected by noise created during seismic testing activities. Cetaceans' primary means of communication, navigation, locating food and mates, and avoiding predators and other threats is through their sense of hearing. Cetaceans' sense of hearing is much more highly developed than that of humans and can detect sounds within a much wider range of frequency. Noise pollution, in the form of repeated or prolonged sounds would adversely impact marine mammals by disrupting otherwise normal behaviors associated with migration, feeding, alluding predators, resting, and breeding, etc. Any

alterations to these behaviors would jeopardize the survival of an individual simply by increasing efforts directed at avoidance of the noise and the perceived threat. In addition, animals distressed by noise generated from survey activities may become more susceptible to disease or predation by species which are not directly affected themselves. Furthermore, the project will add to an existing and increasing cacophony of anthropogenic noise pollution which may already be negatively impacting species.

The Endangered or threatened wildlife or vegetation species habitats rule, N.J.A.C. 7:7E-3.38, seeks to protect endangered and threatened species which are facing possible extinction in the State in the immediate future due to loss of suitable habitat, and past overexploitation through human activities or natural causes. Extinction represents a loss of biodiversity, which would adversely affect education, research and the interrelationship of all living creatures within the coastal ecosystem. Despite the Amended EA's consideration of impacts to sea turtles and marine mammals and the proposed monitoring and mitigation measures, the Department contends that there is insufficient information to conclude that there will be insignificant impacts to the habitat of New Jersey's endangered and threatened wildlife species. Therefore, the project is found to be inconsistent with the Endangered or threatened wildlife or plant species habitats rule, N.J.A.C. 7:7E-3.38.

Considerations

The Department recognizes that NSF can ultimately find this Federal Consistency determination as non-binding and advisory, or disagree with the Department's findings. In such cases, the Department submits the following considerations, if NSF proceeds with the proposed study.

The Department proposes a September to October timeframe. This timeframe would most likely reduce adverse impacts to New Jersey's prime fishing areas, marine fish and fisheries, and endangered or threatened wildlife habitats. In addition, this timeframe would likely avoid hazardous weather conditions and take place outside of the migration of the North Atlantic right whale which occurs mostly between November and April. Some marine mammal species are expected to occur in the area year-round therefore, altering the project during September to October would likely result in no net difference for those species. Furthermore, the geologic formations which this project proposes to map are static and not likely to change if this project is rescheduled to September to October in a year in which the personnel and equipment essential to meet the overall project objectives are available.

If the project cannot be postponed to this year's September to October period, the Department recommends the study be rescheduled to September to October of another year. According to the Amended EA, alternative timeframes for the project were considered but deemed unworkable due to personnel and equipment needs, as well as weather conditions. The Amended EA proffers that the survey vessel is booked into the foreseeable future, however documentation demonstrating such was not provided. Following the cancelled 2014 survey, the Department finds it remarkable and expresses regret that the vessel is being rescheduled for the identical time period in 2015.

If the project is to take place during the proposed June to August timeframe, the Department recommends the inclusion of a field study focused on assessing the project's impacts on fisheries and marine mammals. More specifically, the Department recommends that the study include monitoring of fish behavior, abundance and catch rates. The monitoring should start a minimum of one month prior to project commencement, continue through the duration of the project, and last a minimum of one month after project cessation.

The Department also recommends that an aerial survey be performed over the project area just prior to the vessel leaving its home port to facilitate marine species protection. The flyover would determine if there is a feeding, static, or migrating population of sea turtles or marine mammals. This is especially important for North Atlantic right whales and harbor porpoise in the vicinity of the project area, which these species have a lower recommended PTS threshold level, according to new National Marine Fisheries Service guidelines, currently undergoing public comment. If marine mammals or sea turtles are not observed during the flyover, then the survey could be performed as scheduled. If marine mammals or sea turtles are found within or near the project area during the flyover, then delaying the survey for 3-4 days would be prudent.

In addition to the flyover, the Department recommends the incorporation of a QA/QC plan that would designate one independent person as responsible for ensuring the cessation of sound producing activities if sea turtles or marine mammals are observed during transect runs. The vessel should stop all noise for at least 30 minutes after the animal is no longer observable in the area. The designee would document any observations of sea turtles and send all relevant occurrence information to the Department's Endangered and Nongame Species Program for inclusion into the Biotics database.

The Department is disappointed this proposed seismic study takes a myopic view on research needs. While the study's focus is on climatology and geology, several important issues touch on other areas of research needs, including aquatic biology and fisheries management. The Department views this as contrary to NSF's mission to promote collaborative work on novel, complex issues. In addition, because of the significant concerns raised by multiple states and stakeholders throughout the United States, the Department sees this as an opportunity for NSF to develop scientifically valid consensus on seismic studies' impacts to marine life.

Conclusion

As discussed herein, the Department finds the project inconsistent with the N.J.A.C. 7:7E-3.4 Prime fishing areas, N.J.A.C. 7:7E-8.2 Marine fish and fisheries, and N.J.A.C. 7:7E-3.38 Endangered or threatened wildlife or plant species habitats, due to anticipated, foreseeable adverse impacts to New Jersey's coastal resources. In conclusion, the Department has determined that the project is inconsistent with the Rules on Coastal Zone Management.

The Department views this project as an opportunity to address issues surrounding the impacts of seismic activities on marine life. These issues are consistently raised by a number of stakeholders, including state agencies, members of the commercial and recreational fishing industry, as well as other environmental advocates across various seismic studies. On March 5,

2015, a group of 75 world leading ocean scientists urged President Obama to halt seismic studies for oil and gas exploration because of the "significant, long-lasting and widespread impacts on the reproduction and survival" of threatened whales and commercial fish populations. While this group of prominent scientists focused on seismic studies around oil and gas exploration, it is reflective of the need for further assessments for any study using high-energy sound. If the project proceeds, we urge the NSF to use this study as an opportunity to build scientific consensus on the impacts of high-energy sound on marine life.

Thank you for your attention to and your cooperation with New Jersey's Coastal Zone Management Program. If you have any questions with regard to this determination, please contact Jessica Cobb of my staff at Jessica.Cobb@dep.nj.gov, at the above address, or at (609) 633-2289. Be sure to indicate the Division's file number in all communication.

Sincerely,

David B. Fanz

David B. Fanz, Assistant Director
Division of Land Use Regulation

3/6/15
Date

cc: John Gray, Deputy Chief of Staff
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Elizabeth Semple, Division of Coastal and Land Use Planning
Brandon Muffley, Marine Fisheries Administration
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APR 3 0 2015

Re: Request for Approval to Review the Proposed Marine Geophysical Survey by the *R/V Marcus G. Langseth* in the Federal Waters offshore of New Jersey in June-August 2015

Dear Mr. Fanz:

Thank you for your request to review the proposed marine geophysical survey by the *R/V Marcus G. Langseth* (Project) in the federal waters offshore of New Jersey under the federal consistency requirements of the Coastal Zone Management Act (CZMA). As the survey is beyond the New Jersey coastal zone and unlisted by the state for CZMA review, the New Jersey Department of Environmental Protection (Department) has requested the National Oceanic and Atmospheric Administration's (NOAA's) Office for Coastal Management approval to review the survey under the CZMA Federal Consistency regulations for unlisted federal licenses or permits (15 C.F.R. Part 930, Subpart D) and unlisted federal financial assistance to state and local governments (15 C.F.R. Part 930, Subpart F).

For the reasons below, the Department's request is denied.

DISCUSSION

As you described in your April 21, 2015, letter, the Department has already conducted and completed review of this Project under the CZMA regulations (15 C.F.R. Part 930, Subpart C), and reached a final determination. Nothing in the Department's letter provides a basis for additional review of the project at this time. Rather, the letter states that "it has recently come to the Department's attention that NSF may have erred in characterizing the project as a federal agency activity subject to Subpart C" and -- while the Department stands by its determination made at the conclusion of its review under Subpart C -- additional review is necessary to "preserve New Jersey's rights" due to the possible mischaracterization. Despite these assertions, the Department has provided no convincing explanation as to why it believes the project was not properly characterized as a federal agency activity under Subpart C, nor why additional reviews are necessary in light of the review the Department has already performed. Based on the information that the Department has provided on the Project in its filings, NOAA finds no reason to question the characterization of the project as a federal agency activity or the review that was performed under Subpart C.

As the Department acknowledged in its letter, the CZMA regulations make clear that a project cannot be treated as *both* a federal agency activity under Subpart C and also an activity under Subpart D or F. Here, the Department performed its review of the Project under Subpart C and, having completed that review, additional, parallel, or redundant reviews under other Subparts of the regulations are now precluded. The CZMA regulations do not provide for the "provisional" types of reviews the Department describes, and your current request cannot be approved.

While it is not the basis for our current decision, we also note that even if the reviews the Department is requesting were not otherwise precluded, it is not clear the request would meet the technical requirements set forth in the CZMA rules for reviews under Subpart D or F, including timeliness, proper notice, etc.

CONCLUSION

For the reasons described above, the Office for Coastal Management denies New Jersey's request to conduct additional CZMA reviews of the Project under both Subparts D and F.

Please contact David Kaiser, Senior Policy Analyst, Office for Coastal Management, at 603-862-2719, or Kerry Kehoe, Federal Consistency Specialist, Office for Coastal Management, at 301-563-1151, if you have any questions.

Sincerely,

Dr. Jeffrey Payne
Acting Director
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cc:

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May 1, 2015

Jeffrey Payne, Acting Director
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Re: Response by the National Science Foundation (NSF) to the April 21, 2015 Letter from the New Jersey Department of Environmental Protection (NJDEP) Requesting Federal Consistency Review of the Proposed Rescheduled Marine Seismic Research Survey in the Atlantic Ocean off New Jersey, Summer 2015

Dear Dr. Payne:

NSF is in receipt of NJDEP's letter dated April 21, 2015, in which NJDEP notifies the National Oceanic and Atmospheric Administration's Office of Coastal Management (OCM) of its position that the proposed rescheduled marine geophysical survey by Rutgers, the State University of New Jersey (Rutgers) offshore of New Jersey ("proposed Survey") requires review under Subparts D and F of the Coastal Zone Management Act (CZMA) Federal Consistency regulations. NSF is also in receipt of your letter responding to NJDEP dated April 30, 2015, and concurs with the findings therein. In addition to the conclusions reached in your April 30, 2015 letter, NSF provides the following comments in response to NJDEP's position for your consideration.

I. Background

As you may recall, following an extensive environmental review process, the proposed Survey was originally planned for and did commence on July 1, 2014.[1] Due to mechanical issues with the vessel (the R/V *Marcus G. Langseth* ("*Langseth*")), however, the research was

[1] Because OCM is familiar with the proposed Survey, NSF has omitted a detailed description of it here. A detailed description of the proposed Survey can be found in the *NSF Coastal Zone Management Act (CZMA) Consistency Determination*, dated December 22, 2014, and NSF's *Draft Amended Environmental Assessment for a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Atlantic Ocean off New Jersey, Summer 2015*, dated December 18, 2014.

unable to be completed during the time periods authorized under the Incidental Harassment Authorization (IHA) and the Incidental Take Statement (ITS) issued for the 2014 survey. As a result, NSF informed the National Marine Fisheries Service (NMFS) of its interest in rescheduling the proposed Survey for a 30 day period during the June-August 2015 timeframe. In response, NMFS informed NSF that a new IHA would be required to reschedule the proposed Survey for 2015. NSF then initiated an environmental review process for the proposed Survey.

On October 8, 2014, NSF contacted NJDEP about NSF's interest in rescheduling the proposed Survey for the same time of year during 2015. On October 15, 2014, NSF and NJDEP held a teleconference in which the proposed Survey was discussed and NJDEP's interest in reviewing the proposed Survey under the CZMA was confirmed. Accordingly, on December 22, 2014, NSF submitted to NJDEP its *NSF Coastal Zone Management Act (CZMA) Consistency Determination* ("CD"), with its *Draft Amended Environmental Assessment for a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Atlantic Ocean off New Jersey, Summer 2015* ("Draft Amended EA") appended as "Attachment 1." On March 6, after requesting a 15 day extension of time to respond, NJDEP provided its response to NSF's CD, which concluded that, contrary to NSF's determination, the proposed Survey is inconsistent with three enforceable policies of New Jersey's federally approved coastal management program.[2]

On March 17, 2015, NMFS published in the Federal Register a Notice of intent to issue an Incidental Harassment Authorization ("IHA Notice") for the proposed Survey in response to the IHA application submitted to NMFS on December 23, 2014, on behalf of NSF, Rutgers University ("Rutgers"), and the *Langseth* operator, Columbia University's Lamont-Doherty Earth Observatory (L-DEO). A 30 day public comment period began on the date of publication of the IHA Notice and closed on April 16, 2015. NJDEP submitted comments on the IHA Notice to NMFS during the public comment period.

On April 21, 2015, NJDEP submitted a letter to OCM, Rutgers, L-DEO, and NSF notifying the letter recipients of its position that the proposed Survey requires consistency review under 15 C.F.R. Part 930, Subparts D and F. At no time prior to April 21, 2015, however, did NJDEP notify Rutgers, L-DEO, or NSF of its position.

II. Response to NJDEP's Notice of Required Consistency Review under Subparts D and F

A. Subpart D

Subpart D of the Federal Consistency regulations provides, in pertinent part, as follows:

[2] NJDEP also submitted comments on NSF's Draft Amended EA during the 52 day public comment period (which had an original duration of 37 days, but was later extended by an additional 15 days).

> With the assistance of Federal agencies, State agencies should monitor unlisted federal license or permit activities (e.g., by . . . review of NEPA documents, Federal Register notices). State agencies shall notify Federal agencies, applicants, and the Director [of OCM] of unlisted activities affecting any coastal use or resource which require State agency review **within 30 days** from notice of the license or permit application . . ., otherwise the State agency **waives its right to review the unlisted activity**.

15 C.F.R. § 930.54(a)(1) (emphasis added). NJDEP had both actual and constructive notice that an application for an IHA related to the proposed Survey would be forthcoming.

NSF provided actual notice to NJDEP of the IHA application on December 22, 2014, when it submitted its CD and appended Draft Amended EA.[3] In the transmittal letter accompanying NSF's CD, NSF stated that NMFS was requiring a new IHA for the proposed Survey. In addition, in both the CD and the appended Draft Amended EA, NSF made it clear that an IHA application for the proposed Survey would be submitted to NMFS. Indeed, because the proposed Survey is identical[4] to the 2014 survey, NJDEP should have been well aware that there would be an application for an IHA for the proposed Survey. On March 17, 2015, NMFS published in the Federal Register its IHA Notice, providing constructive notice that an application for an IHA had been submitted to NMFS. Certainly, there can be no doubt that NJDEP was aware of the proposed Survey and the IHA application for many months prior to sending its April 21, 2015 letter; in fact, NJDEP submitted comments during the public comment periods on both the Draft Amended EA and the IHA Notice, and also provided a response to NSF's CD.

Despite the fact that NJDEP had both actual and constructive notice of the IHA application for the proposed Survey, it was not until many months later, April 21, 2015, that NJDEP first requested consistency review under Subpart D. Because that request came more than 30 days after NJDEP received notice of the application for an IHA, NJDEP has waived its right to review the unlisted activity under Subpart D.

B. <u>Subpart F</u>

Subpart F of the Federal Consistency regulations provides for consistency review when a "unit of State or local government . . . submits an application for federal assistance." 15 C.F.R. §

[3] As stated earlier, NSF gave NJDEP actual notice of the proposed Survey as early as October 8, 2014, and, again, in numerous emails and telephone communications from October 2014 to the present. The requirement for an IHA for the proposed Survey was discussed during some of those telephone communications, and, in any event, NJDEP was well aware of the requirement for an IHA based on its involvement in the 2014 survey.
[4] The proposed Survey is identical to the 2014 survey except that the proposed Survey would carry out the research using a smaller array of airguns (4).

930.92. *See also* 15 C.F.R. § 930.98. While Rutgers, a unit of the State of New Jersey, did, indeed, submit an application for federal assistance for the 2014 survey, it did not submit such an application for the 2015 proposed Survey. This was because NSF issued its decision to award a grant of federal funds to Rutgers for the 2014 survey in 2014, and the funds under that award have already been issued. There is no pending application for federal assistance before NSF at this juncture. Therefore, Subpart F of the Federal Consistency regulations does not apply to the proposed Survey.

If, however, it could somehow be construed that the proposed Survey now involves an application for federal assistance (which NSF does not believe it does), NJDEP clearly did not act "immediately," as required under 15 C.F.R 930.98, when it requested consistency review in its April 21, 2015 letter. As explained above in the subsection concerning Subpart D, NJDEP has been well aware of the proposed Survey for many months, having actual notice of it as early as October 8, 2014, and then again on December 22, 2014, when it received NSF's CD with the Draft Amended EA appended to it. NJDEP also had constructive notice of the proposed Survey on December 19, 2014, when NSF posted its Draft Amended EA on its website, and, again, on March 17, 2015, when NMFS published its IHA Notice in the Federal Register. Accordingly, NJDEP does not meet the requirements for obtaining consistency review under Subpart F.[5]

III. NSF's Submission of its CD Under Subpart C

Although NJDEP concedes in its April 21, 2015 letter to OCM that NSF did provide a CD to NJDEP and that it "stands by its Inconsistency Determination," the letter goes on to state that, ". . . it has recently come to the Department's attention that NSF may have erred in characterizing the [proposed Survey] as a federal agency activity subject to Subpart C." (*See* NJDEP letter dated April 21, 2015 at page 2.) To clarify, NSF's CD was properly submitted under Subpart C.

NSF's "Federal agency activity" does come under Subpart C. While NSF does not assert that its "Federal agency activity" falls under 15 C.F.R. § 930.31(a) or (b) (as it is neither a function performed by or on behalf of NSF, nor a federal development project), it does fall within the definition of Subpart C's "residual category of Federal actions that are not covered under subparts D, E, or F of this part." 15 C.F.R. § 930.31(c). For the proposed Survey, NSF, through its environmental reviews, is now in the process of determining whether there are environmental impacts associated with rescheduling the 2014 survey to the same timeframe in 2015; NSF's role, as stated above, is no longer to consider a federal assistance application from Rutgers for the survey. Therefore, NSF's "Federal agency activity" properly falls under 15 C.F.R. § 930.31(c).

[5] NJDEP also failed to meet the "immediately" requirement under Subpart F last year for the 2014 survey.

IV. Conclusion

NSF appreciates the opportunity to provide comments in response to NJDEP's April 21, 2015 letter. NSF hopes that the information set forth above will provide clarity regarding NJDEP's actual and constructive notice of the proposed Survey, and NSF's current role in reviewing whether there are environmental impacts, if any, associated with the rescheduling of the proposed Survey during the June-August 2015 timeframe.

NSF has made significant efforts, especially after the 2014 survey was postponed, to reach out to NJDEP to ensure that NJDEP was: 1) notified of the proposed Survey; 2) given an opportunity for Consistency Review; and 3) provided numerous opportunities to work with NSF to resolve any potential differences. NSF remains committed to working with NJDEP in a positive manner regarding the proposed Survey. If you need any additional information, or would like to discuss the information already provided, please do not hesitate to contact me either by email or by phone at 703-292-7713.

Sincerely,

Holly E. Smith
Environmental Compliance Officer

Cc: Professor James Wright, Graduate Programs Director
The State University of New Jersey at Rutgers

Dr. Gregory S. Mountain
Department of Earth and Planetary Sciences
The State University of New Jersey at Rutgers

Sean C. Soloman, Director
Lamont-Doherty Earth observatory
The Earth Institute, Columbia University

David B. Fanz, Assistant Director
Division of Land Use Regulation
New Jersey Department of Environmental Protection

RUTGERS
Office of the Senior Vice President
and General Counsel

May 5, 2015

Jeffrey Payne, Acting Director
Office for Coastal Management
National Oceanic and Atmospheric Administration
1305 East West Highway
Silver Spring, MD 20910-9997

Re: April 21, 2015 Letter from New Jersey Department of Environmental Protection ("DEP") requesting Coastal Zone Management Act ("CZMA") review of the proposed marine geophysical survey aboard the *R/V Marcus G. Langseth* off the New Jersey coastline in the summer of 2015 (the "Project")

Dear Mr. Payne:

Rutgers University received the above captioned letter from the DEP as well as your response dated April 30, 2015 and the response from the National Science Foundation ("NSF") dated May 1, 2015. I write to confirm Rutgers University's agreement with the conclusions in your April 30, 2015 letter as well as in the NSF's letter dated May 1, 2015. For the reasons you and NSF have explained, Rutgers does not believe DEP has a right to require a review of the Project pursuant to Subpart D or F of the CZMA regulations.

Rutgers continues to stand behind the Project and believes the resulting data will help environmental agencies carry out their missions in the future.

Very truly yours,

Robert Roesener
Senior Associate General Counsel

cc (via email):
Richard W. Murrary, NSF
Holly E. Smith, NSF
Sean C. Solomon, Lamont-Doherty Earth Observatory
John Gray, NJDEP
Greg Mountain, Rutgers

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK

LAMONT-DOHERTY EARTH OBSERVATORY
OFFICE OF THE DIRECTOR

11 May 2015

Dr. Jeffrey L. Payne, Acting Director
Office for Coastal Management
National Oceanic and Atmospheric Administration
1305 East-West Highway
Silver Spring, MD 20910-9997

Re: 21 April 2015 Letter from New Jersey Department of Environmental Protection ("NJDEP") Requesting Approval to Review the Proposed Marine Geophysical Survey by the *R/V Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015 (the "Project")

Dear Dr. Payne:

The Lamont-Doherty Earth Observatory of Columbia University ("LDEO") received the above-captioned letter from the NJDEP and has also received your response dated 30 April 2015 and the comments from the National Science Foundation ("NSF") dated 1 May 2015. LDEO concurs with the conclusions in your 30 April 2015 letter and with the comments provided by NSF in the 1 May 2015 letter. For the reasons set forth in those letters, LDEO does not believe that NJDEP has a right to require a review of the Project pursuant to Subpart D or F of the Coastal Zone Management Act federal consistency regulations.

Sincerely,

Sean C. Solomon
Director

cc (via email):
David B. Fanz, NJDEP
Richard W. Murray, NSF
Holly E. Smith, NSF
Gregory S. Mountain, Rutgers University
James D. Wright, Rutgers University

P.O. Box 1000 61 Route 9W Palisades, NY 10964 845-359-2900 Fax 845-359-2931

National Science Foundation
Geosciences Directorate
Division of Ocean Sciences
Arlington, Virginia

FINAL FEDERAL CONSISTENCY DETERMINATION
for the Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015

PROPOSAL:
OCE 1260237
Principal Investigator/Institution: Gregory Mountain, Rutgers University
Project Title: Collaborative Research: Community-Based 3D Imaging That Ties Clinoform Geometry to Facies Successions and Neogene Sea-Level Change

COLLABORATIVE PROPOSAL:
OCE 1259135
Principal Investigators/Institution: Craig Fulthorpe, James Austin, Mladen Nedimovic, University Texas at Austin

Following an extensive environmental review process, a proposed federally funded marine geophysical research survey, designed to take place approximately 18 – 50 nautical miles (nmi) (33–92 km) off the coast of New Jersey (NJ) and 15 – 47 nmi (27–87 km) from NJ state waters, was authorized by the National Science Foundation (NSF) to commence on July 1, 2014. Due to mechanical issues with the vessel (the R/V *Marcus G. Langseth* (*Langseth*)), however, the research was unable to be completed during the time periods authorized under the Incidental Harassment Authorization (IHA) and the Biological Opinion/Incidental Take Statement (BO/ITS) issued by the National Marine Fisheries Service (NMFS) for the 2014 survey. As a result, NSF informed NMFS of its interest in rescheduling the 2014 survey for a 30 day period during the same June-August timeframe in 2015 (Proposed Activity). In response, NMFS informed NSF that a new IHA would be required to reschedule the 2014 survey, and an environmental review process for the Proposed Activity was initiated by NSF.

NSF's environmental review process for the Proposed Activity included compliance with Subpart C of the Coastal Zone Management Act (CZMA). After learning that a new IHA would be necessary, NSF initiated a dialogue with the New Jersey Department of Environmental Protection (NJDEP) to determine if they were interested in conducting a consistency review of the Proposed Activity under the CZMA, and NJDEP indicated that it was interested in doing so. As described below, NSF prepared a Consistency Determination (CD) to which NJDEP responded (Consistency Review), finding the proposed Activity inconsistent with three enforceable policies of NJ's federally approved Coastal Management Plan (CMP). After receiving NJDEP's Consistency Review, NSF considered it within the context of the entire record for the 2014 survey; the Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey and accompanying Record of Decision (PEIS); the Draft Amended Environmental Assessment and associated public comments; the IHA, BO, and ITS issued in 2015 by NMFS; concurrence from USFWS; and the EFH response from NMFS. Based on all of these sources and the entire record for NSF's CZMA compliance, NSF concludes that the Proposed Activity is, contrary to NJDEP's finding, consistent to the maximum extent practicable with the CMP.

Proposed Activity

The proposal, "Collaborative Research: Community-Based 3D Imaging That Ties Clinoform Geometry to Facies Successions and Neogene Sea-Level Change," was submitted to NSF by lead Principal Investigator (PI) Dr. G. Mountain, of Rutgers University, and collaborating PIs Drs. C. Fulthorpe, M. Nedimovic, and J. Austin, of University of Texas at Austin . Following NSF's merit review process, the proposal was recommended for award in late 2013. A two-year continuing grant, contingent upon obtaining appropriate authorizations and completion of the NSF environmental review process, was awarded on January 15, 2014.[1]

The proposed collaborative research objectives and efforts associated with the Proposed Activity remain unchanged from those planned in 2014. Specifically, the research[2] efforts would include the collection and analysis of data on the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to the present. Despite their existence being clearly indicated in sediment cores recovered during International Ocean Discovery Program (IODP) Expedition 313, features such as river valleys cut into coastal plain sediments, now buried under a kilometer (km) of younger sediment and flooded by today's ocean, cannot be resolved in existing 2-Dimensional (D) seismic data to the degree required to map shifting shallow-water depositional settings in the vicinity of clinoform rollovers. To achieve the research goals, the PIs propose to use a 3-D seismic reflection survey to map sequences around existing IODP Expedition 313 drill sites and analyze their spatial/temporal evolution. Objectives that would then be met include establishing the impact of known Ice House base-level changes on the stratigraphic record; providing greater understanding of the response of nearshore environments to changes in elevation of global sea level; and determining the amplitudes and timing of global sea-level changes during the mid-Cenozoic era.

As was the case with the 2014 survey, the research for the Proposed Activity would be conducted on the NSF-owned research vessel (R/V) *Marcus G. Langseth (Langseth*), which is operated on NSF's behalf by

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[1] The award expires on December 31, 2015. All funding for this two-year grant has been released

[2] In its Consistency Review, NJDEP commented that the focus of the study was on, "climatology and geology, and did not include other areas of research needs, including aquatic biology and fisheries management" which NJDEP found, "contrary to NSF's mission to promote collaborative work on novel, complex issues." While NSF does promote collaborative work on novel complex issues, NSF's mission, as stated in the preamble to the National Science Foundation Act of 1950 (Public Law 810507, as amended) is, "To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." Both the PEIS (Section 1.2) and Draft Amended EA (Chapter I) cite to the mission of NSF. Furthermore, the research proposal for the Proposed Activity was submitted to the NSF Marine Geology and Geophysics program (MG&G) which supports a broad range of research on all aspects of geology and geophysics of the ocean basins and margins, as well as the Great Lakes. Proposals submitted to this program must relate to established program priorities (for more detail see: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=11726). While collaborative interdisciplinary research efforts are encouraged and funded by NSF, they are not a pre-requisite for all funding opportunities, including the NSF MG&G program. The information collected during the survey would support research on various geologic processes and produce a data set for a larger user community of scientists, educators and students. While the research proposal may not have included topics outside of the geosciences, such as aquatic biology as suggested by NJDEP, it is a prime example of community driven scientific collaboration, which in this instance, was determined by a panel of experts to be highly meritorious, met all NSF program requirements, and was determined by NSF Program Officers as worthy of funding. Moreover, it is not appropriate for NJDEP to use the consistency review process to alter the research proposal or the Proposed Activity (National Oceanic and Atmospheric Administration (NOAA) 2009. CZMA Federal Consistency Overview. Section 307 of the Coastal Zone Management Act of 1972. Accessed on May 16, 2015, at http://coast.noaa.gov/czm/consistency/media/FC_overview_022009.pdf. p. 7).

Columbia University's Lamont-Doherty Earth Observatory (L-DEO) pursuant to a cooperative agreement. The research is not related to energy resources or facilities, including oil and gas exploration, development, production, or lease sales, and, therefore, is not subject to Bureau of Ocean Energy Management regulatory jurisdiction pursuant to the Outer Continental Shelf Lands Act. The research is also not related to ocean mining.

Procedural History

2014 Survey

On February 3, 2014, NSF posted a Draft Environmental Assessment (EA) on the NSF website, requesting public review and comment on the 2014 survey during a 30 day public comment period, ending on March 3, 2014. NJDEP did not comment during this public comment period on NSF's Draft EA, which was prepared pursuant to the National Environmental Policy Act (NEPA).

On March 17, 2014, NMFS announced in the Federal Register their intent to issue an Incidental Harassment Authorization (IHA) pursuant to the Marine Mammal Protection Act (MMPA) for the 2014 survey.

On April 9, 2014, in response to a request to extend the public comment period on the IHA, NMFS issued a second notice in the Federal Register extending the comment period by 30 days.

In addition to the formal public notices of the 2014 survey published on the NSF website and in the Federal Register, NSF, NOAA's Office for Coastal Management (OCM) and NJDEP engaged in informal conversations regarding the 2014 survey. These informal conversations began when NSF contacted OCM in late March to discuss CZMA implications regarding the 2014 survey.

On April 14, 2014, OCM left a voicemail message for NSF staff notifying them that the NJDEP informally contacted OCM on April 11, 2014, expressing an interest in the 2014 survey. After receiving the news from OCM, NSF immediately contacted OCM and suggested holding a joint teleconference with NJDEP and OCM to discuss NJDEP's interest in the 2014 survey.

On April 22, 2014, OCM arranged a teleconference with NJDEP and NSF to discuss applicability of the CZMA. The majority of the discussion was devoted to identifying which CZMA Subpart applied to the 2014 survey. Despite repeated requests for NJDEP to identify which enforceable policies it believed were implicated, no response was given to NSF.

Following the April 22, 2014, teleconference with NJDEP, NSF staff held numerous discussions separately with OCM and NJDEP staff to try to identify NJDEP's concerns with the 2014 survey and learn of any relevant enforceable policies NJDEP believed applied.

On May 7, 2014, another teleconference was held with OCM, NJDEP, and NSF staff to again discuss NJDEP's concerns, however, NJDEP again failed to identify any enforceable policies it believed were implicated; only vague requests for delaying the 2014 survey and employing non-specific mitigation measures were made. When NSF asked NJDEP staff to provide specifics regarding these requests, however, none were provided.

On May 15, 2014, NJDEP submitted comments to NMFS pursuant to the MMPA IHA public comment period.

On May 20, 2014, despite NSF's repeated and good-faith efforts to respond to NJDEP's concerns, NJDEP sent an email to NSF staff with an attachment of a letter sent by NJDEP, via regular U.S. mail, from Virginia KopKash, Assistant Commissioner NJDEP to Margaret Davidson, Acting Director OCM requesting review of the 2014 survey under Subparts C and F of the regulations implementing the CZMA, with a carbon copy to NSF. The letter, however, failed to formally identify the relevant enforceable policies of concern to NJDEP. In sum, NJDEP waited three and one-half months to bring their request to OCM to review the 2014 survey under Subpart F of the CZMA's implementing regulations. Further, despite being given many opportunities to engage in a dialogue about their concerns, NJDEP waited until the very end of the lengthy environmental compliance process to make their formal request to review the 2014 survey; the originally proposed 2014 survey sail date of June 3, 2014, was clearly published in the NSF Draft EA, which was made available on the NSF website on February 3, 2014; the originally proposed June 3, 2014 sail date was also published in the NMFS IHA Federal Register notice on March 17, 2014.

On May 29, 2014, NSF responded to NJDEP's consistency review request for the 2014 survey, an unlisted activity, asserting that the state's request was untimely under the CZMA regulations.

On June 18, 2014, OCM, formally responded to, and denied, NJDEP's request to review the 2014 unlisted activity, finding the request untimely.

On July 1, 2014, having received all necessary regulatory authorizations and approvals, and after completing the NSF environmental compliance process, the 2014 survey was authorized to commence. As noted in the Draft Amended EA, during the 2014 survey activity, which took place within the same timeframe in 2014 as is proposed for 2015, no active commercial or recreational fishing vessels were observed during the approximate 13 days the vessel was in or near the survey area. Also during the days at sea in 2014, no fish kills or injuries to fish, marine mammals, seabirds, or sea turtles (or their habitats) were observed by the independently contracted Protected Species Observers (PSOs) aboard the *Langseth*. No reports of marine mammal strandings were reported to NSF as attributable to the 2014 survey.

On July 3, 2014, NJDEP filed a complaint in federal District Court seeing injunctive and declaratory relief. On July 10, 2014, the District Court denied NJDEP's request for emergency injunctive relief, and NJDEP filed an appeal to U.S. Court of Appeals for the Third Circuit. On July 14, 2014, NJDEP's request for emergency injunctive relief was denied by the Third Circuit, and on August 12, 2014, the matter was dismissed from District Court without prejudice.

In August 2014, the 2014 survey was postponed due to mechanical issues with the *Langseth*, with the intent to reschedule in 2015.

2015 Proposed Survey

On October 8, 2014, NSF contacted NJDEP about NSF's interest in rescheduling the 2014 survey for a 30-day period within the same timeframe (June/July/August) in 2015, and a teleconference to discuss details further was arranged for October 15, 2014.

On October 15, 2014, NSF and NJDEP held a teleconference about the Proposed Activity. NSF reviewed NJ's Coastal Management Program Federal Consistency Listings (http://www.state.nj.us/dep/cmp/2008_fc_listing.pdf) and determined the activity to be unlisted. NSF then asked NJDEP if they had interest in reviewing the Proposed Activity under the CZMA, and NJDEP confirmed their interest in conducting a consistency review. By providing early notice about the Proposed Activity, NSF intended to allow for the maximum time available to discuss it with NJDEP and resolve any potential differences prior to submitting a CD and/or during the 90 day consultation period following submission of a CD. At that time, per 15 C.F.R. Part 930.34(d), NSF also requested that NJDEP provide a list of relevant enforceable policies for the Proposed Activity. Despite repeated requests, NJDEP did not provide a list of relevant enforceable policies to NSF.

On November 17, 2014, NSF again contacted NJDEP regarding the Proposed Activity. NSF was informed that a particular NJDEP staff member had been assigned to review the Proposed Activity and manage the collaboration.

On November 20, 2014, NSF spoke briefly about the Proposed Activity with the assigned NJDEP staff member. As a follow-up to this conversation, on November 21, 2014, NSF offered to discuss the Proposed Activity further with NJDEP, either remotely or in person. NJDEP, however, did not respond to NSF's offer.

On December 19, 2014, NSF posted a Draft Amended EA prepared pursuant to NEPA on the NSF website for a 37 day public comment period. NSF later extended the public comment period an additional 15 days, closing February 9, 2015.

On December 22, 2014, despite not receiving a list of relevant enforceable policies from NJDEP, NSF submitted a CD to NJDEP under Subpart C of the federal consistency regulations[3]. Although NSF did not anticipate effects on NJ's coastal uses or resources as a consequence of the Proposed Activity, due to the circumstances surrounding the 2014 survey and NJDEP's expressed interest in reviewing the Proposed Activity for federal consistency, NSF chose to submit a CD to ensure that NJDEP would have the opportunity to have a consistency review[4]. NJDEP's 60 day consistency review period under CZMA Subpart C commenced on December 22, 2014.

In January 2015, NSF contacted NJDEP several times regarding the CD, however, the assigned NJDEP staff member did not contact or engage NSF further on the matter.

On February 9, 2015, NJDEP submitted comments to NSF on the Draft Amended EA for the Proposed Activity.

NSF received a letter from NJDEP requesting a 15 day extension pursuant to 15 CFR 930.41(b) of the CZMA. The letter, which was dated February 11, 2015, was sent via regular U.S mail and postmarked February 12, 2015. NJDEP identified in a previous letter submitted via email to NSF on February 9, 2015, that a final determination on NSF's CD, or request to extend, would be provided to NSF by February 19, 2015. The letter requesting an extension, however, was not received by NSF until February 20, 2015, and did not reach NSF staff until February 23, 2015.[5]

On February 24, 2015, NSF responded to NJDEP's extension request acknowledging that the state wished an additional 15 days (until March 6, 2015) to complete their review of the Proposed Activity. NSF encouraged NJDEP, however, to provide earlier notification so that NSF and NJDEP could maximize the time available within the 90 day notice period to resolve any potential differences.

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[3] Appended to the CD was NSF's Draft Amended EA, which had been posted on NSF's website on December 19, 2014.
[4] As an unlisted activity, per the CZMA, NJDEP would be required to (1) request review of the project and receive approval from NOAA OCM, and (2) prove the proposed activity would have effects on coastal uses and resources.
[5] The request for an extension was not made by e-mail, which NSF had previously requested.

On March 6, 2015, NJDEP provided their Consistency Review to NSF, finding the proposed activity to be "inconsistent" with three enforceable policies of the CMP. Pursuant to 15 CFR Part 930.41 (a), "A state agency shall inform the federal agency of its concurrence with or objection to the Federal agency's consistency determination at the earliest practical time...".[6] Although NJDEP's Consistency Review was slightly ambiguous, NSF has treated it as an objection.

On March 6, 2015, NSF contacted NJDEP to discuss their Consistency Review and to engage in a dialogue regarding NJDEP's concerns. Subsequent teleconferences were held, and NSF stressed interest in trying to resolve differences within the 90 day consultation period (which ended on March 22, 2015). NSF also requested clarifying information on some points noted in NJDEP's Consistency Review.

On March 16, 2015, per NSF's request, NJDEP provided some information regarding commercial and recreational fisheries noted in NJDEP's Consistency Review.

On March 17, 2015, NMFS issued in the Federal Register a notice of intent to issue an IHA and solicitation for comments during a 30-day open public comment period closing April 16, 2015.

On March 25, 2015, NJDEP expressed interest in arranging a meeting to further discuss NJDEP's field study recommendation, provided a scientific publication on the study of the effect of seismics on fish abundance and catch rates, and provided revisions to some of the commercial fisheries information provided to NSF on March 16, 2015.

On April 6, 2015, NSF received a request from NJDEP for informal mediation facilitated by OCM pursuant to 15 CFR Part 930.111. This request was made following NSF's multiple attempts since October 8, 2014, to discuss and resolve potential issues with NJDEP both prior to submission of the CD (as encouraged by CFR 930.36(a)) and during the 90 day consultation period.

On April 9, 2015, NSF agreed to informal mediation within the context of the CZMA and the enforceable policies of the CMP.

On April 16, 2015, the NMFS public comment period on the IHA closed.

On April 20, 2015, NJDEP responded to NSF that they would initiate a request for mediation assistance with OCM. Although unclear to NSF why NJDEP waited 11 days to respond to NSF regarding the informal mediation, NSF provided an immediate response back to NJDEP and OCM on April 21, 2014, to begin informal mediation efforts, and arranged a telecon for that afternoon.

On April 21, 2015, NSF, NJDEP, and NOAA OCM held a telecon to begin a discussion on informal mediation efforts. On that call, NJDEP agreed to contact OCM and NSF on April 23, 2015 about arrangements for a next meeting and additional details regarding recommendations included in their Consistency Review; NJDEP, however, did not follow up with those details.

On April 27, 2015, NSF staff received a letter from NJDEP dated April 21, 2015[7] (mailed via U.S. mail and post marked April 22, 2015) regarding, "Notice of Stage [*sic*] Agency Review of the proposed

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[6] 15 C.F.R. 930.41(a).

[7] On February 24, 2015, NSF requested that NJDEP, in order to facilitate timely communication between our offices, all correspondence be provided by email, regardless of whether a hard copy is also mailed via U.S. mail; NSF extended the same courtesy to NJDEP. Despite acknowledging the need to be sensitive to the timeline, NJDEP ignored NSF's request and sent their letter via regular U.S. mail.

Marine Geophysical Survey by the *R/V Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015." NJDEP stated that the letter, "serves as notice that the proposed Project requires review by the New Jersey Department of Environmental Protection (the "Department") pursuant to 15 C.F.R. 930.54 within Subpart D (Unlisted federal license or permit activities) and 15 C.F.R. 930.98 within Subpart F (Federally assisted activities outside of the coastal zone) of the federal coastal management regulations." Regardless that Subpart C was the appropriate Subpart under which NSF should have and did submit a CD for review, NJDEP, through its April 21, 2015, letter announced that it wanted additional consistency review for the same Proposed Activity, albeit under different subparts. The Proposed Activity would, however, remain the same whether reviewed by NJDEP under Subpart C, D, or F. In addition, NJDEP had ample opportunity to review the project, both in the spring of 2014 when NJDEP waited months to seek review of the 2014 survey – an unlisted activity – and again for the Proposed Activity, which NJDEP knew about since October 8, 2014.

On April 30, 2015, OCM sent a letter to NJDEP denying the request to review the Proposed Activity under Subparts D and F. OCM noted that, as NJDEP had acknowledged in their letter, "...the CZMA regulations make clear that a project cannot be treated as *both* a federal agency activity under Subpart C and also an activity under Subpart D or F. Here, the Department [NJDEP] performed its review of the Project under Subpart C and having completed that review, additional, parallel, or redundant reviews under other Subparts of the regulations are now precluded." In its letter, OCM also indicated, "...that even if the reviews the Department is requesting were not otherwise precluded, it is not clear the request would meet the technical requirements set forth in the CZMA rules for reviews under Subpart D or F, including timeliness, proper notice, etc."

On May 1, 2015, NSF submitted comments to OCM regarding NJDEP's April 21, 2015, request to seek additional consistency review. In its comments, NSF explained why NJDEP should not be given yet another bite at the consistency review apple. Specifically, NSF explained that, because the Proposed Activity did not involve a pending application for federal financial assistance and the agency activity at issue for NSF now is to determine whether rescheduling the 2014 survey to the same timeframe in 2015 would result in any environmental impacts not previously considered, consistency review was appropriate under Subpart C, not F. Moreover, even if Subpart F could be deemed appropriate, NJDEP did not "immediately" seek review as required by the regulations. Finally, NSF explained that, even if NJDEP had a right to review under Subpart D, NJDEP waived their right to seek review because they waited more than 30 days before seeking review.

On May 5 and 11, 2015, Rutgers University and L-DEO, respectively, sent letters to OCM concurring with OCM's findings and the additional comments provided in NSF's letter to OCM dated May 1, 2015.

Mediation efforts by NSF and NJDEP are ongoing, and NSF remains hopeful that an agreement will ultimately be reached.

Enforceable Policies

In their Consistency Review, NJDEP reported their findings that the Proposed Activity was inconsistent with three enforceable policies of the CMP: N.J.A.C. 7:7E-3.4 Prime Fishing Areas; N.J.A.C. 7:7E-8.2 Marine Fish and Fisheries; and N.J.A.C. 7:7E-3.38 Endangered or Threatened Wildlife or Plant Species Habitats. NJDEP stated their determination relied on the NSF PEIS dated June 2011, the NSF Draft Environmental Assessment dated December 2013, the Draft Amended EA dated December 2014, and comments received as part of the public comment period held by NJDEP for their Consistency Review. On March 9, 2015, NSF requested copies of the public comments received by NJDEP; on March 16, 2015, NJDEP provided copies of the public comments which included comments from five entities[8]: Clean Ocean Action, Jersey Coast Anglers Association, New Jersey Outdoor Alliance, and two private citizens. As noted above, NSF reviewed and considered the analysis and information NJDEP presented in their Consistency Review which led them to conclude the Proposed Activity was inconsistent with three enforceable policies of the CMP. After review of the entire CZMA record, NSF concludes, however, that the Proposed Activity is indeed consistent to the maximum extent practical with the enforceable policies of the CMP for the specific reasons set forth below.

N.J.A.C. 7:7E-3.4 Prime Fishing Areas

In their consistency review, NJDEP found that, while seismic surveys were not expressly prohibited by N.J.A.C. 7:7E-3.4 Prime Fishing Areas, based on studies examining seismic survey impacts, it would be reasonably foreseeable that the Proposed Activity would affect fishery distribution, movement, migration, and spawning at identified prime fishing areas. NJDEP further stated that the Proposed Activity would foreseeably result in adverse impacts to the high productivity of New Jersey's commercial and recreational fishing industry. In conclusion, NJDEP found the Proposed Activity to be inconsistent with the prime fishing areas rule, N.J.A.C. 7:7E-3.4, because of the foreseeable effect on utilization of prime fishing areas.

The Prime Fishing Area enforceable policy described at N.J.A.C. 7:7E-3.4 states:

(a) Prime fishing areas include tidal water areas and water's edge areas which have a demonstrable history of supporting a significant local intensity of recreational or commercial fishing activity. These areas include all coastal jetties, groins, public fishing piers or docks, and artificial reefs. Prime fishing areas also include features such as rock outcroppings, sand ridges or lumps, rough bottoms, aggregates such as cobblestones, coral, shell and tubeworms, slough areas and offshore canyons. Prime fishing areas also include areas identified in "New Jersey's Recreational and Commercial Fishing Grounds of Raritan Bay, Sandy Hook Bay and Delaware Bay and The Shellfish Resources of Raritan Bay and Sandy Hook Bay" Figley and McCloy (1988) and those

[8] NJDEP states on page 10 of their Consistency Review, that, "because of the significant concerns raised by multiple states and stakeholders throughout the United Sates, the Department sees this as an opportunity for NSF to develop scientifically valid consensus on seismic studies." NSF reviewed the public comments from the five entities received by NJDEP regarding NSF's CD and found no public comments received from other states. Although no specific reference or citation was provided, NJDEP refers at the conclusion of their letter, on page 11, to a group that has "urged the President" about concerns related to "oil and gas exploration," which is an activity unrelated to the Proposed Activity and is proposed and regulated by a different federal agency. NJDEP's Consistency Review should have focused on *NSF's* Proposed Activity, the enforceable policies of the CMP, and the public comments received as part of NJDEP's review process. Within the bounds of CZMA review, unless public comments relate to the effects of the proposed action on coastal uses and resources and the consistency of the proposed activity to relevant enforceable policies, they should have no bearing on the State's decision.

Furthermore, NSF participates on many interagency committees, in workshops, and on panels related to anthropogenic sound in the marine environment, including for seismic surveys. For example, for approximately the past year and a half NSF has participated on the Subcommittee on Ocean Science and Technology (SOST) Interagency Task Force on Ocean Noise and Marine Life. NSF has also funded numerous awards related to furthering the understanding of the impacts of sound on marine species and the environment. Most recently, in March 2015, NSF provided federal funding for the, "Fourth International Conference on Effects of Noise on Aquatic Life" (see page 14-15 for more details). For a wide variety of technical reasons, it would, however, be impossible for NSF to "develop scientifically valid consensus on seismic studies' impacts to marine life" anticipated from the Proposed Activity as suggested by NJDEP on page 10 of their Consistency Review, as the Proposed Activity is not representative of the myriad scenarios that seismic surveys are conducted or located (i.e., source level, water depth, presence of marine species, etc.). NJDEP's statement and recommendation were inappropriate for inclusion in their Consistency Review and outside of the scope of what should have been included in a State's CZMA review.

areas identified on the map titled, "New Jersey's Specific Sport Ocean Fishing Grounds." This map is available through the Coastal Management Program's website at www.state.nj.us/dep/cmp.

(b) Standards relevant to prime fishing areas are as follows:

1. Permissible uses of prime fishing areas include recreational and commercial finfishing and shellfishing, as presently regulated by the Department's Division of Fish and Wildlife, scuba diving and other water related recreational activities.

2. Prohibited uses include sand or gravel submarine mining which would alter existing bathymetry to a significant degree so as to reduce the high fishery productivity of these areas. Disposal of domestic or industrial wastes must meet applicable State and Federal effluent limitations and water quality standards.

It is clear that the enforceable policy described at N.J.A.C. 7:7E-3.4 does *not* prohibit marine geophysical surveys inside, or outside, NJ state waters, but, rather, specifically identifies the prohibition of sand and gravel submarine mining within the coastal zone and notes conditions for disposal of domestic and industrial waste. Furthermore, in the unlikely event the Proposed Activity did have an effect on prime fishing areas, the enforceable policy described at N.J.A.C. 7:7E-3.4 does not prohibit activities from having effects on prime fisheries areas, other than for sand and gravel submarine mining.

As support for their inconsistency finding, NJDEP also noted in their Consistency Review that the project location and timeframe for the Proposed Activity would foreseeably and adversely affect NJ's prime fishing areas. NJDEP stated that the proposed project area, off the coast of NJ and beyond state waters, would see high commercial and recreational activity during the study period. While NSF agrees with NJDEP that there are waters off NJ that include important fishing areas, NSF disagrees with NJDEP's portrayal that the proposed survey area would be one that would be heavily occupied by recreational and commercial fishermen during the proposed survey time period. As noted in the Draft Amended EA, during the 2014 survey activity, which took place within the same timeframe in 2014 as is proposed for 2015, no active commercial or recreational fishing vessels were observed during the approximate 13 days the vessel was in or near the survey area. To determine fishing vessel traffic during the proposed survey period off NJ, historical National Automated Identification System (NAIS)[9] data from the USCG Navigation Center for June and July 2013 and 2014 was evaluated. The number of fishing vessels equipped with AIS in the proposed survey area was 21–27 per month, with only 4–6 of those vessels spending more than a few hours. During 4 previous research seismic surveys in the survey area, space-use conflicts were not reported to NSF or the Principal Investigators (PIs), nor were there any noticeable effects on commercial or recreational fish catch rates (Draft Amended EA, page 53). The Proposed Activity would occur approximately 18 – 50 nautical miles (nmi) (33–92 km) off the coast of NJ and 15 – 47 nmi (27–87 km) from NJ state waters. Potential impacts to fisheries would be temporary and localized within or near the proposed survey area, and likely would have no effect on prime fishing areas within NJ's state waters (which extend three nautical miles from the NJ shore) or on other related coastal uses or resources. Indeed, NJDEP did not assert in its Consistency Review that any coastal uses or resources within NJ's coastal zone would be impacted by the Proposed Activity. In the unlikely event the Proposed Activity would have an effect on prime fishing areas, the enforceable policy described at N.J.A.C. 7:7E-3.4 would not be implicated because it does not prohibit activities from having effects on prime fishing areas, except for sand and gravel submarine mining. In addition, unlike some other enforceable policies of the CMP, N.J.A.C. 7:7E-3.4 does not provide timeframe restrictions for activities that may have effects on prime fishing areas.

[9] Using the National Automated Identification System (NAIS), detailed information on marine vessel traffic is collected, consolidated, and disseminated to the Coast Guard and other government agencies; the information includes vessel type, name, and other information that allows the data to be sorted by activities, e.g., fishing, diving, sailing, recreational, and cargo. Because AIS-equipped vessels transmit at regular intervals, it is possible to discriminate between vessels that are in the area for a period of time and those that are passing through.

NJDEP also stated in their Consistency Review that the timing of the proposed survey would coincide with a period of high to peak population abundance of several commercially and recreationally important fish species at identified prime fishing areas. Also, in the recommendations included in their Consistency Review, NJDEP stated that they recommended that the Proposed Activity be moved to the September/October 2015 timeframe. Upon request by NSF, on March 16, 2015, NJDEP provided information that they relied upon in making this statement. The information was based on statistical data collected by NOAA for two large areas off the coast of NJ, specifically Statistical Areas 615 and 614. The survey area, however, would occur only within a small portion of NMFS Statistical Area 615. The information provided by NJDEP included commercial and recreational landing data for the combined NMFS Statistical Areas 614 and 615. The information portrayed peak landings in Statistical Areas 614 and 615 during 2011 occurring in the summer months. On March 25, 2015, in response to NSF's request, NJDEP provided data for the NMFS Statistical Areas 614 and 615, uncombined; NJDEP, however, also noted that the information provided on March 16, 2015, was miscalculated and, therefore, corrections had been made to the data. The revised information contradicted the earlier information provided to NSF. Rather than demonstrating peak landings for Statistical Areas 614 and 615 during 2011 in the summer months, the revised information showed the summer as having significantly lower landings than in spring, fall, or winter. Information provided by NJDEP demonstrated that for recreational landings from 2011 to 2014, the highest landings for two out of the four years occurred in September/October. The recreational landings information provided were for all waters off NJ, not just for the survey area or Statistical Area 615. Irrespective, it is essential to distinguish that landing data does not necessarily indicate fish abundance, as landings are affected by both abundance and fishing effort. Furthermore, and more importantly, the enforceable policy described at N.J.A.C. 7:7E-3.4 does not address or include activity restrictions for time periods of population abundance of commercial and recreational fish species at prime fishing areas. As noted previously, time restrictions are, however, included in other enforceable policies of the CMP for certain activities. For example, under N.J.A.C. 7:7E-3A.2 Standards applicable to routine beach maintenance (a) 4, there is a specific time period (March 15 and August 31) during which certain beach maintenance activities, such as beach raking, are prohibited because NJDEP has identified the presence of habitat for threatened and endangered beach nesting shorebirds. Therefore, NJDEP's request that the Proposed Activity be moved to the September/October time-frame is not grounded in any enforceable policy of the CMP.

In NJDEP's Consistency Review, references to studies on potential impacts from airguns on scallop lifecycle stages and concern about reductions in harvestable stock were noted. As stated on page 51 of the Draft Amended EA, "Significant developmental delays and body abnormalities in scallop larvae exposed to seismic pulses were reported by de Soto et al. (2013)[10]. Their experiment used larvae enclosed in 60-ml flasks suspended in a 2-m diameter by 1.3-m water depth tank and ***exposed to a playback of seismic sound at a distance of 5–10 cm***. [Emphasis added] This laboratory experiment would not, however, be representative of the Proposed Activity. Other studies conducted in the field have shown no effects on Dungeness crab larvae or snow crab embryos (Pearson et al., 1994; DFOC 2004 *in* PEIS[11]). Moreover, a major annual scallop-spawning period occurs in the Mid-Atlantic Bight during late summer to fall (August–October), although MacDonald and Thompson (1988 *in* NMFS 2004[12]) reported scallop

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[10] de Soto, N.A, Delorme, N., Atkins, J., Howard, S., William, J., and M. Johnson. Anthropogenic noise causes body malformations and delays development in marine larvae. Sci. Rep. 3:2831. doi: 10.1038/srep02831.

[11] NSF and USGS (National Science Foundation and U.S. Geological Survey). 2011. Final Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey (PEIS). Accessed on 28 April 2015 at http://www.nsf.gov/geo/oce/envcomp/usgs-nsf-marine-seismic-research/nsf-usgs-final-eis-oeis-with-appendices.pdf.

[12] NMFS (National Marine Fisheries Service). 2004. Essential Fish Habitat source document: sea scallop, *Placopecten magellanicus*, life history and habitat characteristics. 2nd edit. NOAA Tech. Memo. NMFS-NE-189. 21 p. Accessed at http://www.nefsc.noaa.gov/publications/tm/tm189/tm189.pdf in June 2014.

spawning off New Jersey during September–November." Therefore, the timing of the Proposed Activity (June/July/August) would mainly avoid the scallop-spawning period. Moving the timing of the Proposed Activity to September/October, as recommended by NJDEP would increase the chances of the Proposed Activity overlapping with the scallop-spawning period.

Based on this information, NSF concludes that there is no support for NJDEP's assertion that the Proposed Activity would take place in a highly utilized commercial and recreational fishing area during a time in which there would be a high to peak population abundance of several important fish species. This conclusion is in further support of NSF's conclusions noted in its PEIS, the 2014 Final EA, the 2015 Draft Amended EA, and CD that the Proposed Activity would not have a significant impact on fisheries in or near the survey area, let alone affect distant prime fishing areas or other coastal uses or resources within the NJ coastal zone. Furthermore, and as noted above, even if there were effects, affecting prime fishing areas is not prohibited by the enforceable policy described at N.J.A.C. 7:7E-3.4 Prime Fishing Areas.

In summary, NJDEP contends that the Proposed Activity could have reasonably foreseeable effects on prime fishing areas, however, they fail to identify how the Proposed Activity, even if there would be effects on prime fishing areas, would be inconsistent with the enforceable policy set forth at N.J.A.C. 7:7E-3.4 Prime Fishing Area. The enforceable policy, N.J.A.C. 7:7E-3.4 Prime Fishing Areas, specifically defines prime fishing areas and identifies prohibited activities in those areas over which the state has jurisdiction. While NJDEP suggests in their Consistency Review that the Proposed Activity would have foreseeable effects on utilization of prime fishing areas, the enforceable policy is not related to and does not address activities that might impact utilization rates of prime fishing areas. Academic seismic research surveys are not identified as activities that are not allowable in prime fishing areas within, or outside of, the NJ coastal zone. As noted in NSF's CD, the Proposed Activity does not involve those activities listed in 7:7E-3.4 Prime Fishing Areas as prohibited (sand or gravel submarine mining, or disposal of domestic or industrial wastes that do not meet applicable State and Federal effluent limitations and water quality standards). More importantly, the enforceable policy does not prohibit activities from having an effect on prime fishing areas, but, rather, prohibits particular activities not proposed by NSF, specifically, sand and gravel submarine mining. For these reasons, NSF concludes that the Proposed Activity is consistent to the maximum extent practicable with NJ's enforceable policy N.J.A.C. 7:7E-3.4 Prime Fishing Areas.

N.J.A.C. 7:7E-8.2 Marine Fish and Fisheries

In their Consistency Review, NJDEP found the Proposed Activity inconsistent with the enforceable policy at N.J.A.C. 7:7E-8.2 Marine Fish and Fisheries. The enforceable policy, N.J.A.C. 7:7E-8.2 Marine Fish and Fisheries, specifically states:

> (b) Any activity that would adversely impact on the natural functioning of marine fish, including the reproductive spawning and migratory patterns or species abundance or diversity of marine fish, is discouraged. In addition, any activity that would adversely impact any New Jersey based marine fisheries or access thereto is discouraged, unless it complies with (c) below.
> (c) The following coastal activities are conditionally acceptable provided that the activity complies with the appropriate general water area rule(s) at N.J.A.C 7:7E-4;
> 1. Construction of submerged cables and pipelines;
> 2. Sand and gravel mining to obtain material for beach nourishment, provided:
> i. The beach nourishment project is in the public interest;
> ii. There are no alternative borrow sites that would result in less impact to marine fish and fisheries;
> iii. Any alteration of existing bathymetry within Prime Fishing areas, as defined at N.J.A.C. 7:7E-3.4, does not reduce the high fishery productivity of these areas; and
> iv. Measures are implemented to minimize and compensate for impacts to marine fish and fisheries

NJDEP provided several reasons why the Proposed Activity was inconsistent with the enforceable policy described under N.J.A.C. 7:7E-8.2 Marine Fish and Fisheries, all of which are addressed below.

New Jersey's rules discourage activities that adversely impact the natural functioning of marine fish: The enforceable policy described at N.J.A.C. 7:7E-8.2 Marine Fish and Fisheries "discourages" but does not *prohibit* activities that adversely impact the natural functioning of marine fish. While the Proposed Activity may have a temporary impact on fish close to the vessel, as supported by the PEIS, 2014 Final EA, and Draft Amended EA, no significant impacts on fish populations and associated Essential Fish Habitat (EFH) would be anticipated. This conclusion is further supported by the EFH consultation conducted for the activity in 2014 and the proposed 2015 activity. The Proposed Activity would occur outside of NJ state waters, and any effects, would likely not affect fish and fisheries within the 3-nmi state waters. It is also important to note that studies evaluating impacts of sound on fish and fisheries vary (e.g., use of a larger source size) and do not necessarily emulate the Proposed Activity or potential impacts. Regardless, as the enforceable policy described at N.J.A.C. 7:7E-8.2 Marine Fish and Fisheries discourages, but does not prohibit activities that may impact marine fish, the Proposed Activity is consistent to the maximum extent practical with the enforceable policy described at N.J.A.C. 7:7E-8.2 Marine Fish and Fisheries.

NJDEP's Consistency Review referenced a study that demonstrated declining catch rates for a number of commercial fisheries during seismic testing activities (Engås, et al., 1996[13]). A substantial difference between the study by Engås et al. (1996) and the proposed activity is that they used a 5000-in^3 airgun array, whereas the proposed 2015 survey would use a 700-in^3 array. A shortcoming of the study by Engås et al. (1996) is that it lasted only 5 days after seismic activities ceased; during that time, trawl catches of cod and haddock and longline catches of haddock showed no increase, whereas longline catches of cod approached the preshooting level.

In NJDEP's letter, they also reported, "More recently, Svein Lokkeborg, et al., highlighted that "reduced catches on fishing grounds exposed to seismic survey activities have been demonstrated."" [Løkkeborg et al., 2012a[14]] The reference in NJDEP's letter is, however, a review in a book, "The effects of noise on aquatic life," whereas the reference provided in the Draft Amended EA is a paper in a journal that presents the results of a field experiment off Norway in 2009. As stated on page 52 of the Draft Amended EA, Løkkeborg et al. (2012b)[15] described in their introduction three studies in the 1990s that showed effects on fisheries. "In contradiction to these findings and fishermen's concerns" (Løkkeborg et al., 2012b), their study off Norway in 2009 showed that gillnet catches during seismic shooting were doubled for redfish (86% increase) and Greenland halibut (132%), whereas longline catches decreased (16% for Greenland halibut, 25% for haddock). These results were explained by greater swimming activity and lowered food search behavior in fish exposed to airgun sound. Also, for all but one fish species (pollock), acoustic mapping did not suggest displacement from fishing grounds (Løkkeborg et al., 2012b). NJDEP stated that, "The conclusions reached by the Løkkeborg study are further supported by other recent studies concluding that catch rates reduced in the presence of seismic studies," referring to Fewtrell and

[13] Engås, A., S. Lokkeborg, E. Ona, and A.V. Soldad. 1996. Effects of seismic shooting on local abundance and catch rates of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*). **Can. J. Fish. Aquat. Sci.** 53:2238-2249.
[14] Løkkeborg, S., E. Ona, A. Vold, and A. Salthaug. 2012a. Effects of sounds from seismic air guns on fish behavior and catch rates. Advances in Experimental Medicine and Biology 730:415-419.
[15] Løkkeborg, S., E. Ona, A. Vold, and A. Salthaug. 2012b. Sounds from seismic air guns: Gear- and species-specific effects on catch rates and fish distribution. **Can. J. Fish. Aquat. Sci.** 69:1278-1291.

McCauley (2012)[16]. Fewtrell and McCauley (2012), however, did not study catch rates, nor did they make any suggestions that their results were applicable to catch rates. Rather, as stated in the Draft Amended EA, they exposed squid, pink snapper, and trevally to pulses from a single airgun. The received sound levels ranged from 120 to 184 dB re 1 dB re 1 $\mu Pa^2 \cdot s$ SEL. Increases in alarm responses were seen in the squid and fish at SELs >147–151 dB re 1 $\mu Pa^2 \cdot s$; the fish swam faster and formed more cohesive groups in response to the airgun sounds, and squid were seen to discharge ink or change their swimming pattern or vertical position in the water column.

In their Consistency Review, NJDEP noted that, due to the time of year and project duration, the potential impacts could significantly affect harvest rates. The survey, however, would only take place for approximately 30 days, not the entire summer season, and only a small portion of the entire survey area would be affected at any one time during seismic operations. As stated in the Draft Amended EA (page 53), “the proposed survey area represents less than one half percent (0.28%) of the area of waters from the NJ shore to the EEZ...” The information presented by NJDEP in their letter, however, presumes loss of an entire harvest season for particular species over the entire NJ coastal region. In the unlikely event the survey were to have an impact on harvest rates, it would impact a much smaller percentage of harvest than what was presented by NJDEP. Furthermore, as noted previously and in the CD and Draft Amended EA, during 4 previous research seismic surveys in the proposed survey area, there were no noticeable effects on commercial or recreational fish catch rates in the months when the activities were undertaken (Draft Amended EA, page 53).

Minimize or mitigate for adverse impacts: The second reason NJDEP provided for finding the proposed activity inconsistent was, “NSF’s failure to minimize or mitigate for adverse impacts to a commercially important fishery, which is inconsistent with NSF’s own guidance...” This allegation – even if true – is not, however, related to the enforceable policy described at N.J.A.C. 7:7E-8.2 Marine Fish and Fisheries; there is no requirement for monitoring and mitigation for activities that may adversely impact marine fish except for those activities specifically defined in N.J.A.C. 7:7E-8.2 (c) 2 related to sand and gravel mining, and the Proposed Activity does not involve sand and gravel mining. Furthermore, although NSF disagrees with NJDEP’s conclusion that pre-survey planning was not conducted, the enforceable policy described at N.J.A.C. 7:7E-8.2 Marine Fish and Fisheries does not require pre-survey planning or an agency to be consistent with their own policies. As the Proposed Activity does not involve sand or gravel mining, and the enforceable policy does not require monitoring and mitigation or agency consistency with their own policies, NSF concludes that the Proposed Activity is consistent with the enforceable policy described at N.J.A.C. 7:7E-8.2 Marine Fish and Fisheries.

Even if relevant to the Consistency Review, which NSF asserts it is not, NJDEP’s conclusion that pre-survey mitigation planning was not conducted lacks merit. Pre-survey mitigation planning is described in the PEIS Section 2.4.1.1 Mitigation Measures (Mitigation during Planning Phases) (page 2-64); PEIS Section 3.3.7 Summary of Environmental Consequences – Fish (page 3-49); and, in the Draft Amended EA, Chapter II, Proposed Action (3)(a) Planning Phase (pages 6-7). During the planning stage for the Proposed Activity, survey timing and seasonal presence of marine species were taken into consideration. Most importantly, it was determined that for the 2015 proposed survey, a relatively small seismic source, 700 in^3, would be sufficient to meet the scientific needs. Based on preliminary information about the survey site provided by the PI, past experience by ship personnel familiar with the survey site, information presented in the 2014 Final EA, federal consultations conducted in 2014, impacts related to fish and space-use conflicts with fishermen, if any, were not expected to be significant. Therefore, during the survey planning stage, given the Proposed Activity, the standard operational monitoring and mitigation measures identified in the PEIS and the 2014 Final EA were viewed as appropriate to observe

[16] Fewtrell, J.L. and R.D. McCauley. 2012. Impact of airgun noise on the behaviour of marine fish and squid. **Mar. Poll. Bull.** 64(5):984-993.

and protect for potential impacts to marine species, including fish, and address potential space-use conflicts. Plans for monitoring and mitigation during operations were identified in the Draft Amended EA, Chapter II, Proposed Action (3)(b) Operational Phase (pages 7-8) and were consistent with the PEIS. As articulated in the Draft Amended EA, during survey operations, fishing activities could occur within the survey area; however, a safe distance would need to be kept from the *Langseth* and the towed seismic equipment. As identified during pre-survey planning efforts and specified in the Draft Amended EA, during operations, LDEO would coordinate with the U.S. Coast Guard to issue Notice to Mariners to avoid space-use conflicts with any fishermen in the area. Conflicts would be avoided and, therefore, impacts would be negligible. Greater clarification of PSO roles for monitoring for impacts to fish will be included in the Final Amended EA for the Proposed Activity based on NJDEP comments submitted to NSF during the public comment period on the Draft Amended EA. In addition to pre-survey planning, the Draft Amended EA provided detailed information in Chapter III, Fish, Essential Fish Habitat, and Habitat Areas of Particular Concern Section, on the two fish species listed under the ESA as Endangered that could occur within the study area: the New York Bight distinct population segment (DPS) of the Atlantic sturgeon, and the shortnose sturgeon, and the two candidate species for listing: the cusk and the Northwest Atlantic and Gulf of Mexico DPS of the dusky shark. Of the four potential species identified, two of them, the Atlantic and shortnose sturgeons, would be less likely to be found within the survey area because of their estuarine and nearshore coastal distribution. The Draft Amended EA, Chapter III, Fisheries Section also included analysis of the types of fish and commercial and recreational fisheries that could occur within and near the proposed survey site.

LDEO also has significant experience working in and around fisheries vessels while towing seismic equipment. A recent example includes the *Langseth* successfully coordinating with and working in and around fisheries vessels during a seismic survey conducted off the coast of North Carolina in 2014. In addition, during a survey in the Gulf of Mexico in 2007/2008, numerous vessels, including small fishing and shrimp boats, operated near the *Langseth*, approaching within 200 m of the vessel (Holst and Beland 2008)[17].

National Marine Fisheries Service (NMFS) findings and guidance: The third reason NJDEP found the Proposed Activity to be inconsistent with the enforceable policy was they felt NSF had not addressed a recommendation made by NMFS in a letter to NSF dated June 18, 2014, that delineated the conclusions of the EFH consultation for the 2014 survey. Contrary to NJDEP's interpretation, however, as stated in the letter, NMFS required no specific EFH conservation recommendations pursuant to Section 305(b)(2) of the Magnuson-Stevens Act for the Proposed Activity. Whereas NMFS suggested that additional research and monitoring were needed "to gain a better understanding of the potential effects seismic survey activities may have on EFH, federally managed species, their prey and other NOAA trust resources, and should be a component of future NSF funded seismic survey activities," it was not a requirement of the EFH consultation. Even though this was not a requirement for the survey to proceed, NSF has engaged in activities to gain a better understanding of the potential effects seismic survey activities may have on the marine environment, including on fish and EFH. For example, NSF provided federal funding for the, "Fourth International Conference on Effects of Noise on Aquatic Life" (AN2016), which is a follow-on from international meetings held in Nyborg, Denmark (2007), Cork, Ireland (2010), and Budapest, Hungary (2013; www.an2013.org), all of which NSF also provided funding. The major goal of AN2016 will be to define the current state of knowledge on the impact of underwater noise and, in particular, explore the progress made in this field in the three years since the previous conference. The meeting will bring together researchers, regulators/policy makers, and industry with an interest in

[17] Holst, M. and J. Beland. 2008. Marine mammal and sea turtle monitoring during Lamont-Doherty Earth Observatory's seismic testing and calibration study in the northern Gulf of Mexico, November 2007–February 2008. LGL Rep. TA4295-2. Rep. from LGL Ltd., King City, Ont., for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and Nat. Mar. Fish. Serv., Silver Spring, MD. 76 p.

different animal groups, including marine mammals, turtles, fish and invertebrates. Regardless of NJDEP's misinterpretation that additional research and monitoring were a requirement of the 2014 EFH consultation and that NSF has not made any efforts on this front, NJDEP did not identify how this issue relates to the enforceable policy described at N.J.A.C. 7:7E-8.2 Marine Fish and Fisheries. The enforceable policy described at N.J.A.C. 7:7E-8.2 Marine Fish and Fisheries includes no reference or provision for fisheries monitoring and mitigation except for those activities specifically defined in N.J.A.C. 7:7E-8.2 (c) 2. related to sand and gravel mining. As the Proposed Activity does not involve sand or gravel mining, and monitoring and mitigation are not requirements of the enforceable policy, NSF concludes that the Proposed Activity is consistent with the enforceable policy described at N.J.A.C. 7:7E-8.2 Marine Fish and Fisheries. Although not relevant for the consistency review, for clarity, NSF has in fact consulted on EFH with NMFS, the federal agency with jurisdiction over EFH for the Proposed Activity, and NMFS has drawn the same conclusion as in 2014 and provided no conservation recommendations.

Concerns raised by the Department's stakeholders: NJDEP also cited concerns raised by the Departments stakeholders, including members of New Jersey's commercial and recreational fishing industry as a reason for finding the Proposed Activity inconsistent with the enforceable policy. On January 21, 2015, NJDEP announced in the DEP Bulletin a 15-day public comment period for the CD review. After receiving NJDEP's Consistency Review on March 6, 2015, NSF requested on March 9, 2015, copies of the public comments received by NJDEP. NJDEP provided those comments to NSF on March 16, 2015. After NSF's review of the five comments received from NJDEP, NSF concluded that the comments focused on potential effects of the Proposed Activity, but did not define or describe how the Proposed Activity was consistent or not with the enforceable policy described at N.J.A.C. 7:7E-8.2 Marine Fish and Fisheries.

For the reasons noted above, NSF disagrees with NJDEP's inconsistent finding, and concludes that the Proposed Activity is consistent to the maximum extent practicable with the enforceable policy described at N.J.A.C. 7:7E-8.2 Marine Fish and Fisheries. Although NJDEP has suggested several recommendations for NSF to consider implementing should the Proposed Activity move forward, NJDEP did not specifically clarify how implementation of those recommendations would make the Proposed Activity consistent with this particular enforceable policy.

N.J.A.C. 7:7E-3.38 Endangered or Threatened Wildlife or Plant Species Habitats

In their Consistency Review, NJDEP, contends that there was "insufficient information to conclude that there will be insignificant impacts to the habitat of New Jersey's endangered and wildlife species" and, therefore, found the Proposed Activity inconsistent with the enforceable policy set forth at N.J.A.C. 7:7E-3.38 Endangered or Threatened Wildlife or Plant Species Habitats. That enforceable policy states, in pertinent part, as follows:

7:7E-3.38 Endangered or threatened wildlife or plant species habitats

(a) Endangered or threatened wildlife or plant species habitats are terrestrial and aquatic (marine, estuarine or freshwater) areas known to be inhabited on a seasonal or permanent basis by or to be critical at any stage in the life cycle of any wildlife or plant identified as "endangered" or "threatened" species on official Federal or State lists of endangered or threatened species, or under active consideration for State or Federal listing. The definition of endangered or threatened wildlife or plant species habitats includes a sufficient buffer area to ensure continued survival of the population of the species as well as areas that serve an essential role as corridors for movement of endangered or threatened wildlife. Absence of such a buffer area does not preclude an area from being endangered or threatened wildlife or plant species habitat.

1. Areas mapped as endangered or threatened wildlife species habitat on the Department's Landscape Maps of Habitat for Endangered, Threatened and Other Priority Wildlife (known hereafter as Landscape Maps) are subject to the requirements of this section unless excluded in accordance with (c)2 below. Buffer areas, which are part of the endangered or threatened wildlife species habitat, may extend beyond the mapped areas. The Department's Landscape Maps, with a listing of the endangered and threatened species within a specific area, are available from the Department's Division of Fish and Wildlife, Endangered and Nongame Species Program at the Division's web address, www.state.nj/us/dep/fgw/ensphome.

* * *

(b) Development of endangered or threatened wildlife or plant species habitat is prohibited unless it can be demonstrated, through an Endangered or Threatened Wildlife or Plant Species Impact Assessment as described at N.J.A.C. 7:7E-3C.2, that endangered or threatened wildlife or plant species habitat would not directly or through secondary impacts on the relevant site or in the surrounding area be adversely affected.

At the outset, the Proposed Activity involves a rescheduled marine seismic research survey and does not appear to constitute a "development activity" as contemplated by NJ in its CMP. Examples of development activities provided in NJ's CMP include such things as waterfront development facilities; construction, relocation, or enlargement of any building or structure; site preparation (grading, filling, excavation) on beaches and dunes; and residential, commercial, industrial, and public development. N.J.A.C. 7:7E-1.8 Definitions. Therefore, N.J.A.C. 7:7E-3.38 does not apply to the Proposed Activity.

Further, even if the Proposed Activity could somehow be deemed to be a "development activity," it would occur substantially outside of NJ state waters and would be highly unlikely to impact species habitat areas depicted in NJDEP's Landscape Map referred to in 7.7E-3.38(a)(1). Indeed, NJDEP does not indicate in its Consistency Review how the Proposed Activity, which would conduct research located, at the closest point, approximately 15 nmi from the NJ coastal zone, would impact species habitat located on the Landscape Map. Accordingly, the Proposed Activity does not implicate N.J.A.C. 7:7E-3.38.

Aside from the points made above, NSF did prepare an assessment of the potential impacts of the Proposed Activity on marine species and habitat within and near the survey area, and concluded that endangered or threatened wildlife or plant species habitat would not directly or through secondary impacts on the relevant site or in the surrounding area be adversely affected. Specifically, NSF prepared a Draft Amended EA (which tiered from the PEIS and the 2014 Final EA), a CD, an application for an Incidental Harassment Authorization, and submitted consultation and concurrence requests under Section 7 of the Endangered Species Act. The conclusion of no significant impacts was validated by the National Marine Fisheries Service (NMFS), the federal agency charged with regulating activities having the potential to impact marine mammals and threatened and endangered species, when it issued an Incidental Harassment Authorization (IHA) and Biological Opinion (BO)/Incidental Take Statement (ITS) on May 7, 2015. In addition, U.S. Fish and Wildlife Service concurred that the proposed activity may affect but would not adversely affect endangered and threatened species under their jurisdiction.

The information NJDEP provided in its Consistency Review did not support their finding that there would be impacts to endangered and threatened species habitat, but, rather, focused on potential impacts to marine species that might occur if they were close to the seismic sources during operations (i.e., outside of NJ state waters), which is not applicable to N.J.A.C. 7:7E-3.38. Moreover, as noted in the Draft

Amended EA (page vi), impacts from the Proposed Activity would primarily be anticipated from use of the airguns and impacts (if any) from the proposed airgun source would mainly be to marine species themselves, and not to their habitat. In addition, impacts to marine species would be temporary in nature and would occur relatively close to the vessel. In sum, the analysis NJDEP included in their Consistency Review did not demonstrate how airguns would have impacts on habitat, including habitat in NJ state waters, as a result of the Proposed Activity.

NJDEP also included information about sea turtles in their Consistency Review, including the statement, “Sea turtles likely use sound for navigation, predator avoiding, locating prey, and other activities,” with a reference to “Piniak et al. 2012”; the full reference for that citation, however, was not provided to NSF. Similarly, a reference to “Moein et al. 1995” was provided regarding the impacts of anthropogenic noise on sea turtles, however a full reference for that citation was not provided. Moein et al. (1994)[18], however, investigated the avoidance behavior and physiological responses of loggerhead turtles exposed to an operating airgun, as well as the effects on their hearing. The turtles were held in a netted enclosure ~18 m by 61 m by 3.6 m deep, with an airgun of unspecified size at each end. The turtles exhibited avoidance during the first presentation of airgun sounds at a mean range of 24 m, but the avoidance response waned quickly. Based on physiological measurements, there was some evidence of increased stress in the sea turtles, but this stress could also have resulted from the handling of the turtles. Five confined turtles exposed to a few hundred pulses from a single airgun exhibited some change in their hearing when tested within 24 h after exposure relative to pre-exposure hearing, and hearing had reverted to normal when tested two weeks after exposure. The results are consistent with the occurrence of temporary threshold shift (TTS) upon exposure of the turtles to airgun pulses. There was no indication of permanent hearing loss.

NJDEP also stated in their Consistency Review, “Therefore, sea turtles may be migrating through the project area during the critical June to July period, making them susceptible not only to impacts (e.g., behavior changes, hearing loss) from seismic activity, but to entanglement in the seismic array gear, and injury or mortality due to ship strikes.” NSF assumes that, in that statement, “critical June to July period” means “relevant June to July period”, as that period is not critical for sea turtles. Entrapment of sea turtles in the *Langseth* gear is highly unlikely because of the equipment design, and ship strikes are unlikely because of the slow vessel speed associated with survey operations. As stated on page 50 of the Draft Amended EA, “In decades of seismic surveys carried out by the R/V *Langseth* and its predecessor, the R/V *Ewing*, Protected Species Observers (PSOs) and other crew members have seen no seismic sound-related sea turtle injuries or mortality, including during 2014 survey activities [off New Jersey].” Although NJDEP suggests, “Effects from air gun noise to smaller turtles would undoubtedly be greater than those observed in monitoring studies, while their ability to swim away or avoid the array due to their size will be reduced...” no scientific references were provided to support this conclusion, nor were specific references provided to identify to which “monitoring studies” NJDEP was referring. Whereas smaller sea turtles might be slightly more disadvantaged at swimming away from the source, because of the vessel operating speed, the ship would pass by any sea turtle relatively quickly regardless of its size. PSOs would also monitor and mitigate for sea turtles around the vessel.

NJDEP also reported in their Consistency Review, “Acoustic detections of whale calls by Geo-Marine, Inc. confirmed the presence of right whales within 37 km of the shoreline, approximately between Seaside Park and Stone Harbor, during all seasons, concluding that some individual right whales occur in the nearshore waters off New Jersey either transiently or regularly.” While it is possible, it is not likely that a small number of North Atlantic right whales (NARWs) could be off New Jersey in June. Geo-

[18] Moein, S.E., J.A. Musick, J.A. Keinath, D.E. Barnard, M. Lenhardt, and R. George. 1994. Evaluation of seismic sources for repelling sea turtles from hopper dredges. Rep. from Virginia Inst. Mar. Sci., Gloucester Point, VA, for U.S. Army Corps of Engineers. 33 p.

Marine, Inc.'s (GMI's) acoustic recording effort was in March, June, September, and December 2008, and March and August 2009. The majority of acoustic detections of NARWs were in March 2008 (78 or 60%), whereas there were only 7 detections in March 2009, indicating annual differences or, more likely, methodological limitations. There were 12 acoustic detections in June 2008. NARW sightings were few: during the study period (aerial and vessel surveys once or twice monthly between February 2008 and June 2009), there were a total of 4 sightings during November, December, and January. As stated on page 8 of the Draft Amended EA, "Special mitigation measures were considered for this cruise. Although it is very unlikely that a NARW would be encountered, the airgun array would be shut down if one is sighted at any distance from the vessel because of the species' rarity and conservation status."

NJDEP's Consistency Review also notes concerns about sound effects (page 8-9): "Noise pollution, in the form of repeated or prolonged sounds would adversely impact marine mammals by disrupting otherwise normal behaviors associated with migration, feeding, alluding predators, resting, and breeding, etc. Any alterations to these behaviors would jeopardize the survival of an individual simply by increasing efforts directed at avoidance of the noise and the perceived threat." In both sentences, "would" should be replaced by "could". The proposed rescheduled survey is expected to result in only minor behavioral disturbances that would be expected to have only negligible impacts both on individual marine mammals and on the associated species and stocks. The type of effects described by NJDEP would only occur if marine mammals were excluded from critical areas for migration, feeding, or breeding at critical times, and that would not be the case off New Jersey in summer. A recent special issue of the journal *Aquatic Mammals* (February 2015) was devoted to the identification and description by NOAA of "important biological areas" (IBAs) in U.S. waters; for an area to be biologically important for cetacean species, stocks, or populations, it needs to meet at least one of the following four criteria: areas and times within which (1) a particular species selectively mates, gives birth, or is found with neonates or calves (*Reproductive Areas*); (2) aggregations of a particular species preferentially feed, (3) a substantial portion of a species is known to migrate (*Migratory Corridors*); and (4) small and resident populations occupy a limited geographic extent (*Small and Resident Population*). The only IBA off New Jersey is the NARW migratory corridor during March–April and November–December, which the timing of the proposed 2015 survey in June/July/August would avoid.[19]

NJDEP further noted in their Consistency Review (page 10): "This is especially important for North Atlantic right whales and harbor porpoise[20] in the vicinity of the project area, which these species [sic] have a lower recommended PTS threshold level, according to new National Marine Fisheries Service guidelines, currently undergoing public comment."[21] NMFS did recommend lower TTS and PTS thresholds for harbor porpoises (and other high-frequency cetaceans), but not for North Atlantic right whales, which are low-frequency cetaceans. As stated on page 40 of the Draft Amended EA, "The limited available data suggest that *harbor porpoises* show stronger avoidance of seismic operations …" which would reduce their susceptibility to incurring TTS.

The survey would occur at its closest point approximately 15 nmi outside the NJ coastal zone. Analysis of effects on habitat in the PEIS, the 2014 Final EA, and the Draft Amended EA, all concluded that

[19] LaBrecque, E., C. Curtice, J. Harrison, S.M. Van Parijs, and P.N. Halpin. 2015. Biologically important areas for cetaceans within U.S. waters—east coast region. p. 17-29 *In*: S.M. Van Parijs, C. Curtice, and M.C. Ferguson (eds.), Biologically important areas for cetaceans within U.S. waters. **Aquat. Mamm.** (Special Issue) 41(1). 128 p.
[20] NSF would be interested in receiving the Department's Endangered and Nongame Species Program's records of harbor porpoise occurring in the project vicinity and during the project period for future consideration. As stated on page 25 of the Draft Amended EA, "In summer, sightings mapped from numerous sources extended only as far south as off northern Long Island, New York".
[21] NMFS has not issued new acoustic guidance. In 2013, NMFS issued draft acoustic guidance for public review and comment. The public comment period has closed and NMFS is currently revising the guidance based on public comment, however, it remains unclear when, or if, new guidance will be issued.

impacts from survey activity would not be significant in or near the survey area; therefore, farther away from the survey area, including within NJ state waters, effects would either be reduced or not expected. Federal regulatory agencies with jurisdiction over the survey area concurred that impact on species and habitat for both the 2014 survey and the proposed 2015 survey would not be significant and all necessary authorizations were issued. No impacts on habitats were observed or reported during the portion of the 2014 survey that was conducted (Ingram et al., 2014)[22]. NJDEP contended in their Consistency Review that there was insufficient information to conclude impacts on endangered or threatened wildlife habitats within the NJ coastal zone would be insignificant; however, uncertainty, even by NJDEP's definition, does not make the Proposed Activity inconsistent with the enforceable policy – especially if the Proposed Activity is not a development activity. For the above noted reasons, NSF concludes that the Proposed Activity is consistent to the maximum extent practicable with the enforceable policy described at N.J.A.C. 7:7E-3.38 Endangered or Threatened Wildlife or Plant Species Habitats.

NJDEP Recommendations

As noted above, NJDEP included several recommendations in their Consistency Review and requested NSF consider and include them in the Proposed Activity should NSF decide to move forward over NJDEP's stated opposition. NSF considered these recommendations in the context of the enforceable policies of the CMP, per the CZMA, and responds to each recommendation below.

1. Shift the survey to a September/October timeframe

NJDEP suggested shifting the survey to a September/October timeframe for 2015, or to a September/October timeframe of a future year. Whereas NSF has taken into consideration alternative times to conduct the survey, NJDEP has disregarded reasons provided in the Draft Amended EA for survey scheduling limitations, including presence of marine species, weather, and personnel and equipment availability.

There is no indication in seasonal marine mammal density data that September/October would be preferable to June through August. NJDEP has failed to identify how the September/October timeframe is more optimal and less impactful than the June/July/August timeframe proposed by NSF -- a timeframe that federal agencies with jurisdiction over endangered and threatened species in the area have also found to be of an optimal period to operate with respect to marine mammals. These agencies also found in 2014 that the 2014 survey, also authorized to occur during the June/July/August timeframe, would not result in significant impacts to marine species, including endangered or threatened species, and their habitats, and met the criteria for obtaining an IHA. At most, with implementation of monitoring and mitigation measures, the Proposed Activity, like the 2014 survey, could result in Level B harassment (behavior modification) to marine mammals. Given that the federal agencies charged with protecting marine mammals and endangered and threatened species authorized the same activity during the June/July/August timeframe in 2014, it is logical that NSF has proposed that the project occur within the same time period in 2015.

NJDEP also suggested that September/October would likely avoid hazardous weather conditions. This time period, however, is actually peak season for hurricanes[23]; some of NJ's deadliest recorded storms have occurred during September/October. The most recent deadliest hurricane that hit the NJ shoreline was Hurricane Sandy which impacted the state from October 26, 2012 to November 8, 2012. The

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[22] Ingram, H., L. Marcella, L. Curran, C. Frey, and L. Dugan. 2014. Draft protected species mitigation and monitoring report: 3-D seismic survey in the northwest Atlantic Ocean off New Jersey, 1 July 2014–23 July 2014, R/V *Marcus G. Langseth*. Rep. from RPS, Houston, TX, for Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY.

[23] http://climate.rutgers.edu/stateclim/?section=menu&%20target=nj_hurricane_history

hurricane was declared a major disaster on October 30, 2012.[24] Hurricane Sandy was responsible for 73 deaths in the United States and cost billions of dollars in assistance.[25] The rough weather encountered by the *Langseth* during the 2014 survey demonstrates the challenges of conducting oceanographic research even during optimal weather periods, and similarly, highlights the potential safety hazards of operating during suboptimal weather periods.

NJDEP assumed the PI and science team were available at any time to conduct the survey. The science team consists of upwards of 35 people, including senior scientists and students. During the September/October timeframe, the lead PI and a collaborating PI have teaching obligations, and, two collaborating PIs are scheduled to conduct field work at sea on other research cruises. It is also not reasonable to anticipate that the *Langseth* would be available in the North Atlantic Ocean in the near term future. Although the *Langseth* has been in the North Atlantic for the last year and a half in support of academic research activities, this is the first time it has operated along the U.S. East Coast since it began science operations for NSF in 2008. At present, the *Langseth* is scheduled to support other research activities in 2015, including a research activity in the Mediterranean Sea; the *Langseth* is scheduled to depart in support of that activity in September. After that survey, the vessel is scheduled to transit to the east coast of South America, the west coast of South America, then on to the southwest Pacific Ocean. Therefore, it is not a reasonable assumption that the *Langseth* would be available to work along the U.S. East Coast in the foreseeable future. In addition, as a U.S. government-owned national asset, it is NSF's responsibility to operate the vessel in the most efficient way possible; thus, when scheduling the vessel in support of research activities, factors such as minimizing transits are considered.

In addition, NJDEP has suggested that the geologic formations at the target depths of interest are static and not likely to change if the Proposed Activity were rescheduled to September to October in a future year in which the personnel and equipment essential to meet the overall project objectives are available. This suggestion, however, does not take into account that the research was proposed by researchers and students with professional and academic careers that depend upon the collection of these data and successful completion of the survey. In other words, there is a timeliness factor involved with the Proposed Activity, as well as a desire to have the scientific results incorporated into the broader scientific community in the near term.

NJDEP also suggested that this recommendation would reduce impacts to prime fishing areas, marine fish and fisheries, and endangered or threatened wildlife habitats**.** NJDEP has failed, however, to demonstrate how implementation of this recommendation would make the activity consistent with enforceable policies of the CMP. In particular, as noted above, data provided to NSF by NJDEP on March 25, 2015, for the NMFS Statistical Areas 614 and 615 showed that commercial landings in 2011 were much lower in summer than in spring, fall, or winter. For recreational landings for all waters off NJ from 2011 to 2014, the highest landings for two out of the four years occurred in September/October. Other points identified by NJDEP do not support that moving the survey to September/October would reduce potential environmental impacts as purported by NJDEP, or how they relate to the enforceable policies.

2. Field Study

NJDEP also recommended that, if the Proposed Activity were to take place during the June to August timeframe, that a field study focused on assessing the Proposed Activity's impacts on fisheries and marine mammals be included. NJDEP indicated the study should include monitoring of fish behavior, abundance and catch rates; monitoring should start a minimum of one month prior to project commencement, continue through the duration of the project, and last a minimum of one month after project cessation. NJDEP did not, however, provide a description of how the study should be conducted

[24] http://www.fema.gov/disaster/4086
[25] http://www.fema.gov/sandy-recovery-office

in its Consistency Review, nor did they explain how implementation of such a study would make the Proposed Activity consistent with the enforceable policies of the CMP.

The Proposed Activity does, though, include a monitoring plan focused on assessing the project's impacts on marine species, including marine mammals, sea turtles, sea birds, and fish. As described earlier, and in the Draft Amended EA (pages 5-8 and 45), the associated IHA application (on which NJDEP commented on April 16, 2015), and the IHA and BO/ITS issued on May 7, 2015, 5 NMFS approved PSOs would be independently contracted to be present during the survey to conduct monitoring activities and implement mitigation measures. Rotating shifts of PSOs would allow two observers to monitor for marine species during daylight hours, and 1 observer to monitor the Passive Acoustic Monitoring system during day and night-time seismic operations. Although inclusion of PSOs during a seismic survey is a standard measure required by the PEIS, it is also a requirement of the IHA and BO/ITS issued by NMFS, and was identified and required in the IHA issued for the survey in 2014. PSOs would monitor and report on the presence and behavior of marine species, and implement any of the mitigation measures for the research activity as described in the NSF Draft Amended EA, LOC issued by USFWS, and the IHA and BO/ITS, including the cessation of seismic sources. PSOs would document any observations, including species behavior and abundance, during the survey as described by the Draft Amended EA and as required by the IHA and BO/ITS. Although the survey would only occur within a small area within statistical area 615, fish catch rates for both statistical areas 614 and 615 could be obtained from the NOAA database (http://www.st.nmfs.noaa.gov/st1/commercial/index.html) and assessed for comparative analysis when that information becomes available. Within 90 days of the conclusion of the survey, an observation report would be provided to NMFS, it could also, following NMFS' approval, be provided to NJDEP's Endangered and Nongame Species Program for inclusion into the Biotics database. Pre-survey monitoring would commence upon departure from port and during initial gear deployment; monitoring would continue throughout the duration of the survey. Post-survey monitoring would occur upon conclusion of the seismic operations, during gear retrieval, transit through survey area, and transit to port. Should a support vessel be used during the survey, the vessel could serve as an additional platform for marine species observations, with an enhanced focus on fish monitoring. Although not originally proposed, to address concerns about space-use conflicts, throughout the duration of the survey, the R/V *Langseth* and any support vessel could keep a log of all vessels observed within the survey area; the complete log could be included in the formal report of PSO observations submitted to NJDEP's Endangered and Nongame Species Program. In addition, NAIS data could be evaluated and reported to NJDEP to confirm vessel activity in the survey area.

NJDEP, as stated above, has failed to demonstrate how their recommendation relates to the enforceable policies of the CMP and how implementation of this recommendation would make the activity consistent with the enforceable policies of the CMP. Regardless, the Proposed Activity, which would include the above-mentioned monitoring plan, already satisfies the majority of the goals of the field study recommended by NJDEP.

3. Aerial survey

NJDEP suggested that an aerial survey be performed over the survey area just prior to the vessel leaving its home port to facilitate marine species protection. NJDEP suggested the flyover would determine if there were feeding, static, or migrating populations of sea turtles or marine mammals; if animals were not observed during the flyover, then the survey could be performed as scheduled. If marine mammals or sea turtles were found within or near the project area during the flyover, then NJDEP suggested a 3-4 day delay of the survey would be prudent. NJDEP noted that a flyover would be important for North Atlantic right whales and harbor porpoises in the vicinity because they have lower recommended Permanent Threshold Shift levels according to NMFS draft acoustic guidance currently undergoing public comment.[26] NSF comments on Temporary Threshold Shift TTS and PTS levels on the two species are given on p. 18 of this letter.

The flyover request by NJDEP is not, however, a scientifically rigorous or effective mitigation measure. Regardless, NSF did bring this recommendation to the attention of NMFS during the IHA consultation process. NMFS, the federal agency with jurisdiction to regulate activities having the potential to affect marine mammals in the proposed survey area, however, did not recommend conducting aerial surveys as a mitigation measure that would further protect marine mammals in the IHA or BO/ITS issued for the proposed survey. If this measure were to be included in the study, it would unnecessarily add noise to the survey area and would require assessment under NEPA, ESA and MMPA.

Importantly, because of the high risk nature of marine mammal aerial surveys, especially those that occur farther offshore, NSF would only consider conducting one if it were recommended or required, and scientifically justified, by NMFS. On May 17, 2008, a Cessna 337A, N5382S, crashed while attempting to divert to Eagles Nest Airport (31E), West Creek, New Jersey for an emergency landing and the certified commercial pilot and one passenger were fatally injured, and the other two passengers were seriously injured.[27] The plane was conducting a marine mammal survey flight for a study funded by NJDEP. Here, the Proposed Activity would take place substantially beyond the nearshore area that NJDEP had contracted for the fatal aerial survey, further increasing risk in the event of an in-flight emergency.

Aside from the high risk associated with this recommendation, NJDEP has not demonstrated that this measure has biologically relevant scientific merit and would improve marine species protection. In contrast, the monitoring plan proposed by NSF includes standard and systematic monitoring and mitigation measures for seismic surveys. The *Langseth* would carry five PSOs on board to observe for marine species around the vessel and survey area. Observations would begin during daylight hours immediately upon leaving port. During deployment of seismic gear, PSOs would have the opportunity to monitor around the vessel and observe for feeding, static, or migrating populations of sea turtles or marine mammals. Seismic operations would not begin if marine mammals, sea turtles, or sea birds were observed within a designated zone around the seismic source. The standard monitoring and mitigation measures described in the PEIS and Draft Amended EA would be followed along with the additional measures set forth in the associated IHA and BO/ITS.

In sum, NJDEP has failed to demonstrate how their recommendation for an aerial survey is tied to the enforceable policies of the CMP and how this measure would make the Proposed Activity more consistent with the enforceable policies of the CMP. Therefore, NSF concludes that the Proposed Activity is consistent to the maximum extent practical with the CMP, regardless of whether this recommendation is implemented.

4. QA/QC Plan

NJDEP also suggested a, "QA/QC[28] plan that would designate one independent person as responsible for ensuring the cessation of sound producing activities if sea turtles or marine mammals are observed during transect runs." NJDEP suggests the vessel should stop all noise for at least 30 minutes after the animal is no longer observable in the area. The designee would document any observations of sea turtles and send

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[26] As explained earlier, the NMFS draft acoustic guidance is no longer undergoing public comment. NMFS is currently revising the guidance based on public comment, however, it remains unclear when, or if, new guidance will be issued.

[27] NJDEP EBS Final Report: Volume III, July 2010; http://www.kathrynsreport.com/2013/01/trenton-new-jersey-woman-injured-in.html**)**

[28] QA/QC was not defined by NJDEP, however, NSF has assumed it to mean "Quality Assurance/Quality Control."

the information to NJDEP's Endangered and Nongame Species Program for inclusion in the Biotics database.

As described in the Draft Amended EA (pages 5- 8) and associated IHA application (pages 34-40), five NMFS approved PSOs would be independently contracted to participate on the survey. Although inclusion of PSOs during a seismic survey is a standard measure required by the PEIS and has been the case for previous surveys, it is also a requirement of the IHA and BO/ITS recently issued by NMFS. PSOs would monitor and report on the presence and behavior of marine species, and direct the implementation of the mitigation measures for the research activity as described in the NSF Draft Amended EA, LOC issued by USFWS, and IHA and BO/ITS, including the cessation of seismic sources due to presence of marine species within a designated area around the vessel. PSOs would document any observations during the survey as described by the Draft Amended EA, IHA, and BO/ITS. As the survey would be conducted in federal waters outside of NJ state waters and NMFS has federal jurisdiction over the protection of marine mammals, NSF and LDEO would be legally required to follow the monitoring and mitigation requirements dictated in the IHA and BO/ITS issued by NMFS; this includes adhering to designated cessation periods of the seismic source due to presence of marine mammals.

In addition to the five independently contracted PSOs, NSF offered NJDEP the opportunity to identify a staff member to participate as an observer during the survey, should it go forward. Whereas ultimate authority to enforce the requirements of the IHA, including cessation of seismic activity, would remain with the PSOs, the NJDEP observer would have the opportunity to monitor, make recommendations, record and document observations, and provide observations to NJDEP's Endangered and Nongame Species Program for inclusion in the Biotics database. After NMFS approval, the formal report of PSO observations could be provided to NJDEP's Endangered and Nongame Species Program for inclusion in the Biotics database. To address concerns about space-use conflicts, throughout the duration of the survey, the R/V *Langseth* and any support vessel could keep a log of all vessels observed within the survey area; the complete log could be included in the formal report of PSO observations submitted to NJDEP's Endangered and Nongame Species Program. NAIS data could also be evaluated and reported to NJDEP to confirm vessel activity in the survey area. These offers and suggestions were repeatedly made to New Jersey over the past several months; unfortunately, however, NJDEP has not responded to any of these offers and suggestions.

NJDEP's proposed recommendation for a QA/QC plan is not related to the enforceable policies of the CMP. Regardless, the NSF Proposed Activity already meets this recommendation. NSF concludes, therefore, that the Proposed Activity is consistent to the maximum extent practicable with the enforceable policies of the CMP.

Conclusion

For the reasons stated herein, and in the entire CZMA record, NSF concludes that the Proposed Activity is consistent to the maximum extent practicable with the enforceable policies of the CMP. With regard to the recommendations advanced by NJDEP in their consistency review, NSF has considered them and concludes that the Proposed Activity already meets two of the three recommendations (field study [in part] and QA/QC plan) suggested if the proposed survey were to take place in the June/July/August timeframe; the remaining recommendation (aerial survey) raises safety concerns and fails to meet the proposed mitigative intent of furthering protection of marine mammals and sea turtles; therefore, NSF finds no justification for its implementation. Given that the NSF Proposed Activity includes a systematic and robust monitoring and mitigation plan that was approved both last year and this year by the federal agency with the authority to regulate activities to protect marine mammals and sea turtles, the concerns raised by NJDEP for marine species protection have been addressed. For these additional reasons, NSF's conclusion that the Proposed Activity is consistent to the maximum extent practicable with the enforceable policies of the CMP is reaffirmed.

APPENDIX K

COASTAL ZONE MANAGEMENT ACT COMPLIANCE – NEW YORK

STATE OF NEW YORK
DEPARTMENT OF STATE
ONE COMMERCE PLAZA
99 WASHINGTON AVENUE
ALBANY, NY 12231-0001

ANDREW M. CUOMO
GOVERNOR

CESAR A. PERALES
SECRETARY OF STATE

August 1, 2014

Lawrence Rudolph, General Counsel
Office of the Director
National Science Foundation
Room 1265 S
4201 Wilson Boulevard
Arlington, VA 22230

Re: Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey

Dear Mr. Rudolph:

The New York Department of State (DOS) recently learned of the marine geophysical survey funded by the National Science Foundation and being conducted by Columbia University's Lamont-Doherty Earth Observatory on the R/V *Marcus G. Langseth* in the northwest Atlantic Ocean off New Jersey. DOS administers New York State's federally-approved Coastal Management Program, pursuant to the Coastal Zone Management Act, 1972, as amended (16 U.S.C. § 1451 et seq.) and is responsible for reviewing direct federal actions, actions requiring federal authorization or permits, and federally-assisted activities (including those receiving federal funding) for consistency with the enforceable policies of New York State's Coastal Management Program. Consistency provisions apply both to activities with reasonably foreseeable effects on the State's coastal resources and uses occurring within the State's waters and to activities outside of the State's coastal zone, including federal waters.

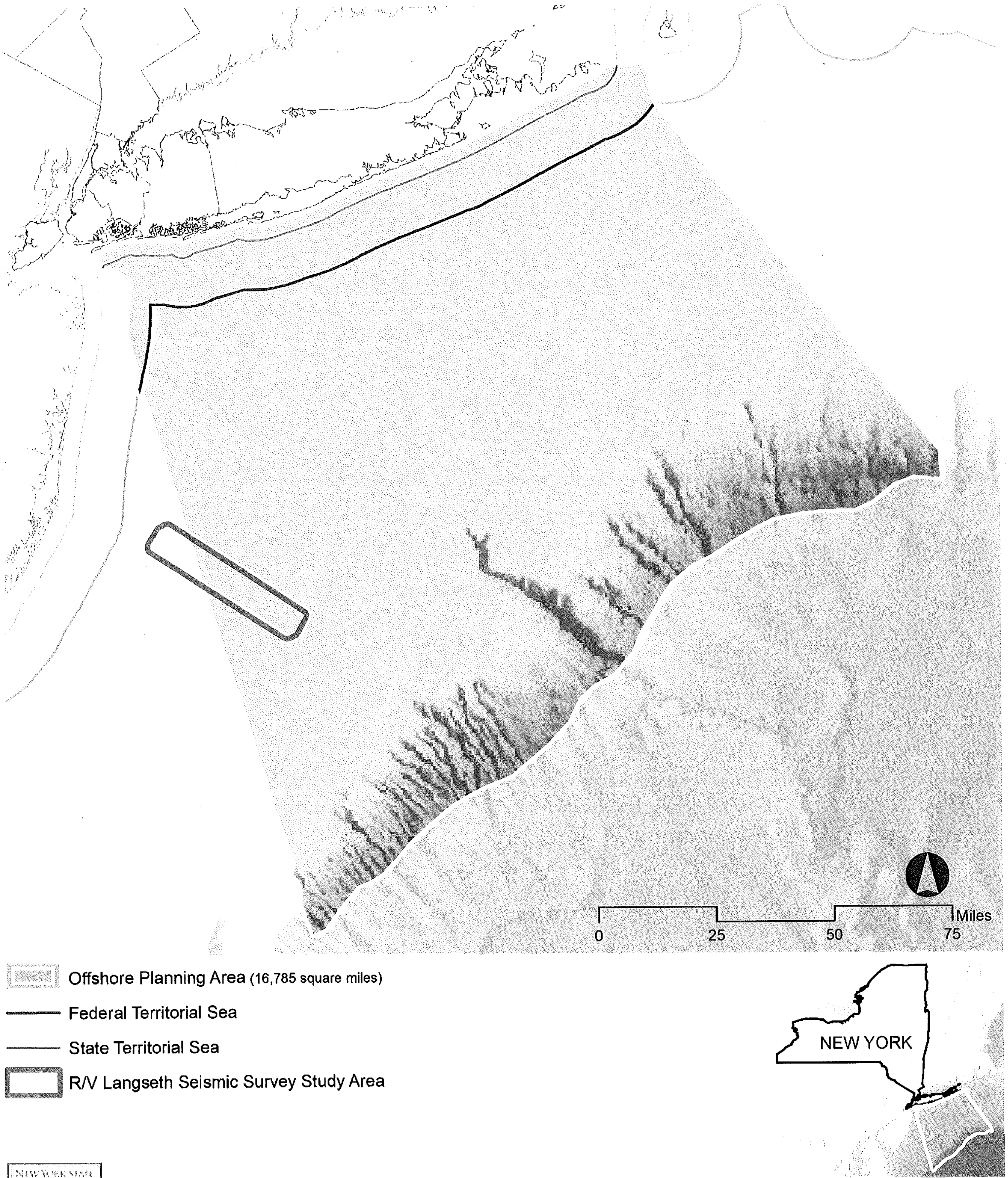
DOS is engaged in an ongoing ocean resources analysis that includes identifying connections between offshore areas and New York's coastal uses and resources, particularly within an area identified in the recently released *2013 Offshore Atlantic Ocean Study* (see attached figure). Consistent with Presidential Executive Order 13547 (Stewardship of the Ocean, Our Coasts, and the Great Lakes), DOS is leading a State offshore planning effort and working in concert with other states, federal agencies and tribes to better understand and manage activities between the offshore and coastal areas. Based on available information, DOS is concerned that the seismic research being conducted on the current cruise may affect New York's resources and uses. DOS requests that NSF provide information to DOS on all relevant current and proposed future actions so that DOS may review them for federal consistency with New York State's coastal policies in accordance with federal requirements. DOS requests that NSF consult with DOS when planning future cruises in or near the DOS planning area to help identify and address or minimize potential effects.

Sincerely,

Gregory Capobianco
Office of Planning and Development

Enclosure
c: Holly Smith, National Science Foundation
R. Kerry Kehoe, NOAA Office of Ocean and Coastal Resource Management
Marty Rosen, New Jersey Coastal Management Program
Sean Higgins, Columbia University Lamont-Doherty Earth Observatory Office of Marine Operations

New York Offshore Planning Area



Produced by New York State Department of State (June 2014)

Data Sources: US Marine Cadastre, NYSDOS

NATIONAL SCIENCE FOUNDATION
4201 WILSON BOULEVARD
ARLINGTON, VIRGINIA 22230

January 16, 2015

Jeffrey Zappieri
Office of Planning and Development
New York Department of State
99 Washington Avenue, Suite 1010
Albany, NY 12231-0001

RE: Consistency Determination for a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015

Dear Mr. Zappieri:

In 2014, the National Science Foundation (NSF) funded a research project proposed by lead Principal Investigator (PI) Dr. Gregory Mountain of Rutgers University and collaborators Drs. James Austin, Craig Fulthorpe, and Mladen Nedimović of University of Texas Austin to study sea level rise in the Atlantic Ocean off of the coast of New Jersey, which included a marine geophysical survey. NSF's environmental compliance, including all federal regulatory obligations, was completed for the research activity on July 1, 2014, and the survey commenced. Unfortunately, due to mechanical issues with the vessel, the survey was unable to be completed during the effective periods of the Incidental Harassment Authorization (IHA) and Incidental Take Statement (ITS) issued for the survey. NSF is interested in rescheduling the research survey for a 30 day period between June-August 2015, approximately the same time frame as originally planned and authorized in 2014. According to National Marine Fisheries Service (NMFS), a new IHA is required to reschedule the survey in 2015. As such, per the Coastal Zone Management Act (CZMA), the state of New York may request review of unlisted federal license or permit activities for consistency. NSF contacted New York Department of State's Coastal Management Program (NY CMP) on October 30, 2014 to confirm the State's interest in reviewing the unlisted activity. On January 9, 2015, NY CMP confirmed interest in reviewing the project. Per CFR 15 930.34, NSF, both in October 2014 and in subsequent contacts, requested NY CMP identify relevant enforceable policies applicable to the project, however, none were identified. NSF prepared a Draft Amended Environmental Assessment (EA) (Attachment 1) to address NSF's requirements under the National Environmental Policy Act (NEPA) of 1969, as amended, for the proposed NSF federal action and in support of other necessary regulatory processes, and that document has been available on NSF's Division of Ocean Sciences public website since December 19, 2014.

The proposed collaborative research objectives and efforts remain unchanged from those planned in 2014. The proposed research efforts would include the collection and analysis of data on the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to the present. Despite their existence being clearly indicated in sediment cores recovered during International Ocean Discovery Program (IODP) Expedition 313, features such as river valleys cut into coastal plain sediments, now buried under a kilometer (km) of younger sediment and flooded by today's ocean, cannot be resolved in existing 2-D seismic data to the degree required to map shifting shallow-water depositional settings in the vicinity of clinoform rollovers. To achieve the project's goals, the PIs propose to use a 3-D seismic reflection survey to map sequences around existing IODP Expedition 313 drill sites and analyze their spatial/temporal evolution. Objectives that would then be met include establishing the impact of known Ice House base-level changes on the stratigraphic record; providing greater understanding of the response of nearshore environments to changes in elevation of global sea level; and determining the amplitudes and timing of global sea-level changes during the mid-Cenozoic era.

The proposed seismic survey would be conducted on the NSF-owned research vessel (R/V) *Marcus G. Langseth (Langseth*), which is operated on our behalf by Columbia University's Lamont-Doherty Earth Observatory (L-DEO). The proposed activity is not related to energy resources or facilities, including oil and gas exploration, development, production, or lease sales, and, therefore, is not subject to Bureau of Ocean Energy Management's regulatory jurisdiction pursuant to the Outer Continental Shelf Lands Act. The proposed activity is also not related to ocean mining.

Although NSF does not anticipate effects on the coastal resources of New York as a consequence of the proposed research activity, due to the circumstances surrounding the 2014 survey and New York's expressed interest in reviewing the proposed 2015 survey, NSF has chosen to submit this Consistency Determination. Due to these unique circumstances, NSF does not consider this to be precedent setting in that all future NSF seismic surveys would require a Consistency Determination, but, rather, makes its determination with regard to the applicability of the CZMA on the unique circumstances associated with each site specific survey.

The attached NSF Consistency Determination for the proposed seismic survey is based on review of the proposed activity's conformance with the enforceable policies of New York's Coastal Management Program. Support for this Consistency Determination is provided through analysis included in the Draft Amended EA prepared pursuant to NEPA for the proposed activity (Attachment 1). The proposed activity is consistent (to the maximum extent practicable) with the enforceable policies of New York's Coastal Management Program.

Pursuant to 15 CFR 930.41, the New York Coastal Management Program has 60 days from the receipt of this letter in which to concur with or object to this Consistency Determination, or to request an extension under 15 CFR Section 930.41(b). If New York does not provide a response to NSF within 60 days of receipt of NSF's Consistency Determination, then the State's concurrence will be presumed (15 CFR 930.41(a)).

Should you have any questions about the information provided, please feel free to contact me at hesmith@nsf.gov or (703) 292-7713.

Sincerely,

Holly Smith

Holly Smith
Environmental Compliance Officer

Attachment 1: Draft Amended Environmental Assessment for a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015

cc: Gregory Capobianco, NYDOS
Jeff Herter, NYDOS
Michael Snyder, NYDOS
Liz Podowski, NYDOS
Kerry Kehoe, NOAA Office of Ocean and Coastal Resource Management
Sarah Mesrobian, NSF

NSF COASTAL ZONE MANAGEMENT ACT (CZMA)
CONSISTENCY DETERMINATION

This document provides the New York (NY) Coastal Management Program (CMP) with the National Science Foundation's (NSF) Consistency Determination pursuant to the CZMA implementing regulations at 15 CFR Part 930, Subpart C for a collaborative research project entitled, "Community-Based 3-D Imaging That Ties Clinoform Geometry to Facies Successions and Neogene Sea-Level Change." The research proposal has been reviewed under the NSF merit review process and identified as an NSF program priority to meet NSF's critical need to foster a better understanding of Earth processes. The information in this Consistency Determination is provided in response to New York's expressed interest in consistency review and addresses the issues in 15 CFR 930.31(c) and 930.39.

The collaborative research activity is proposed to be conducted during an approximate 30 day period during June-August 2015, and would include a marine geophysical survey in the Atlantic Ocean off the coast of New Jersey. The proposed research activity was funded entirely by NSF and would be led by lead Principal Investigator (PI) Dr. Gregory Mountain (Rutgers University) and collaborating PIs Drs. James Austin, Craig Fulthorpe, and Mladen Nedimović (University of Texas at Austin).

NSF prepared an Environmental Assessment (EA) for the research activity to take place in 2014. NSF's environmental compliance, including all federal regulatory obligations, was completed for the research activity on July 1, 2014, and the survey commenced. Due to mechanical issues with the vessel, the survey was unable to be completed during the effective periods of the Incidental Harassment Authorization (IHA) and Incidental Take Statement (ITS) issued for the survey. Pursuant to the National Environmental Policy Act, as amended, NSF has prepared a Draft Amended EA to evaluate the potential impacts on the human and natural environment associated with the activity proposed to occur in summer 2015, including those to endangered and threatened species listed under the Endangered Species Act (ESA) and marine mammals protected by the Marine Mammal Protection Act (MMPA). The Draft Amended EA identifies and includes analyses for any differences between the 2014 and proposed 2015 research activity.

The Draft Amended EA, entitled, "Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015", was prepared on NSF's behalf by LGL Limited, environmental research associates (LGL) (Attachment 1). The Draft Amended EA tiers to the Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey (NSF/USGS PEIS, 2011) and the 2014 Final EA and Finding of No Significant Impact (FONSI) issued by NSF. The Draft Amended EA also incorporates by reference the U.S. Fish and Wildlife Service (USFWS) ESA concurrence letter issued in 2014 and the Biological Opinion, Essential Fish Habitat (EFH) concurrence letter, Incidental Harassment Authorization, and Final Environmental Assessment and FONSI issued by the National Marine Fisheries Service in 2014. The conclusions from the Draft Amended EA were used to inform the NSF Division of Ocean Sciences (OCE) management of potential environmental impacts of the proposed activity. OCE concurs with the Draft Amended EA's findings that implementation of the proposed activity would not have a significant impact on the environment. OCE will continue to review information between now and the time of the issuance of the Final Amended EA and, if any contrary conclusion is reached during this timeframe regarding environmental impacts, we will immediately notify you of such a conclusion. The proposed research activity is not related to oil and gas exploration, development, production, or lease sales, and, therefore, is not subject to Bureau of Ocean Energy Management's regulatory jurisdiction pursuant to the Outer Continental Shelf Lands Act (OCSLA).

The purpose of the proposed collaborative research activity is to collect and analyze data on the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to present. Despite their existence being clearly indicated in sediment cores recovered during International Ocean Discovery Program (IODP) Expedition 313, features such as river valleys cut into coastal plain sediments, now buried under a kilometer (km) of younger sediment and flooded by today's ocean, cannot be resolved in existing 2-D seismic data to the degree required to map shifting shallow-water depositional settings in the vicinity of clinoform rollovers. To achieve the project's goals, the lead and collaborating PIs, propose to use a 3-D seismic reflection survey to map sequences around existing IODP Expedition 313 drill sites and analyze their spatial/temporal evolution. Objectives that would then be met include establishing the impact of known Ice House base-level changes on the stratigraphic record; providing greater understanding of the response of nearshore environments to changes in elevation of global sea level; and determining the amplitudes and timing of global sea-level changes during the mid-Cenozoic era. The research objectives remain the same as those described for the 2014 survey. The proposed seismic survey would be conducted on the NSF-owned research vessel (R/V) *Marcus G. Langseth* (*Langseth*), which is operated on our behalf by Columbia University's Lamont-Doherty Earth Observatory (L-DEO) through a Cooperative Agreement entered into in 2012.

The proposed marine seismic survey would take place in federal waters within the Exclusive Economic Zone of the U.S. (EEZ) and substantially outside of NY state waters, for approximately (~) 30 days during summer 2015. The proposed survey area is located in the Atlantic Ocean, ~92–134 kilometers (km) (~50–72 nautical miles [nmi]) outside of NY state waters (Attachment 1, Figure [Fig.] 1). Water depths in the survey area are ~20–75 meters (m). The proposed full-fold 3-D box/survey area is defined by the coordinates at the four corners (including turns and run-in and run-out of each line): 39:38:00°N, 73:44:36°W; 39:43:12°N, 73:41:00°W; 39:25:30°N, 73:06:12°W; and 39:20:06°N, 73:10:06°W. According to NY Department of State (DOS), DOS is engaged in an ongoing ocean resources analysis that includes identifying connections between offshore areas and New York's coastal uses and resources, particularly within a large offshore area identified in the *2013 Offshore Atlantic Ocean Study* released by NY DOS in June 2014. The proposed survey area would partially overlap a small area within this offshore planning area. The location of the proposed survey area, however, has not been identified by the state of New York as a special geographic area within their federally approved CMP. Although the proposed survey area is near the Northwest Atlantic Detailed Analysis Area (NW Atlantic DAA) described in the NSF/USGS PEIS, it does not include intermediate and deep-water depths. The proposed research activity would avoid the North Atlantic right whale migration period. The survey location would be the same as that analyzed for the 2014 survey, in which NSF and NMFS determined would result in no significant impacts.

The procedures to be used for the survey would be the same as those proposed for the 2014 survey and similar to those used during previous seismic surveys by L-DEO, and would use conventional seismic methodology. The survey would involve one source vessel, the *Langseth* and potentially one support vessel. The *Langseth* would deploy two pairs of subarrays of 4 airguns as an energy source; the subarrays would fire alternately, with a total volume of ~700 inch $(in)^3$. The receiving system would be a passive component of the proposed activity and would consist of a system of hydrophones: four 3000-m hydrophone streamers at 75-m spacing, or preferably, a combination of two 3000-m hydrophone streamers and a Geometrics P-Cable system. As the airgun array is towed along the survey lines, the hydrophone streamers would receive the returning acoustic signals and transfer the data to the on-board processing system.

A total of ~4900 km of 3-D survey lines, including turns, would be conducted in an area 12 x 50 km with a line spacing of 150 m in two 6-m wide race-track patterns (Attachment 1, Figure 1). There would be additional seismic operations in the survey area associated with airgun testing and repeat coverage of any areas where initial data quality is sub-standard. In our calculations (Attachment 1, § IV Proposed Action (1)(e)), 25% has been added for those additional operations. The survey parameters noted here support the proposed research goals and, from that perspective, differ from the NW Atlantic DAA survey parameters presented in the NSF/USGS PEIS. The same amount of surveying proposed for 2015 was analyzed for the 2014 survey. Because of mechanical/equipment issues on the survey vessel along with weather issues (including Hurricane Arthur) in 2014, the full 3-D array of equipment could not be deployed. Given equipment limitations, only ~61 hours (h) of seismic survey data were collected in 2014, with only ~43 h at full power (700 in^3) on survey tracklines. Of the 43 h of data collected, ~22 h were of substandard data quality as a result of equipment damage from rough seas. However, the existing data did allow confirmation that the smaller 700-in^3 source array was suitable for the project, thus eliminating potential use of the larger 1400-in^3 array originally proposed in 2014.

In addition to the operations of the airgun array, a multibeam echosounder (MBES) and a sub-bottom profiler (SBP) would also be operated from the *Langseth* continuously throughout the survey, however not during transit. All planned geophysical data acquisition activity would be conducted by L-DEO with on-board assistance by the scientists who have proposed the study. The vessel would be self-contained, and the crew would live aboard the vessel with potential personnel transfer on/off the *Langseth* by a small support vessel. No anchoring or installments of equipment are planned to occur as part of the proposed research survey.

Monitoring and mitigation measures would be implemented during the survey, including use of Protected Species Visual Observers (PSVOs), Passive Acoustic Monitoring (PAM), exclusion zones calculated for each airgun source and tow depths, speed or course alterations, power or shut downs, and ramp-up procedures (Attachment 1, § II Proposed Action (3) and § IV Proposed Action (1)(d)). In addition, the airgun source would be shut down at any distance for North Atlantic right whales due to their critical status and for any large concentrations of marine mammals encountered. Ultimately, should the project move forward, any monitoring and mitigation measures required by an IHA and ITS issued pursuant to the MMPA and ESA, respectively, would be implemented.

Consultations
NSF has initiated consultations with the National Marine Fisheries Service (NMFS) and USFWS under Section 7 of the ESA, and, in coordination with the ship operator of the *Langseth,* has submitted an IHA application under the MMPA for the survey. NSF has initiated consultation on Essential Fish Habitat (EFH) pursuant to the Magnuson Stevens Act. NSF has submitted a Consistency Determination to the New Jersey Department of Environmental Protection for the proposed activity. The proposed activity is not related to oil and gas exploration, development, production, or lease sales, and, therefore, is not subject to Bureau of Ocean Energy Management regulatory jurisdiction pursuant to the OCSLA.

Potential Effects to New York Coastal Resources
During preparation of the Draft Amended EA and in accordance with the CZMA (16 USC §1451, *et seq.*), NSF considered whether the proposed activity would have any effect on coastal uses or resources of the state of NY. Potential impacts of the seismic survey on the environment, if any, would be primarily a result of the operation of the airgun array. The increased underwater noise may result in avoidance behavior by marine mammals, sea turtles, seabirds, and fish, and other forms of disturbance. At most, effects on marine mammals may be interpreted as falling within the MMPA definition of "Level B Harassment" for those species managed by NMFS. No long-term or significant effects would be expected on individual marine mammals, sea turtles, seabirds, fish, the populations to which they belong, or their habitats as a result of this proposed action. Mitigation measures proposed in the Draft Amended EA for the survey are consistent with those required by NMFS for the 2014 survey and would reduce potential risks to marine species (Attachment 1, § II Proposed Action (3) and § IV Proposed Action (1)(d)).

The marine seismic survey, which would be conducted substantially outside of NY state waters, would not preclude fisheries vessels from operating within or around the survey area. A safe distance, however, would need to be kept between the *Langseth* and other vessels to avoid entanglement with the towed seismic equipment (Attachment 1, § IV Proposed Action (2)(c)). L-DEO would use Notice to Mariners broadcasts to alert mariners, including fishers and scuba divers, of the survey activity. During the proposed seismic survey, only a small fraction of the survey area would be ensonified by the source array at any given time (Attachment 1, § IV Proposed Action (4)), and the distance at which Level B harassment (disturbance) from seismic sound (160 dB) could occur is, at its maximum, only 6.1 km from the source; that sound level would remain substantially outside of NY state waters (~86 km). Disturbance to fish species would be short-term and localized, and there would be no significant impacts on commercial or recreational fisheries (Attachment 1, § IV Proposed Action (2)(c)). No fish kills or injuries were observed during 2014 survey activity, or during decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing* (Attachment 1, § IV(2)(c)). Given the proposed activity, including the short duration of the survey, temporary nature of potential impacts to marine species, and substantial distance from the survey to the coastal zone, impacts on marine species within NY state waters are only remotely possible (i.e., if an animal near the vessel moved into state waters). Access to NY beaches and fisheries in state waters would not be impeded by the proposed offshore activity. Although not expected, any potential space-use conflicts with commercial or recreational fisheries activities outside of state waters would be avoided through communications. During 2014 survey activity no actively operating fisheries vessels were encountered by the *Langseth* within the survey area (Attachment 1, § IV Proposed Action (2)(c)).

No significant impacts on shipwrecks and dive sites, including the one known dive site within the survey area, would be expected. Airgun sounds would have no effects on solid structures, and there would be no deployment of gear on the seafloor during the survey. The only potential effects could be temporary displacement of fish and invertebrates from the dive site within the survey area (Attachment 1, § IV Proposed Action (5)).

Significant impacts on, or conflicts with, divers or diving activities would be avoided through communication with the diving community before and during the survey and publication of a Notice to Mariners about operations in the area. In particular, dive operators with dives scheduled on the one known shipwreck site the "*Lillian*" during the survey would be contacted directly. That dive site represents only a very small percentage of the recreational dive sites off the coast of New Jersey and New York. During 2014 survey activity, L-DEO coordinated with local dive shops/groups, and no actively operating scuba vessels were encountered by the *Langseth* within the survey area (Attachment 1, § IV Proposed Action (5)).

New York Enforceable Policies

NSF requested on multiple occasions that NY CMP identify, per 15 CFR 930.34, relevant enforceable policies applicable to the project; to date, none was identified. NSF reviewed New York's enforceable policies, and responds to the following enforceable policies that could be remotely construed as potentially relevant to the proposed activity:

Policy 2: Facilitate the siting of water dependent uses and facilities on or adjacent to coastal waters.

Policy 7: Significant coastal fish and wildlife habitats will be protected, preserved, and where practical, restored so as to maintain their viability as habitats.

Policy 8: Protect fish and wildlife resources in the coastal area from the introduction of hazardous wastes and other pollutants which bio-accumulate in the food chain or which cause significant sublethal or lethal effect on those resources.

Policy 9: Expand recreational use of fish and wildlife resources in coastal areas by increasing access to existing resources, supplementing existing stocks, and developing new resources.

Policy 18: To safeguard the vital economic, social and environmental interests of the state and of its citizens, proposed major actions in the coastal area must give full consideration to those interests, and to the safeguards which the state has established to protect valuable coastal resource areas.

Policy 19: Protect, maintain, and increase the level and types of access to public water-related recreation resources and facilities.

Policy 30: Municipal, industrial, and commercial discharge of pollutants, including but not limited to, toxic and hazardous substances, into coastal waters will conform to state and national water quality standards.

Policy 34: Discharge of waste materials into coastal waters from vessels subject to state jurisdiction will be limited so as to protect significant fish and wildlife habitats, recreational areas and water supply areas.

Policy 36: Activities related to the shipment and storage of petroleum and other hazardous materials will be conducted in a manner that will prevent or at least minimize spills into coastal waters; all practicable efforts will be undertaken to expedite the cleanup of such discharges; and restitution for damages will be required when these spills occur.

Policy 39: The transport, storage, treatment and disposal of solid wastes, particularly hazardous wastes, within coastal areas will be conducted in such a manner so as to protect groundwater and surface water supplies, significant fish and wildlife habitats, recreation areas, important agricultural land, and scenic resources.

Policy 43: Land use or development in the coastal area must not cause the generation of significant amounts of acid rain precursors: nitrates and sulfates.

Policy 44: Preserve and protect tidal and freshwater wetlands and preserve the benefits derived from these areas.

NSF Proposed Research Activity

Based upon the following information, data and analysis, the NSF finds that the proposed research activity is consistent to the maximum extent practicable with the enforceable policies of the New York Coastal Management Program.

Policy 2: Facilitate the siting of water dependent uses and facilities on or adjacent to coastal waters.

The proposed research activity would be located in federal waters within the EEZ and substantially outside of the NY coastal zone. The proposed activity would not require development or construction of facilities within or adjacent to NY state coastal waters. The proposed activity, however, is a water-dependent activity: a scientific/educational activity which, by its nature, requires the use of coastal waters to gain access to the offshore survey site. The *Langseth* would use NY ports and transit through NY state waters to the proposed survey site. The proposed research activity would not be expected to be the cause of conditions dangerous to life or health, and any disturbance to enjoyment of NY State land and waters would not materially increase. Per the findings of the Draft Amended EA (Attachment 1, § III), no changes to current land uses or activities in the project area would result from the proposed survey and no visual resources would be expected to be negatively impacted as the area of operation is substantially outside of the land and coastal view shed. Therefore, the proposed activity is consistent to the maximum extent practicable with New York's Enforceable Policy 2 concerning the facilitation of water dependent uses and facilities.

Policy 7: Significant coastal fish and wildlife habitats will be protected, preserved, and where practical, restored so as to maintain their viability as habitats.

The proposed research activity would be located in federal waters within the EEZ and substantially outside of the NY coastal zone. The proposed research activity may have impacts on federally listed endangered and threatened species (Attachment 1, § III); however, no areas of special critical wildlife habitat have been identified within the survey area except for EFH. The proposed survey area is not located within any designated special areas such as rookeries, ecotones, or colonial waterbird habitat. Additionally, the location of the proposed survey area has not been identified by the state of New York as a special geographic area within their federally approved CMP. Because the proposed activity could have an effect on federally listed endangered and threatened species, NSF and L-DEO are consulting with NMFS and USFWS to ensure compliance with federal regulations including the MMPA and ESA.

No temporary or permanent development would occur as a result of the proposed research activity. As described in the Draft Amended EA (Attachment 1, § IV), minimal, if any, effects on and interference with endangered and threatened species habitat would be expected. The proposed survey location has been selected to meet the scientific objectives proposed by the PIs. As described in the Draft Amended EA (Attachment 1, § II Proposed Action (1)), the survey site location is a unique siliciclastic passive margin which has the potential to elucidate the timing and amplitude of eustatic change during the "Ice House" period of Earth history. The proposed research would tie to and build upon research previously conducted at the survey site and allow for the acquisition of a 3-D seismic volume of the inner-middle shelf of the NJ margin. For these reasons, alternative site locations would not meet research goals and therefore would not be feasible.

The proposed research activity includes a suite of monitoring and mitigation measures. These monitoring and mitigation measures include standard monitoring and mitigation measures established by the NSF/USGS PEIS and include special mitigation measures for North Atlantic right whales. They are described in detail in the NSF/USGS PEIS (Section 2.4.4.1) and in the Draft Amended EA (Attachment 1, § II Proposed Action (3) and § IV Proposed Action (1)(d)). These monitoring and mitigation measures are conservative and have been approved by NMFS and USFWS for other US academic research seismic surveys, including the 2014 survey off NJ. NSF and L-DEO would adhere to any monitoring and mitigation measures required by regulatory agencies, including those defined in an IHA and ITS for the survey. Therefore, the proposed activity is consistent to the maximum extent practicable with New York's Enforceable Policy 7 concerning coastal fish and wildlife habitats.

Policy 8: Protect fish and wildlife resources in the coastal area from the introduction of hazardous wastes and other pollutants which bio-accumulate in the food chain or which cause significant sublethal or lethal effect on those resources.

The proposed research activity would be located in federal waters within the EEZ and substantially outside of the NY coastal zone. Solid waste from the vessel would be transferred to shore for disposal at an approved disposal facility. The vessel would operate in compliance with its waste management plan, Clean Water Act, and the International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78), International Maritime Organization (IMO) for all solid waste discharges. Recycling programs would comply with local state regulatory requirements.

Grey water discharge (showers, dishwashing, deck drains, etc.) could be 40 m^3/d and black water discharge (sanitary waste) could be 19 m^3/day. All liquid discharges would be treated in accordance with the IMO standards prior to ocean discharge.

Ballast water would be stored in dedicated ballast tanks to improve vessel stability. No oil would be present in ballast/preload tanks or in the discharged ballast/preload water. If oil is suspected to be in water, it would be tested and, if necessary, treated to ensure that oil concentrations in the discharge do not exceed 15 mg/L, as required by MARPOL 73/78, IMO.

Bilge water often contains oil and grease that originate in the engine room and machinery spaces. Before discharge, bilge water would be treated in accordance with MARPOL 73/78, IMO using an oil/water separator or transferred to shore for disposal at an approved disposal facility. The extracted water would be tested to ensure that the discharges contain no more than 15 mg/L of oil.

Machinery spaces would be equipped with drip trays, curbs and gutters, and other devices to prevent spilled or leaked materials from entering the water. Waste material from drip pans and work spaces would be collected in a closed system designed for that purpose and would be returned to the process cycle, recycled, or transferred ashore.

All project-related wastes would be disposed of in accordance with federal and international requirements (Attachment 1, § III) and in conformance with national water quality standards. When the vessel uses NY ports or transits through NY state waters, any wastes would be disposed of in accordance with NY state requirements and conform with NY state water quality standards so as to protect fish and wildlife resources in the coastal area from the introduction of hazardous wastes and other pollutants which bio-accumulate in the food chain or which cause significant sublethal or lethal effect on those resources. Therefore, the proposed activity is consistent to the maximum extent practicable with New York's Enforceable Policy 8 concerning the protection of fish and wildlife resources in the coastal area from the introduction of hazardous wastes and other pollutants which bio-accumulate in the food chain or which cause significant sublethal or lethal effect on those resources.

Policy 9: Expand recreational use of fish and wildlife resources in coastal areas by increasing access to existing resources, supplementing existing stocks, and developing new resources.

The survey activity is proposed to take place in federal waters within the EEZ, however substantially outside of NY state waters (~92–134 km (~50–72 nmi)) (Attachment 1, Fig. 1).

The proposed activity would not include any development or construction. The area of the proposed survey, is relatively small, ~600 km^2 (~324 nmi^2). The overall area of NY's 2013 Offshore Planning Area (OPA) encompasses ~43,473 km^2 (~16,785 mi^2). Thus the portion of the proposed survey area that falls within the OPA (~400 km^2) represents less than one percent (0.92%) of the OPA. The area of the proposed survey plus the largest mitigation zone of 6.1 km is ~1460 km^2. The portion of that area that falls within the OPA (~970 km^2) would represent about two percent (2.23%) of the area of the OPA. As noted in the Draft Amended EA (Attachment 1, § IV Proposed Action (2)(c)), fishing activities would not be precluded from operating in the proposed survey area. Any impacts to fish species would be expected to occur only very close to the survey vessel, thus substantially outside of NY state waters, and would be temporary in nature.

Most commercial fish catches by weight (almost all menhaden) and most recreational fishing trips off the coast of New Jersey (87% in 2013) occur in waters within 5.6 km from shore, although the highest-value fish (e.g., flounder and tuna) are caught offshore. As noted above, the closest distance between the proposed survey and NY state waters is ~92 km (~50 nmi), so interactions between the proposed survey and recreational commercial fisheries would be highly unlikely; interaction with commercial fisheries is theoretically possible, but unlikely. Two possible conflicts are the *Langseth*'s streamer entangling with fixed fishing gear and temporary displacement of fishers within the survey area, although it is relatively small (12 x 50 km). Fishing activities could occur within the survey area; however, a safe distance would need to be kept from the *Langseth* and the towed seismic equipment. The towed hydrophone streamers proposed for this survey, however, would only be ~3 km, which is relatively short compared to many seismic surveys and therefore poses less potential conflict. Conflicts would be avoided and, therefore, impacts would be negligible, through communication with the fishing community and publication of a Notice to Mariners about operations in the area. No fisheries activities except vessels in transit were observed in the survey area during the ~13 days that the Langseth was there in July 2014. Due to the location, short duration, and nature of activity, it would not be expected that the proposed activity would have an effect on commercial and recreational fisheries or the local economies to which they contribute, such as marinas, charter fleets, restaurants, and lodging establishments.

Given the proposed research activity, no significant impacts on marine invertebrates, marine fish, their EFH, and their fisheries would be expected. In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, Protected Species Observers (PSOs) and other crew members have seen no seismic sound-related fish or invertebrate injuries or mortality. No fish kills or injuries were observed during 2014 survey activity (Attachment 1, § IV Proposed Action (2)(c)). Furthermore, past seismic surveys in the proposed survey area (2002, 1998, 1995, 1990) did not result in noticeable effects on commercial or recreational fish catches, based on a review of multi-year NMFS fish catch data in the months when seismic surveys were undertaken. (Attachment 1, § IV Proposed Action (2)(c)).

There is a whale watching industry off the coast of New Jersey and New York, most of which occurs relatively close to shore. Because of the distance between the proposed activity and shore (especially the NY coast), the likely distance from any of the marine mammal watching activities, and the short and temporary duration of any potential impacts to marine mammals, it would be unlikely that the marine mammal watching industry would be affected by the proposed activity. No whale watching vessels were encountered by the *Langseth* during the ~13 days the vessel was in the survey area in 2014.

The proposed research activity would not occur within NY state waters or interfere with access to recreational use of NY coastal fish and wildlife resources or affect access to existing NY coastal resources. The proposed survey would occur substantially outside of NY state waters. The proposed activity is not related to initiatives that would restock or develop new fisheries resources. Therefore, the proposed activity is consistent to the maximum extent practicable with New York's enforceable policy 9 concerning access to recreational use of fish and wildlife resources.

Policy 18: To safeguard the vital economic, social and environmental interests of the state and of its citizens, proposed major actions in the coastal area must give full consideration to those interests, and to the safeguards which the state has established to protect valuable coastal resource areas.

The survey activity is proposed to take place in federal waters within the EEZ, however substantially outside of NY state waters (~92–134 km (~50–72 nmi)) (Attachment 1, Fig. 1). The proposed activity would not include any development or construction. The area of the proposed survey, is relatively small, ~600 km^2 (~324 nmi^2). The overall area of NY's 2013 Offshore Planning Area (OPA) encompasses ~43,473 km^2 (~16,785 mi^2). Thus the portion of the proposed survey area that falls within the OPA (~400 km^2) represents less than one percent (0.92%) of the OPA. The area of the proposed survey plus the largest mitigation zone of 6.1 km is ~1460 km^2. The portion of that area that falls within the OPA (~970 km^2) would represent about two percent (2.23%) of the area of the OPA. As noted in the Draft Amended EA (Attachment 1, § IV Proposed Action (2)(c)), fishing activities would not be precluded from operating in the proposed survey area. Any impacts to fish species would be expected to occur very close to the survey vessel, thus substantially outside of NY state waters, and would be temporary in nature.

Most commercial fish catches by weight (almost all menhaden) and most recreational fishing trips off the coast of New Jersey (87% in 2013) occur in waters within 5.6 km from shore, although the highest-value fish (e.g., flounder and tuna) are caught offshore, as discussed earlier. As noted above, the closest distance between the proposed survey and NY state waters is ~92 km (~50 nmi), so interactions between the proposed survey and recreational fisheries would be highly unlikely; interaction with commercial fisheries is theoretically possible, but unlikely. Two possible conflicts are the *Langseth*'s streamer entangling with fixed fishing gear and temporary displacement of fishers within the survey area, although it is relatively small (12 x 50 km). Fishing activities could occur within the survey area; however, a safe distance would need to be kept from the *Langseth* and the towed seismic equipment. The towed hydrophone streamers proposed for this survey, however, would only be ~3 km, which is relatively short compared to many seismic surveys and therefore poses less potential conflict. Conflicts would be avoided and, therefore, impacts would be negligible, through communication with the fishing community and publication of a Notice to Mariners about operations in the area. No fisheries activities except vessels in transit were observed in the survey area during the ~13 days that the *Langseth* was there in July 2014. Because of the location, short duration, and nature of activity, it is not expected that the proposed activity would have an effect on commercial and recreational fisheries or the local economies to which they contribute, such as marinas, charter fleets, restaurants, and lodging establishments.

Given the proposed research activity, no significant impacts on marine invertebrates, marine fish, their EFH, and their fisheries would be expected. In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, Protected Species Observers (PSOs) and other crew members have seen no seismic sound-related fish or invertebrate injuries or mortality. No fish kills or injuries were observed during 2014 survey activity (Attachment 1, § IV Proposed Action (2)(c)). Furthermore, past seismic surveys in the proposed survey area (2002, 1998, 1995, 1990) did not result in noticeable effects on commercial or recreational fish catches, based on a review of multi-year NMFS fish catch data in the months when seismic surveys were undertaken (Attachment 1, § IV Proposed Action (2)(c)).

There is a whale watching industry off the coast of New Jersey and New York, most of which occurs relatively close to shore. Because of the distance between the proposed activity and shore, the likely distance from any of the marine mammal watching activities, and the short and temporary duration of any potential impacts to marine mammals, it would be unlikely that the marine mammal watching industry would be affected by the proposed activity. No whale watching vessels were encountered by the *Langseth* during the ~13 days the vessel was in the survey area in 2014.

NSF has considered whether the proposed action, which would occur substantially outside of NY state waters, would have an effect on the vital economic, social and environmental interests of the state and of its citizens. The proposed research activity would not affect these vital interests of the state and the safeguards which the state has established to protect valuable coastal resource areas. Therefore, the proposed activity is consistent to the maximum extent practicable with New York's Enforceable Policy 18 concerning the economic, social, and environmental interests of the state and of its citizens.

Policy 19: Protect, maintain, and increase the level and types of access to public water-related recreation resources and facilities.

The survey activity is proposed to take place in federal waters within the EEZ, however, substantially outside of NY state waters (~92–134 km (~50–72 nmi)) (Attachment 1, Fig. 1). Access to NY beaches and fisheries in state waters would not be impeded by the proposed offshore activity. No temporary or permanent construction would be conducted at the survey site to inhibit future access to the site or to the NY coastal zone. Survey activity in 2014 resulted in no known space-use conflicts and no issues with public access to the NY coastal zone, including recreation resources and facilities.

Most commercial fish catches by weight (almost all menhaden) and most recreational fishing trips off the coast of New Jersey (87% in 2013) occur in waters within 5.6 km from shore, although the highest-value fish (e.g., flounder and tuna) are caught offshore. As noted above, the closest distance between the proposed survey and NY state waters is ~92 km (~50 nmi), so interactions between the proposed survey and recreational fisheries would be highly unlikely; interaction with commercial fisheries is theoretically possible, but unlikely. Two possible conflicts are the *Langseth*'s streamer entangling with fixed fishing gear and temporary displacement of fishers within the survey area, although it is relatively small (12 x 50 km). Fishing activities could occur within the survey area; however, a safe distance would need to be kept from the *Langseth* and the towed seismic equipment. The towed hydrophone streamers proposed for this survey, however, would only be ~3 km, which is relatively short compared to many seismic surveys and therefore poses less potential conflict. Conflicts would be avoided and, therefore, impacts would be negligible, through communication with the fishing community and publication of a Notice to Mariners about operations in the area. No fisheries activities except vessels in transit were observed in the survey area during the ~13 days that the *Langseth* was there in July 2014. Because of the location, short duration, and nature of activity, it is not expected that the proposed activity would have an effect on commercial and recreational fisheries or the local economies to which they contribute, such as marinas, charter fleets, restaurants, and lodging establishments.

Therefore, the proposed activity is consistent to the maximum extent practicable with New York's Enforceable Policy 19 which concerns protecting, maintaining, and increasing the level and types of access to public water-related recreation resources and facilities.

Policy 30: Municipal, industrial, and commercial discharge of pollutants, including but not limited to, toxic and hazardous substances, into coastal waters will conform to state and national water quality standards.

The proposed survey would occur in federal waters within the EEZ, substantially outside of NY state waters. No municipal, industrial, or commercial discharge of pollutants would be made in coastal waters during the proposed activity. No hazardous materials would be generated during the proposed activity (Attachment 1, § III). Chemicals and hazardous materials that would be stored on the survey vessel and consumed during the project include industrial cleaners, paints, lubricants, etc. All hazardous materials would be managed according to applicable guidelines and regulations to prevent environmental and human health impacts. Material Safety Data Sheets (MSDS) and worker training records would be made available according to applicable regulations. Combustible materials (e.g., oily rags, paint cans) would be handled separately in hazardous materials containers. Although hazardous waste generation would not be expected, any generated unexpectedly would be brought to shore for treatment and/or disposal. The seismic vessel is equipped with solid-streamer technology; this type of streamer is not reliant on flotation fluid to achieve a neutral ballast state, thus eliminating the risk of an accidental spill. Therefore, the proposed activity is consistent to the maximum extent practicable with New York's Enforceable Policy 30 concerning discharge of pollutants into coastal waters.

Policy 34: Discharge of waste materials into coastal waters from vessels subject to state jurisdiction will be limited so as to protect significant fish and wildlife habitats, recreational areas and water supply areas.

The proposed survey would occur in federal waters within the EEZ, substantially outside of NY state waters. Solid waste from the vessel would be transferred to shore for disposal at an approved disposal facility. The vessel would operate in compliance with its waste management plan, Clean Water Act, and the International Convention for the Prevention of Pollution From

Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78), International Maritime Organization (IMO) for all solid waste discharges. Recycling programs would comply with local state regulatory requirements.

Grey water discharge (showers, dishwashing, deck drains, etc.) could be 40 m^3/d and black water discharge (sanitary waste) could be 19 m^3/day. All liquid discharges would be treated in accordance with the IMO standards prior to ocean discharge.

Ballast water would be stored in dedicated ballast tanks to improve vessel stability. No oil would be present in ballast/preload tanks or in the discharged ballast/preload water. If oil is suspected to be in water, it would be tested and, if necessary, treated to ensure that oil concentrations in the discharge do not exceed 15 mg/L, as required by MARPOL 73/78, IMO.

Bilge water often contains oil and grease that originate in the engine room and machinery spaces. Before discharge, bilge water would be treated in accordance with MARPOL 73/78, IMO using an oil/water separator or transferred to shore for disposal at an approved disposal facility. The extracted water would be tested to ensure that the discharges contain no more than 15 mg/L of oil.

Machinery spaces would be equipped with drip trays, curbs and gutters, and other devices to prevent spilled or leaked materials from entering the water. Waste material from drip pans and work spaces would be collected in a closed system designed for that purpose and would be returned to the process cycle, recycled, or transferred ashore.

All project-related wastes would be disposed of in accordance with federal and international requirements (Attachment 1, § III) and in conformance with national water quality standards. When the vessel uses NY ports or transits through NY state waters, any wastes would be disposed of in accordance with NY state requirements and conform with NY state water quality standards so as to protect fish and wildlife habitats, recreational areas, and water supply areas. Therefore, the proposed activity is consistent to the maximum extent practicable with New York's Enforceable Policy 34 concerning discharge of waste into coastal waters from vessels subject to state jurisdiction so as to protect fish and wildlife habitats, recreational areas, and water supply areas.

Policy 36: Activities related to the shipment and storage of petroleum and other hazardous materials will be conducted in a manner that will prevent or at least minimize spills into coastal waters; all practicable efforts will be undertaken to expedite the cleanup of such discharges; and restitution for damages will be required when these spills occur.

The proposed survey would occur in federal waters within the EEZ, substantially outside of NY state waters; however, the vessel would use NY ports and transit through NY state waters to the proposed survey site. No hazardous materials would be generated during the proposed activity (Attachment 1, § III). Only small amounts of chemicals and hazardous materials, such as industrial cleaners, paints, and lubricants, would be stored on the survey vessel and consumed during the project. The *Langseth* is not an oil tanker and would not store significant quantities of petroleum; the only petroleum that would be stored on the vessel would be that which would fuel the ship and lubricants for the ship's machinery. Any storage of petroleum and other hazardous materials on the vessel would be conducted in a manner that would prevent or at least minimize spills into coastal waters. The vessel has a hazardous spill plan approved by the U.S. Coast Guard. The vessel complies with all federal and international requirements and adheres to University-National Oceanographic Laboratory Safety Standards. No petroleum or hazardous waste spills would be expected into coastal waters, however if there were, all practicable efforts would be undertaken to expedite the cleanup of such discharges, and any restitution for damages would be undertaken as required by law. Therefore, the proposed activity is consistent to the maximum extent practicable with New York's Enforceable Policy 36 concerning the shipment and storage of petroleum and other hazardous materials.

Policy 39: The transport, storage, treatment and disposal of solid wastes, particularly hazardous wastes, within coastal areas will be conducted in such a manner so as to protect groundwater and surface water supplies, significant fish and wildlife habitats, recreation areas, important agricultural land, and scenic resources.

The proposed survey would occur in federal waters within the EEZ, substantially outside of NY state waters. As noted previously, all project-related wastes would be disposed of in accordance with federal and international requirements (Attachment 1, §III) and in conformance with any national water quality standards. When the vessel uses NY ports or transits through NY state waters, any wastes would be disposed of in accordance with any NY state requirements and in conformance with any NY state water quality standards so as to protect groundwater and surface water supplies, significant fish and wildlife habitats, recreation areas, important agricultural land, and scenic resources. Therefore, the proposed activity is consistent to the maximum extent practicable with New York's Enforceable Policy 39 concerning the transport, storage, treatment and disposal of solid wastes, particularly hazardous wastes, within coastal areas.

Policy 43: Land use or development in the coastal area must not cause the generation of significant amounts of acid rain precursors: nitrates and sulfates.

The proposed survey would occur in federal waters within the EEZ, substantially outside of NY state waters; however, the vessel may use NY ports or transit through NY state waters to the proposed survey site. The proposed activity would not involve land use or development in the coastal area and would not generate significant amounts of acid rain precursors: nitrates and/or sulfates. Therefore, the proposed activity is consistent to the maximum extent practicable with New York's Enforceable Policy 43 concerning land use or development in the coastal area and generation of acid rain precursors.

Policy 44: Preserve and protect tidal and freshwater wetlands and preserve the benefits derived from these areas.

The proposed survey would occur in federal waters within the EEZ, substantially outside of NY state waters. Although the vessel would use NY ports and transit through NY state waters to the proposed survey site, the vessel would use major shipping lanes and would not affect tidal wetlands (including coastal fresh marsh; intertidal marsh; coastal shoals, bars and flats; littoral zone; high marsh or salt meadow; and formerly connected tidal wetlands) or fresh wetlands (including marshes, swamps, bogs, and flats). Therefore, the proposed activity is consistent to the maximum extent practicable with New York's Enforceable Policy 44 concerning the preservation and protection of tidal and freshwater wetlands and preservation of the benefits derived from these areas.

Required State and Local Permits
No state, county, and local permits are necessary for the proposed activity.

Conclusion
The proposed activity would not have any significant impacts to NY state coastal resources or uses. Therefore, the proposed activity is consistent, to the maximum extent practicable, with the enforceable policies of New York's federally approved Coastal Management Program.

Pursuant to CFR 930.41, the New York Coastal Management Program has 60 days from the receipt of this letter in which to concur with or object to this Consistency Determination, or to request an extension under 15 CFR Section 930.41(b). The State's concurrence will be presumed if the States' response is not received by NSF on the 60th day from receipt of this Determination.

The States' response should be sent via email to:

Holly Smith
National Science Foundation
Division of Ocean Sciences
4201 Wilson Blvd.
Room 725
Arlington, VA 22230
Email: hesmith@nsf.gov

Attachment 1: Draft Environmental Assessment for a Marine Geophysical Survey by the R/V *Marcus G. Langseth* off New Jersey, Summer 2015

Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey, Summer 2015

Prepared for

Lamont-Doherty Earth Observatory
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and

National Science Foundation
Division of Ocean Sciences
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18 December 2014

LGL Report TA8349-3

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ABSTRACT

The State University of New Jersey at Rutgers (Rutgers), with funding from the U.S. National Science Foundation (NSF), proposes to conduct a high-energy, 3-D seismic survey on the R/V *Marcus G. Langseth* in the northwest Atlantic Ocean ~25–85 km from the coast of New Jersey in summer 2015. The NSF-owned *Langseth* is operated by Columbia University's Lamont-Doherty Earth Observatory (L-DEO) under an existing Cooperative Agreement. Although the *Langseth* is capable of conducting high energy seismic surveys using up to 36 airguns with a discharge volume of 6600 in^3, the proposed seismic survey would only use a small towed subarray of 4 airguns with a total discharge volume of ~700 in^3. The seismic survey would take place outside of U.S. state waters within the U.S. Exclusive Economic Zone (EEZ) in water depths ~20–75 m.

NSF, as the funding agency, has a mission to "promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense…". The proposed seismic survey would collect data in support of a research proposal that has been reviewed under the NSF merit review process and identified as an NSF program priority. It would provide data necessary to study the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to present and enable follow-on studies to identify the magnitude, time, and impact of major changes in sea level.

The survey was originally proposed for implementation in 2014. NSF environmental compliance, including all federal statutory and regulatory obligations, was completed for the survey on 1 July 2014, and the survey commenced. Because of mechanical issues with the vessel, the survey was unable to be completed during the effective periods set forth in the Incidental Harassment Authorization (IHA) and Incidental Take Statement (ITS) issued for the survey. According to the U.S. National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS), although the survey has not changed from what was approved in 2014, a new IHA will be required to conduct the same survey during a rescheduled time in 2015. This Draft Amended Environmental Assessment (Draft Amended EA) has been prepared on behalf of NSF pursuant to the National Environmental Policy Act (NEPA) to address any impacts associated with the rescheduled time for the survey, and in support of other necessary regulatory processes, including the IHA process.

As operator of the *Langseth,* L-DEO has requested an Incidental Harassment Authorization (IHA) from the U.S. National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) to authorize the incidental, i.e., not intentional, harassment of small numbers of marine mammals should this occur during the seismic survey. The analysis in the Draft Amended EA also supports the IHA application process and provides information on marine species not addressed by the IHA application, including seabirds and sea turtles that are listed under the U.S. Endangered Species Act (ESA), including candidate species. As analysis on endangered/threatened species was included, the Draft Amended EA is being used to support ESA Section 7 consultations with NMFS and U.S. Fish and Wildlife Service (USFWS). The Draft Amended EA will also be used in support of consultation with NMFS Greater Atlantic Regional Fisheries Office for Essential Fish Habitat (EFH) under the Magnuson-Stevens Act. Alternatives addressed in this Draft Amended EA consist of a corresponding program at a different time with issuance of an associated IHA and the no action alternative, with no IHA and no seismic survey. This document tiers to the Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey (June 2011) and Record of Decision (June 2012), referred to herein as PEIS. It also tiers to the Final EA for the proposed survey off New Jersey dated 1 July 2014. The proposed survey area off the coast of New Jersey is near one of the detailed

analysis areas (DAAs) in the PEIS; however, this Draft Amended EA and the 2014 Final EA were prepared because a different energy source level and configuration would be used for the proposed survey, and the proposed survey covers only shelf waters whereas the DAA was on the shelf and slope. Additionally, this Draft Amended EA addresses the differences from and updates to the Final EA for the 2014 survey.

Numerous species of marine mammals inhabit the proposed survey area off the coast of New Jersey. Several of these species are listed as ***endangered*** under the U.S. Endangered Species Act (ESA): the sperm, North Atlantic right, humpback, sei, fin, and blue whales. Other ESA-listed species that could occur in the area are the ***endangered*** leatherback, hawksbill, green, and Kemp's ridley turtles and roseate tern, and the ***threatened*** loggerhead turtle and piping plover. The ***endangered*** Atlantic sturgeon and shortnose sturgeon could also occur in or near the study area. ESA-listed ***candidate species*** that could occur in the area are the cusk, dusky shark, and great hammerhead shark.

Potential impacts of the seismic survey on the environment would be primarily a result of the operation of the airgun array. A multibeam echosounder and sub-bottom profiler would also be operated. Impacts would be associated with underwater noise, which could result in avoidance behavior by marine mammals, sea turtles, seabirds, and fish, and other forms of disturbance. An integral part of the planned survey is a monitoring and mitigation program designed to minimize potential impacts of the proposed activities on marine animals present during the proposed research, and to document as much as possible the nature and extent of any effects. Injurious impacts to marine mammals, sea turtles, and seabirds have not been proven to occur near airgun arrays, and are not likely to be caused by the other types of sound sources to be used. However, despite the relatively low levels of sound emitted by the subarray of airguns, a precautionary approach would still be taken. The planned monitoring and mitigation measures would reduce the possibility of any effects.

As was the case with the approved 2014 survey, protection measures designed to mitigate the potential environmental impacts to marine mammals and sea turtles would include the following: ramp ups; typically two, but a minimum of one dedicated observer maintaining a visual watch during all daytime airgun operations; two observers 30 min before and during ramp ups during the day and at night; no start ups during poor visibility or at night unless at least one airgun has been operating; passive acoustic monitoring (PAM) via towed hydrophones during both day and night to complement visual monitoring (unless operational issues prevent it or the system and back-up system are both damaged during operations); and power downs (or if necessary shut downs) when marine mammals or sea turtles are detected in or about to enter designated exclusion zones. L-DEO and its contractors are committed to applying these measures in order to minimize potential effects on marine mammals and sea turtles and other environmental impacts.

With the planned monitoring and mitigation measures, unavoidable impacts to each species of marine mammal and sea turtle that could be encountered would be expected to be limited to short-term, localized changes in behavior and distribution near the seismic vessel. At most, effects on marine mammals may be interpreted as falling within the U.S. Marine Mammal Protection Act (MMPA) definition of "Level B Harassment" for those species managed by NMFS. No long-term or significant effects would be expected on individual marine mammals, sea turtles, seabirds, fish, the populations to which they belong, or their habitats.

LIST OF ACRONYMS

~	approximately
ADCP	Acoustic Doppler current profiler
ALWTRP	Atlantic Large Whale Take Reduction Plan
AMVER	Automated Mutual-Assistance Vessel Rescue
BOEM	Bureau of Ocean Energy Management
CETAP	Cetacean and Turtle Assessment Program
CITES	Convention on International Trade in Endangered Species
CZMA	Coastal Zone Management Act
DAA	Detailed Analysis Area
dB	decibel
DoN	Department of the Navy
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ESA	(U.S.) Endangered Species Act
EZ	Exclusion Zone
FAO	Food and Agriculture Organization of the United Nations
FM	Frequency Modulated
GIS	Geographic Information System
h	hour
hp	horsepower
HRTRP	Harbor Porpoise Take Reduction Plan
Hz	Hertz
IHA	Incidental Harassment Authorization (under MMPA)
in	inch
IOC	Intergovernmental Oceanographic Commission of UNESCO
IODP	Integrated Ocean Drilling Program
IUCN	International Union for the Conservation of Nature
kHz	kilohertz
km	kilometer
kt	knot
L-DEO	Lamont-Doherty Earth Observatory
LFA	Low-frequency Active (sonar)
m	meter
min	minute
MBES	Multibeam Echosounder
MFA	Mid-frequency Active (sonar)
MMPA	(U.S.) Marine Mammal Protection Act
ms	millisecond
NEPA	(U.S.) National Environmental Policy Act
NJ	New Jersey
NEFSC	Northeast Fisheries Science Center
NMFS	(U.S.) National Marine Fisheries Service
NRC	(U.S.) National Research Council

NSF	National Science Foundation
OBIS	Ocean Biogeographic Information System
OCS	Outer Continental Shelf
OEIS	Overseas Environmental Impact Statement
OAWRS	Ocean Acoustic Waveguide Remote Sensing
p or pk	peak
PEIS	Programmatic Environmental Impact Statement
PI	Principal Investigator
PTS	Permanent Threshold Shift
PSO	Protected Species Observer
PSVO	Protected Species Visual Observer
RL	Received level
rms	root-mean-square
R/V	research vessel
s	second
SAR	U.S. Marine Mammal Stock Assessment Report
SBP	Sub-bottom Profiler
SCUBA	Self contained underwater breathing apparatus
SEFSC	Southeast Fisheries Science Center
TTS	Temporary Threshold Shift
SEL	Sound Exposure Level
SPL	Sound Pressure Level
UNEP	United Nations Environment Programme
U.S.	United States of America
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
USN	U.S. Navy
µPa	microPascal
vs.	versus
WCMC	World Conservation Monitoring Centre

I. PURPOSE AND NEED

The purpose of this Draft Amended EA is to provide the information needed to assess the potential environmental impacts associated with the use of a 4-airgun subarray during the proposed seismic survey off the coast of New Jersey. The survey was originally proposed for implementation in 2014. NSF environmental compliance, including all federal legal and regulatory obligations, was completed for the project on 1 July 2014, and the survey commenced. Because of mechanical issues with the vessel, the survey was unable to be completed during the effective periods of the Incidental Harassment Authorization (IHA) and Incidental Take Statement (ITS) issued for the survey. According to NMFS, a new IHA Application is required to reschedule the survey in 2015.

This Draft Amended EA was prepared pursuant to the National Environmental Policy Act (NEPA), and tiers to the Programmatic Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) for Marine Seismic Research funded by the National Science Foundation or Conducted by the U.S. Geological Survey (NSF and USGS 2011) and Record of Decision (NSF 2012), referred to herein as the PEIS. It also tiers to the Final EA for the proposed survey off New Jersey dated 1 July 2014. The proposed survey area off the coast of New Jersey is near one of the detailed analysis areas (DAAs) presented in the PEIS; however, a different energy source level and configuration would be used for the proposed survey, and the proposed survey covers only shelf waters whereas the DAA was on the shelf and slope. This Draft Amended EA was prepared to consider the survey proposed for 2015, provide updates, and address differences in the analysis prepared for the 2014 survey and the PEIS DAA. The Draft Amended EA provides details of the proposed action at the site-specific level and addresses potential impacts of the proposed seismic survey on marine mammals, as well as other species of concern in the area, including sea turtles, seabirds, fish, and invertebrates. The Draft Amended EA will be used in support of an application for an Incidental Harassment Authorization (IHA) from the National Marine Fisheries Service (NMFS), and re-initiation of Section 7 consultations under the Endangered Species Act (ESA). The IHA would allow for non-intentional, non-injurious "take by harassment" of small numbers of marine mammals during the proposed seismic survey directed by Rutgers in the Atlantic Ocean off New Jersey. The Draft Amended EA will also be used in support of consultation with NMFS Greater Atlantic Regional Fisheries Office for Essential Fish Habitat (EFH) under the Magnuson-Stevens Act.

To be eligible for an IHA under the U.S. Marine Mammal Protection Act (MMPA), the proposed "taking" (with mitigation measures in place) must not cause serious physical injury or death of marine mammals, must have negligible impacts on the species and stocks, must "take" no more than small numbers of those species or stocks, and must not have an unmitigable adverse impact on the availability of the species or stocks for legitimate subsistence uses.

Mission of NSF

NSF was established by Congress under the National Science Foundation Act of 1950 (Public Law 810507, as amended) and is the only federal agency dedicated to the support of fundamental research and education in all scientific and engineering disciplines. Further details on the mission of NSF are described in § 1.2 of the PEIS.

Purpose of and Need for the Proposed Action

As noted in the PEIS, § 1.3, NSF has a continuing need to fund seismic surveys that enable scientists to collect data essential to understanding complex Earth processes recorded in sediments on and beneath the ocean floor. The purpose of the proposed action is to collect data across existing Integrated Ocean Drilling Program (IODP) Expedition 313 drill sites on the inner-middle shelf of the New Jersey continental margin

to reveal the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to the present. Features such as river valleys cut into coastal plain sediments, now buried under a km of younger sediment and flooded by today's ocean, cannot be identified and traced with existing 2-D seismic data, despite their existence being clearly indicated in sediment cores recovered during IODP Expedition 313. These and other erosional and depositional features would be imaged using 3-D seismic data and would enable follow-on studies to identify the magnitude, time, and impact of major changes in sea level. The proposed seismic survey would collect data in support of a research proposal that has been reviewed under the NSF merit review process and identified as an NSF program priority to meet NSF's critical need to foster an understanding of Earth processes.

Background of NSF-funded Marine Seismic Research

The background of NSF-funded marine seismic research is described in § 1.5 of the PEIS.

Statutory and Regulatory Setting

The statutory and regulatory setting of this Draft Amended EA is described in § 1.8 of the PEIS, including the

- National Environmental Protection Act (NEPA);
- Marine Mammal Protection Act (MMPA);
- Endangered Species Act (ESA);
- Magnuson-Stevens Act for Essential Fish Habitat (EFH); and
- Coastal Zone Management Act (CZMA).

II. ALTERNATIVES INCLUDING PROPOSED ACTION

In this Draft Amended EA, three alternatives are evaluated: (1) the proposed seismic survey and issuance of an associated IHA, (2) a corresponding seismic survey at an alternative time, along with issuance of an associated IHA, and (3) no action alternative. Additionally, two alternatives were considered but were eliminated from further analysis. A summary table of the proposed action, alternatives, and alternatives eliminated from further analysis is provided at the end of this section.

Proposed Action

The project objectives and context, activities, and mitigation measures for Rutger's planned seismic survey are described in the following subsections. The proposed action remains the same as described for the 2014 survey, except where noted.

(1) Project Objectives and Context

Rutgers plans to conduct a 3-D seismic survey using the L-DEO operated R/V *Marcus G. Langseth* (*Langseth*) on the inner-middle shelf of the New Jersey continental margin (Fig. 1). As noted previously, the goal of the proposed research is to collect and analyze data on the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to present. Despite their existence being clearly indicated in sediment cores recovered during IODP Expedition 313, features such as river valleys cut into coastal plain sediments, now buried under a km of younger sediment and flooded by today's ocean, cannot be resolved in existing 2-D seismic data to the degree required to map shifting shallow-water depositional settings in the vicinity of clinoform rollovers. To achieve the project's goals, the lead Principal Investigator (PI), Dr. G. Mountain (Rutgers University), and collaborating PIs Drs. J.

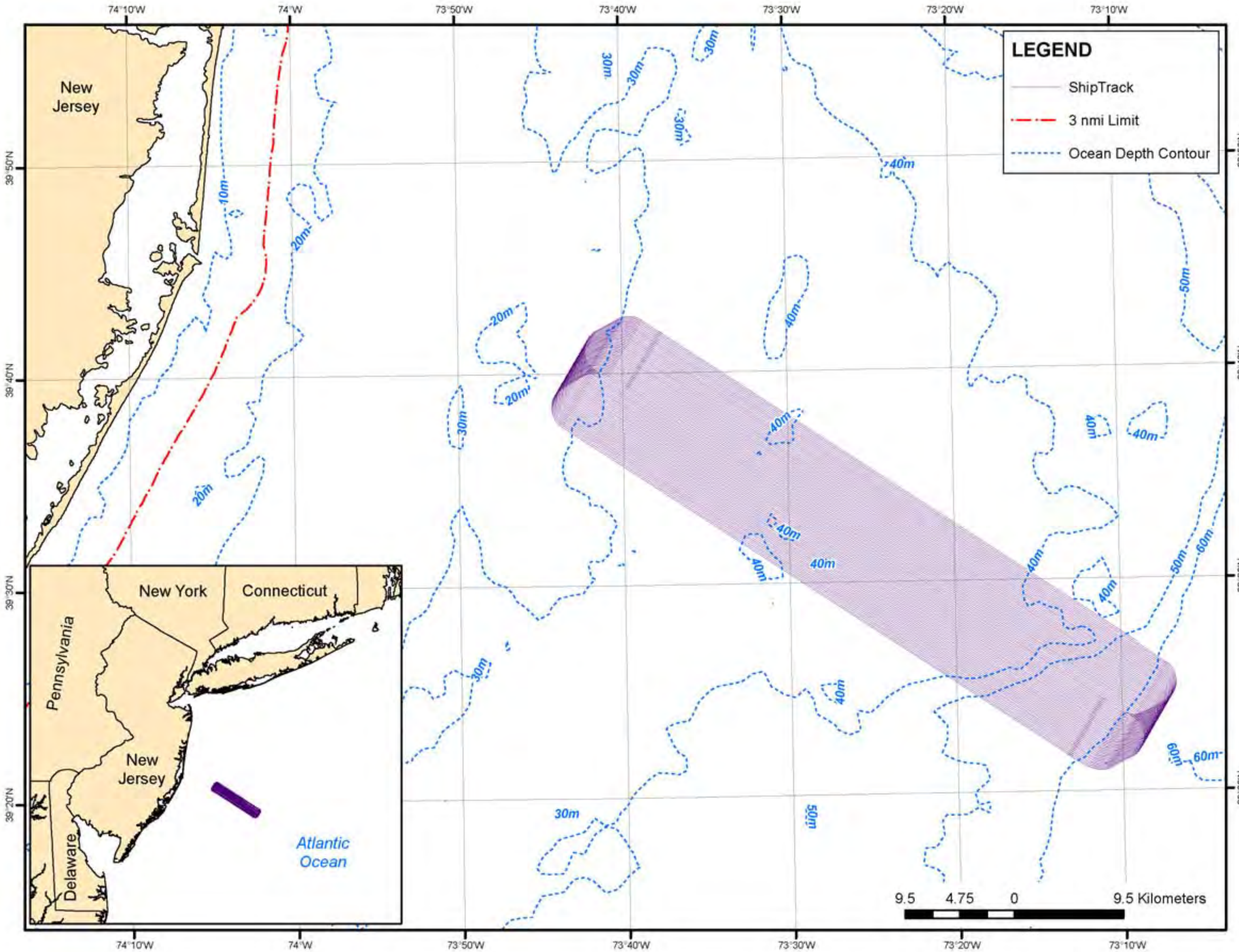

Figure 1. Location of the proposed seismic survey in the Atlantic Ocean off the coast of New Jersey.

Austin, C. Fulthorpe, and M. Nedimović (University of Texas at Austin), propose to use a 3-D seismic reflection survey to map sequences around existing IODP Expedition 313 drill sites and analyze their spatial/temporal evolution. Objectives that would then be met include establishing the impact of known Ice House base-level changes on the stratigraphic record; providing greater understanding of the response of nearshore environments to changes in elevation of global sea level; and determining the amplitudes and timing of global sea-level changes during the mid-Cenozoic. The project objectives remain the same as those described for the 2014 survey.

(2) Proposed Activities

(a) Location of the Activities

The proposed full-fold 3-D box/survey area is located in the Atlantic Ocean, ~25–85 km off the coast of New Jersey (Fig. 1). This area is defined by the coordinates at the four corners (including turns and run-in and run-out of each line): 39:38:00°N, 73:44:36°W; 39:43:12°N, 73:41:00°W; 39:25:30°N, 73:06:12°W; and 39:20:06°N, 73:10:06°W.

Water depths across the survey area are ~20–75 m. The seismic survey would be conducted outside of state waters and within the U.S. EEZ, and is scheduled to occur for ~30 days during June–August 2015. Although the proposed survey area is near the NW Atlantic DAA described in the PEIS, it does not include intermediate- and deep-water depths. The survey location would be the same as that for the 2014 survey.

(b) Description of the Activities

The procedures to be used for the survey would be the same as those proposed for the 2014 survey and similar to those used during previous NSF-funded seismic surveys and would use conventional seismic methodology. The survey would involve one source vessel, the *Langseth,* which is owned by NSF and operated on its behalf by Columbia University's L-DEO through a Cooperative Agreement entered into in 2012, and one support vessel. The *Langseth* would deploy two pairs of subarrays of 4 airguns as an energy source; the subarrays would fire alternately, with a total volume of ~700 in^3. The receiving system would be a passive component of the proposed activity and would consist of a system of hydrophones: four 3000-m hydrophone streamers at 75-m spacing, or preferentially, a combination of two 3000-m hydrophone streamers and a Geometrics P-Cable system. As the airgun array is towed along the survey lines, the hydrophone streamers would receive the returning acoustic signals and transfer the data to the on-board processing system.

A total of ~4900 km of 3-D survey lines, including turns, would be shot in an area 12 x 50 km with a line spacing of 150 m in two 6-m wide race-track patterns (Fig. 1). There would be additional seismic operations in the survey area associated with airgun testing and repeat coverage of any areas where initial data quality is sub-standard. In our calculations [see § IV(3)], 25% has been added for those additional operations. The survey parameters noted here support the proposed research goals and therefore differ from the NW Atlantic DAA survey parameters presented in the PEIS. The same transect lengths and area of survey proposed for 2015 was analyzed for the 2014 survey. Because of mechanical/equipment issues on the survey vessel along with weather issues (including Hurricane Arthur), the full 3-D array of equipment could not be deployed. Given equipment limitations, only ~61 h of seismic survey data were collected in 2014, with only ~43 h at full power (700 in^3) on survey tracklines. Of the 43 h of data collected, ~22 h were of substandard data quality because of equipment damage from rough seas. However, the existing data did allow confirmation that the smaller 700-in^3 source array was suitable for the project, thus eliminating potential use of the larger 1400-in^3 array originally proposed in 2014.

In addition to the operations of the airgun array, a multibeam echosounder (MBES) and a sub-bottom profiler (SBP) would be operated from the *Langseth* continuously throughout the survey, but not during transits. All planned geophysical data acquisition activities would be conducted with on-board assistance by

the scientists who have proposed the study. The vessel would be self-contained, and the crew would live aboard the vessel with some personnel transfer on/off the *Langseth* by a small vessel.

(c) Schedule

The *Langseth* would depart from New York, NY, and spend ~8 h in transit to the proposed survey area. Setup, deployment, and streamer ballasting would take ~3 days. The seismic survey would take 30 days plus 2 contingency days, and the *Langseth* would spend one day for gear retrieval and transit back to New York. The survey would be conducted during summer (June–August) 2015. Operations could be delayed or interrupted because of a variety of factors including equipment malfunctions and weather-related issues, but use of the airguns would not occur outside of the effective IHA period.

(d) Vessel Specifications

The *Langseth* is described in § 2.2.2.1 of the PEIS. The vessel speed during seismic operations would be ~4.5 kt (~8.3 km/h).

The support vessel would be a multi-purpose offshore utility vessel similar to the *Northstar Commander*, which is 28 m long with a beam of 8 m and a draft of 2.6 m. It is powered by a twin-screw Volvo D125-E, with 450 hp for each screw.

(e) Airgun Description

During the survey, the airgun array to be used would be the full 4-string array with most of the airguns turned off (see § II 3(a) for an explanation of the source level selection). The active airguns would be 4 airguns in one string on the port side forming Source 1, and 4 airguns in one string on the starboard side forming Source 2. These identical port and starboard sources would be operated in “flip-flop” mode, firing alternately as the ship progresses along the track, as is common for 3-D seismic data acquisition. Thus, the source volume would not exceed 700 in^3 at any time. Whereas the full array is described and illustrated in § 2.2.3.1 of the PEIS, the smaller subarrays proposed for this survey are described further in Appendix A. The subarrays would be towed at a depth of 4.5 or 6 m. The shot interval would be ~5-6 s (~12.5 m). Because the choice of the precise tow depth would not be made until the survey because of sea and weather conditions, we have assumed the use of 6 m for the impacts analysis and take estimate calculations, as that results in the farthest sound propagation. Mitigation zones have been calculated for the source level and tow depths, (see below and Appendix A, Table A2), and during operations the relevant mitigation zone would be applied.

During the attempted survey in 2014, the 700-in^3 airgun array was determined to be sufficient to image the geological targets of research interest. Thus, the 1400-in^3 array proposed as an operational possibility in the 1 July 2014 Final EA has been eliminated from the analysis in this Draft Amended EA.

(f) Additional Acoustical Data Acquisition Systems

Along with the airgun operations, two additional acoustical data acquisition systems would be operated during the survey, but not during transits: a multibeam echosounder (MBES) and sub-bottom profiler (SBP). The ocean floor would be mapped with the Kongsberg EM 122 MBES and a Knudsen Chirp 3260 SBP. These sources are described in § 2.2.3.1 of the PEIS.

(3) Monitoring and Mitigation Measures

Standard monitoring and mitigation measures for seismic surveys are described in § 2.4.4.1 of the PEIS and are described to occur in two phases: pre-cruise planning and during operations. The following sections describe the efforts during both stages for the proposed actions.

(a) Planning Phase

As discussed in § 2.4.1.1 of the PEIS, mitigation of potential impacts from the proposed activities begins during the planning phase of the proposed activities. Several factors were considered during the planning phase of the proposed activities, including

1. Energy Source—Part of the considerations for the proposed survey was to evaluate whether the research objectives could be met with a smaller energy source than the full, 36-airgun, 6600-in^3 *Langseth* array, and it was decided that the scientific objectives could be met using an energy source comprising 4 airguns (total volume 700 in^3 volume) towed at a depth of ~4.5 or 6 m. Two such subarrays of 4 airguns would be used alternately (flip-flop mode); one would be towed on the port side, the other one on the starboard side. Thus, the source volume would not exceed 700 in^3 at any time. We have assumed in the impacts analysis and take estimate calculations the use of the 4-airgun array towed at 6 m as that would result in the farthest sound propagation. Based on the research goals and current knowledge of environmental conditions in the survey area based on 2014 activities, the 1400-in^3 source level proposed for possible use in 2014 is no longer viewed necessary and has not been included in this analysis. For the DAA off the coast of New Jersey included in the PEIS, the energy source level analyzed was a pair of 45/105-in^3 GI guns, however this source level was not viewed as adequate for meeting the research goals of the proposed survey.
2. Survey Timing—The PIs worked with L-DEO and NSF to identify potential times to carry out the survey taking into consideration key factors such as environmental conditions (i.e., the seasonal presence of marine mammals, sea turtles, and seabirds), weather conditions, equipment, and optimal timing for other proposed seismic surveys using the *Langseth*. Some marine mammal species are expected to occur in the area year-round, so altering the timing of the proposed project likely would result in no net benefits for those species. Some migratory species are expected to be farther north at the time of the survey, so the survey timing is beneficial for those species.
3. Mitigation Zones—During the planning phase, mitigation zones for the proposed survey were calculated based on modeling by L-DEO for both the exclusion zone (EZ) and the safety zone; these zones are given in Table 1 and Appendix Table A2. A more detailed description of the modeling process used to develop the mitigation zones can be found in Appendix A. Received sound levels in deep water have been predicted by L-DEO for the 4-airgun array and the single Bolt 1900LL 40-in^3 airgun that would be used during power downs. Scaling factors between those arrays and the 18-airgun, 3300-in^3 array, taking into account tow depth differences, were developed and applied to empirical data for the 18-airgun array in shallow water in the Gulf of Mexico from Diebold et al. (2010). The use of the 4-airgun array towed at 6 m is assumed in the impacts and take estimate analysis as that would result in the farthest sound propagation. During actual operations, however, the corresponding mitigation zone would be applied for the selected source level. The 1 July 2014 Final EA included mitigation zones and take calculations for a 1400-in^3 array, however, that source level has been determined to be unnecessary and is not included in this analysis.

   Table 1 shows the 180-dB EZ and 160-dB "Safety Zone" (distances at which the rms sound levels are expected to be received) for the mitigation airgun and the 4-airgun subarray. The 160 and 180-dB re 1 μPa_{rms} distances are the criteria currently specified by NMFS (2000) for cetaceans. The 180-dB distance has also been used as the EZ for sea turtles, as required by NMFS in most other recent seismic projects per the IHAs. Per the Biological Opinion issued in 2014 (Appendix C of the 1 July 2014 Final EA), a 166-dB distance would be used for Level B takes for sea turtles. Per the IHA for this survey issued in 2014 (Appendix D of the 1 July

TABLE 1. Predicted distances to which sound levels ≥180 and 160 dB re 1 μPa_{rms} would be received during the proposed 3-D survey off New Jersey, using a 4-airgun, 700-in^3 subset of 1 string at 4.5- or 6-m tow depth and the 40-in^3 airgun. Radii are based on scaling described in the text of Appendix A and Figures A2 to A6, and the assumption that received levels on an rms basis are, numerically, 10 dB higher than the SEL values.[1]

Source and Volume	Water Depth	Predicted RMS Radii (m)	
		180 dB	160 dB
4-airgun subarray (700 in^3) @ 4.5 m	<100 m	378	5240
4-airgun subarray (700 in^3) @ 6 m	<100 m	439	6100
Single Bolt airgun (40 in^3) @ 6 m	<100 m	73	995

2014 Final EA), the Exclusion Zone was increased by 3 dB (thus operational mitigation would be at the 177-dB isopleth), which adds ~50% to the power-down/shut-down radius. NSF does not view this overly precautionary approach appropriate, and it is not included here. A recent retrospective analysis of acoustic propagation of *Langseth* sources in a coastal/shelf environment from the Cascadia Margin off Washington suggests that predicted radii (using an approach similar to that used here) for *Langseth* sources were 2–3 times larger than measured in shallow water, so in fact were very conservative (Crone et al. 2014).

Southall et al. (2007) made detailed recommendations for new science-based noise exposure criteria. In December 2013, NOAA published draft guidance for assessing the effects of anthropogenic sound on marine mammals (NOAA 2013a), although at the time of preparation of this Draft Amended EA, the date of release of the final guidelines and how they would be implemented are unknown. As such, this Draft Amended EA has been prepared in accordance with the current NOAA acoustic practices, and the procedures are based on best practices noted by Pierson et al. (1998), Weir and Dolman (2007), Nowacek et al. (2013), and Wright (2014).

Enforcement of mitigation zones via power and shut downs would be implemented in the Operational Phase, as noted below unless otherwise prescribed by the IHA.

(b) Operational Phase

Marine species, including marine mammals and sea turtles, are known to occur in the proposed survey area. However, the number of individual animals expected to be approached closely during the proposed activities would be relatively small in relation to regional population sizes. To minimize the likelihood that potential impacts could occur to the species and stocks, monitoring and mitigation measures proposed during the operational phase of the proposed activities, which are consistent with the PEIS and past IHA requirements, include

1. monitoring by protected species visual observers (PSVOs) for marine mammals, sea turtles, and seabirds;

[1] Sound sources are primarily described in sound pressure level (SPL) units. SPL is often referred to as rms or "root mean square" pressure, averaged over the pulse duration. Sound exposure level (SEL) is a measure of the received energy in a pulse and represents the SPL that would be measured if the pulse energy were spread evenly over a 1-s period.

2. passive acoustic monitoring (PAM);
3. PSVO data and documentation;
4. mitigation during operations (speed or course alteration; power-down, shut-down, and ramp-up procedures; and special mitigation measures for rare species, species concentrations, and sensitive habitats).

The proposed operational mitigation measures are standard for all high energy seismic cruises, per the PEIS, and therefore are not discussed further here. Special mitigation measures were considered for this cruise. Although it is very unlikely that a North Atlantic right whale would be encountered, the airgun array would be shut down if one is sighted at any distance from the vessel because of the species' rarity and conservation status. It is also unlikely that concentrations of large whales of any species would be encountered, but if so, they would be avoided.

With the proposed monitoring and mitigation provisions, potential effects on most if not all individuals would be expected to be limited to minor behavioral disturbances. Those potential effects would be expected to have negligible impacts both on individual marine mammals and on the associated species and stocks. Ultimately, survey operations would be conducted in accordance with all applicable U.S. federal regulations and IHA requirements.

Alternative 1: Alternative Survey Timing

An alternative to issuing the IHA for the period requested and to conducting the project then would be to conduct the project at an alternative time, such as late spring or early fall (avoiding the North Atlantic right whale migration season) implementing the same monitoring and mitigation measures as under the Proposed Action, and requesting an IHA to be issued for that alternative time. An evaluation of the effects of this Alternative Action is given in § IV.

Alternative 2: No Action Alternative

An alternative to conducting the proposed activities is the "No Action" alternative, i.e., do not issue an IHA and do not conduct the research operations. If the research is not conducted, the "No Action" alternative would result in no disturbance to marine mammals because of the absence of the proposed activities. Although the No-Action Alternative is not considered a reasonable alternative because it does not meet the purpose and need for the Proposed Action, per CEQ regulations it is included and carried forward for analysis in § IV.

Alternatives Considered but Eliminated from Further Analysis

(1) Alternative E1: Alternative Location

The New Jersey (NJ) continental margin has for decades been recognized as among the best siliciclastic passive margins for elucidating the timing and amplitude of eustatic change during the "Ice House" period of Earth history, when glacioeustatic changes shaped continental margin sediment sections around the world. There is a fundamental need to constrain the complex forcing functions tying evolution and preservation of the margin stratigraphic record to base-level changes. This could be accomplished by following the transect strategy adopted by the international scientific ocean drilling community. This strategy involves integration of drilling results with seismic imaging. In keeping with this strategy, the proposed seismic survey would acquire a 3-D seismic volume encompassing the three existing IODP Expedition 313 (Exp313) drill sites on the inner-middle shelf of the NJ margin. Exp313, the latest chapter in the multi-decade Mid-Atlantic Transect, represents the scientific community's best opportunity to link excellently sampled and logged late Paleogene-Neogene prograding clinoforms to state-of-the-art

3-D images. Exp313 borehole data would provide lithostratigraphy, geochronology, and paleobathymetry. 3-D seismic imaging would put these sampled records in a spatially accurate, stratigraphically meaningful context. Such imagery would allow researchers to map sequences around Exp313 sites with a resolution and confidence previously unattainable, and to analyze their spatio-temporal evolution.

No other scientific ocean drilling boreholes are available on the NJ shelf or elsewhere that provide such high sediment recoveries and high-quality well logs as those of Exp313. The need to tie the proposed 3-D survey to Exp313 drill sites means that it is not possible to conduct the survey in a different area. Also, positioning a 3-D volume requires broad coverage by pre-existing 2-D seismic data. Such data, collected over more than two decades, are readily available on the NJ shelf. Furthermore, the proposed research underwent the NSF merit review process, and the science, including the site location, was determined to be meritorious.

(2) Alternative E2: Use of Alternative Technologies

As described in § 2.6 of the PEIS, alternative technologies to the use of airguns were investigated to conduct high-energy seismic surveys. At the present time, these technologies are still not feasible, commercially viable, or appropriate to meet the Purpose and Need. Additional details about these technologies are given in the Final USGS EA (RPS 2014).

Table 2 provides a summary of the proposed action, alternatives, and alternatives eliminated from further analysis.

III. Affected Environment

As described in the PEIS, Chapter 3, the description of the affected environment focuses only on those resources potentially subject to impacts. Accordingly, the discussion of the affected environment (and associated analyses) has focused mainly on those related to marine biological resources, as the proposed short-term activities have the potential to impact marine biological resources within the proposed Project area. These resources are identified in Section III, and the potential impacts to these resources are discussed in Section IV. Initial review and analysis of the proposed Project activities determined that the following resource areas did not require further analysis in this Draft Amended EA:

- *Air Quality/Greenhouse Gases*—Project vessel emissions would result from the proposed activities; however, these short-term emissions would not result in any exceedance of federal Clean Air standards. Emissions would be expected to have a negligible impact on the air quality within the survey area;
- *Land Use*—All proposed activities would be in the marine environment. Therefore, no changes to current land uses or activities in the Project area would result from the proposed Project;
- *Safety and Hazardous Materials and Management*—No hazardous materials would be generated or used during proposed activities. All Project-related wastes would be disposed of in accordance with federal and international requirements;
- *Geological Resources (Topography, Geology and Soil)*—The proposed Project would result in no displacement of soil and seafloor sediments. Proposed activities would not adversely affect geologic resources as no impacts would occur;
- *Water Resources*—No discharges to the marine environment are proposed within the Project area that would adversely affect marine water quality. Therefore, there would be no impacts to water resources resulting from the proposed Project activities;
- *Terrestrial Biological Resources*—All proposed Project activities would occur in the marine environment and would not impact terrestrial biological resources;

Table 2. Summary of Proposed Action, Alternatives Considered, and Alternatives Eliminated

Proposed Action	Description
Proposed Action: Conduct a marine geophysical survey and associated activities in the Atlantic Ocean off New Jersey	Under the Proposed Action, a 3-D seismic reflection survey would take place in the Atlantic Ocean off New Jersey during the summer of 2015. When considering transit; equipment deployment, maintenance, and retrieval; weather; marine mammal activity; and other contingencies, the proposed activities would be expected to be completed in ~34 days. The standard monitoring and mitigation measures identified in the NSF PEIS would apply and are described in further detail in this document (§ II [3]), along with any additional requirements identified by regulating agencies. All necessary permits and authorizations, including an IHA, were requested and received from regulatory bodies in 2014 and would be requested again for 2015.
Alternatives	Description
Alternative 1: Alternative Survey Timing	Under this Alternative, the survey operations would be conducted at a different time of the year, such as late spring or early fall. The standard monitoring and mitigation measures identified in the NSF PEIS would apply. These measures are described in further detail in this document (§ II [3]) and would apply to survey activities conducted during an alternative survey time period, along with any additional requirements identified by regulating agencies as a result of the change. All necessary permits and authorizations, including an IHA, would be requested from regulatory bodies.
Alternative 2: No Action	Under this Alternative, no proposed activities would be conducted and seismic data would not be collected. No permits and authorizations, including an IHA, would be requested from regulatory bodies, as the Proposed Action would not be conducted.
Alternatives Eliminated from Further Analysis	Description
Alternative E1: Alternative Location	The survey location has been specifically identified because of the data available for that location, including borehole data from three IODP Expedition 313 drill sites that would provide lithostratigraphy, geochronology, and paleobathymetry, and broad coverage by pre-existing 2-D seismic data. The proposed 3-D seismic imaging would put these sampled records in a spatially accurate, stratigraphically meaningful context. Such imagery would allow researchers to map sequences around the drill sites with a resolution and confidence previously unattainable, and to analyze their spatio-temporal evolution. Furthermore, the proposed science underwent the NSF merit review process, and the science, including the site location, was determined to be meritorious. Thus, conducting the proposed survey at a different location was eliminated from further consideration.
Alternative E2: Alternative Survey Techniques	Under this alternative, alternative survey techniques would be used, such as marine vibroseis, which could potentially reduce impacts on the marine environment. Alternative technologies were evaluated in the PEIS, § 2.6. At the present time, however, these technologies are still not feasible, commercially viable, or appropriate to meet the Purpose and Need. NSF currently owns the *Langseth*, and its primary capability is to conduct seismic surveys; no other viable technologies are available to NSF. Thus, this Alternative was eliminated from further consideration.

- *Socioeconomic and Environmental Justice*—Implementation of the proposed Project would not affect, beneficially or adversely, socioeconomic resources, environmental justice, or the protection of children. No changes in the population or additional need for housing or schools would occur. Because of the location of the proposed activity and distance from shore, human activities in the area around the survey vessel would be limited to SCUBA diving, commercial and recreational fishing activities and other vessel traffic. Fishing, SCUBA diving, vessel traffic, and potential impacts are described in further detail in §§ III and IV. Additionally, there is a marine mammal watching industry in New Jersey. Because of the distance from shore to the proposed survey site, it would be unlikely that marine mammal watching boat tours would coincide with the proposed survey site or be impacted by

the proposed activities. Most activities are conducted within ~20 km of the coast, with the majority occurring closer inshore. Some boat tours occur well south (~100 km) of the proposed survey area around Cape May and in Delaware Bay. Some dolphin watching cruises take place off Atlantic City fairly close to shore. Tours typically are ~1.5–3 h long. Although marine mammals around the seismic survey may avoid the vessel during operations, this behavior would be of short duration and temporary. Given the distance from shore to the proposed activities, the likely distance from any of the few marine mammal watching activities, and the short and temporary duration of any potential impacts to marine mammals, it would be unlikely that the marine mammal watching industry would be affected by the proposed activities and, therefore, this issue is not analyzed further in this assessment. Furthermore, no whale watching vessels were encountered by the *Langseth* during the ~13 days the vessel was in the survey area in 2014. No other socioeconomic impacts would be anticipated as a result of the proposed activities;

- *Visual Resources*—No visual resources would be anticipated to be negatively impacted as the area of operation is significantly outside of the land and coastal view shed; and
- *Cultural Resources*—With the following possible exceptions, there are no known cultural resources in the proposed Project area. One shipwreck, a known dive site, is in or near the survey area (see Fig. 2 in § III): the *Lillian* (Galiano 2009; Fisherman's Headquarters 2014; NOAA 2014a). Shipwrecks are discussed further in § IV. Airgun sounds would have no effects on solid structures; no significant impacts on shipwrecks would be anticipated (§ IV). No impacts to cultural resources would be anticipated.

Physical Environment and Oceanography

The water off the U.S. east coast consists of three water masses: coastal or shelf waters, slope waters, and the Gulf Stream. Coastal waters off Canada, which originate mostly in the Labrador Sea, move southward over the continental shelf until they reach Cape Hatteras, NC, where they are entrained between the Gulf Stream and slope waters. North of Cape Hatteras, an elongated cyclonic gyre of slope water that forms because of the southwest flow of coastal water and the northward flowing Gulf Stream is present most of the year and shifts seasonally relative to the position of the north edge of the Gulf Stream. Slope water eventually merges with the Gulf Stream water. The Gulf Stream flows through the Straits of Florida and then parallel to the continental margin, becoming stronger as it moves northward. It turns seaward near Cape Hatteras and moves northeast into the open ocean.

The shelf waters off New Jersey are part of the Mid-Atlantic Bight, which includes shelf waters from Cape Hatteras, NC, to southern Cape Cod. The shelf is dominated by a sandy to muddy-sandy bottom (Steimle and Zetlin 2000; USGS 2000 *in* DoN 2005). The shelf off New Jersey slopes gently and uniformly seaward to the shelf-slope transition 120–150 km offshore in water depths 120–160 m (Carey et al. 1998 *in* GMI 2010). The shelf edge off New Jersey is incised by the Hudson Canyon to the north and the Wilmington Canyon to the south. Several smaller canyons also occur along the shelf edge. The Hudson Canyon is the largest canyon off the east coast of the U.S. The proposed survey area is entirely on the shelf.

The shelf waters off New Jersey become stratified in the spring as the water warms, and are fully stratified throughout the summer, i.e., warmer, fresher water accumulates at the surface and denser, colder, more saline waters occur near the seafloor. The stratification breaks down in fall because of mixing by wind and surface cooling (Castelao et al. 2008). Summer upwelling occurs off New Jersey, where nutrient-rich cold water is brought closer to the surface and stimulates primary production (Glenn et al. 2004; NEFSC 2013a). The primary production of the northeast U.S. continental shelf is

1536 mg C/m^2/day (Sea Around Us 2013). The salinity of shelf water usually increases with depth and is generally lower than the salinity of water masses farther offshore primarily because of the low-salinity input from rivers and estuaries.

There are numerous artificial reefs in shelf waters off New Jersey, including materials such as decommissioned ships, barges, and reef balls or hollow concrete domes (Steimle and Zetlin 2000; Figley 2005); these reefs can provide nursery habitat, protection, and foraging sites to marine organisms. Since 1984, more than 3500 of these artificial patch reefs have been constructed off New Jersey (Figley 2005).

Protected Areas

Several federal Marine Protected Areas (MPAs) or sanctuaries have been established ~500 km north of the proposed survey area, primarily with the intention of preserving cetacean habitat (Hoyt 2005; CetaceanHabitat 2013). These include the Cape Cod Bay Northern Right Whale Critical Habitat Area, the Great South Channel Northern Right Whale Critical Habitat Area east of Cape Cod, the Gerry E Studds Stellwagen Bank National Marine Sanctuary in the Gulf of Maine, and Jeffrey’s Ledge, a proposed extension to the Stellwagen Bank National Marine Sanctuary. The Monitor National Marine Sanctuary is located to the southeast of Cape Hatteras, North Carolina. There are also five state Ocean Sanctuaries in Massachusetts waters including Cape Cod, Cape Cod Bay, Cape and Islands, North Shore, and South Essex Ocean Sanctuaries (Mass.Gov 2013). These sanctuaries include most Massachusetts state waters except for the area east of Boston. In addition, three Canadian protected areas also occur in the Northwest Atlantic for cetacean habitat protection, including the Bay of Fundy Right Whale Conservation Area, Roseway Basin Right Whale Conservation Area, and Gully Marine Protected Area off the Scotian Shelf. The proposed survey is not located within or near any federal, state, or international MPA or sanctuary.

The Harbor Porpoise Take Reduction Plan (HPTRP) is intended to reduce the interactions between harbor porpoises and commercial gillnets in four management areas: waters off New Jersey, Mudhole North, Mudhole South, and Southern Mid Atlantic (NOAA 2010b). The HPTRP is not relevant to this EA because harbor porpoises are not expected to occur in the survey area.

Marine Mammals

Thirty-one cetacean species (6 mysticetes and 25 odontocetes) could occur near the proposed survey site (Table 3). Six of the 31 species are listed under the U.S. Endangered Species Act (ESA) as ***Endangered***: the North Atlantic right, humpback, blue, fin, sei, and sperm whales. In fact, only five species were observed during the 13-day cruise in 2014, including one humpback whale, plus one unidentified baleen whale and one unidentified dolphin (Ingram et al. 2014). An additional four cetacean species, although present in the wider western North Atlantic Ocean, likely would not be found near the proposed survey area between ~39–40°N because their ranges generally do not extend as far north (Clymene dolphin, *Stenella clymene*; Fraser’s dolphin, *Lagenodelphis hosei*; melon-headed whale, *Peponocephala electra*; and Bryde’s whale, *Balaenoptera brydei*). Although the secondary range of the beluga whale (*Delphinapterus leucas*) may range as far south as New Jersey (Jefferson et al. 2008), and there have been at least two sightings off the coast of New Jersey (IOC 2013), this species is not included here as it is unlikely to be encountered during the proposed survey. Similarly, no pinnipeds are included; harp seals (*Pagophilus groenlandicus*) and hooded seals (*Cystophora cristata*) are rare in the proposed survey area, and gray (*Halichoerus grypus*) and harbor seals (*Phoca vitulina*) have a more northerly distribution during the summer (DoN 2005) and are therefore not expected to occur there during the survey. No pinnipeds were observed during the 13-day cruise in 2014. Information on grey, harbor, and harp seals is included in the 2014 NMFS EA for this project, and is incorporated into this Draft Amended EA by reference as if fully set forth herein (Appendix E of the 1 July 2014 Final EA).

TABLE 3. The habitat, occurrence, regional population sizes, and conservation status of marine mammals that could occur in or near the proposed survey area in the Northwest Atlantic Ocean off New Jersey.

Species	Habitat	Occurrence in survey area in summer	Regional/SAR abundance estimates[1]	ESA[2]	IUCN[3]	CITES[4]
Mysticetes						
North Atlantic right whale	Coastal and shelf	Rare	455 / 455[5]	EN	EN	I
Humpback whale	Mainly coastal, banks	Common	11,600[6] / 823[7]	EN	LC	I
Minke whale	Mainly coastal	Rare	138,000[8] / 20,741[9]	NL	LC	I
Sei whale	Mainly offshore	Uncommon	10,300[10] / 357[11]	EN	EN	I
Fin whale	Slope, pelagic	Uncommon	26,500[12] / 3522[5]	EN	EN	I
Blue whale	Coastal, shelf, pelagic	Rare	855[13] / 440[5]	EN	EN	I
Odontocetes						
Sperm whale	Pelagic	Common	13,190[14] / 2288[15]	EN	VU	I
Pygmy sperm whale	Off shelf	Uncommon	N.A. / 3785[16]	NL	DD	II
Dwarf sperm whale	Off shelf	Uncommon	N.A. / 3785[16]	NL	DD	II
Cuvier's beaked whale	Pelagic	Uncommon	N.A. / 6532[17]	NL	LC	II
Northern bottlenose whale	Pelagic	Rare	N.A. / N.A.	NL	DD	II
True's beaked whale	Pelagic	Rare	N.A. / 7092[18]	NL	DD	II
Gervais' beaked whale	Pelagic	Rare	N.A. / 7092[18]	NL	DD	II
Sowerby's beaked whale	Pelagic	Rare	N.A / 7092[18]	NL	DD	II
Blainville's beaked whale	Pelagic	Rare	N.A. / 7092[18]	NL	DD	II
Rough-toothed dolphin	Mainly pelagic	Rare	N.A. / 271[5]	NL	LC	II
Bottlenose dolphin	Coastal, offshore	Common	N.A / 89,080[19]	NL^	LC	II
Pantropical spotted dolphin	Mainly pelagic	Rare	N.A. / 3333[5]	NL	LC	II
Atlantic spotted dolphin	Mainly coastal	Common	N.A. / 44,715[5]	NL	DD	II
Spinner dolphin	Coastal, pelagic	Rare	N.A. / N.A.	NL	DD	II
Striped dolphin	Off shelf	Uncommon	N.A. / 54,807[5]	NL	LC	II
Short-beaked common dolphin	Shelf, pelagic	Common	N.A. / 173,486[5]	NL	LC	II
White-beaked dolphin	Shelf <200 m	Rare	10s–100s of 1000s[20] / 2003[5]	NL	LC	II
Atlantic white-sided dolphin	Shelf and slope	Uncommon	10s–100s of 1000s[21] / 48,819[5]	NL	LC	II
Risso's dolphin	Mainly shelf, slope	Common	N.A. /18,250[5]	NL	LC	II
False killer whale	Pelagic	Extralimital	N.A. / N.A.	NL	DD	II
Pygmy killer whale	Mainly pelagic	Rare	N.A. / N.A.	NL	DD	II
Killer whale	Coastal	Rare	N.A. / N.A.	NL*	DD	II
Long-finned pilot whale	Mainly pelagic	Uncommon	780K[22] / 26,535[5]	NL[†]	DD	II
Short-finned pilot whale	Mainly pelagic	Uncommon	780K[22] / 21,515[5]	NL	DD	II
Harbor porpoise	Coastal	Rare	~500K[23] / 79,883[24]	NL	LC	II

N.A. = Data not available or species status was not assessed.

[1] SAR (stock assessment report) abundance estimates are from the 2013 U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments (Waring et al. 2014) as noted, and regional abundance estimates are for the North Atlantic regions as noted.

[2] U.S. Endangered Species Act; EN = Endangered, NL = Not listed

[3] Codes for IUCN classifications from IUCN Red List of Threatened Species (IUCN 2013): EN = Endangered; VU = Vulnerable; LC = Least Concern; DD = Data Deficient

[4] Convention on International Trade in Endangered Species of Wild Fauna and Flora (UNEP-WCMC 2013): Appendix I = Threatened with extinction; Appendix II = not necessarily now threatened with extinction but may become so unless trade is closely controlled

[5] Estimate for the Western North Atlantic Stock (Waring et al. 2014)

[6] Best estimate for the western North Atlantic in 1992–1993 (IWC 2013)

[7] Minimum estimate for the Gulf of Maine stock (Waring et al. 2014)

[8] Best estimate for the North Atlantic in 2002–2007 (IWC 2013)

[9] Estimate for the Canadian East Coast Stock (Waring et al. 2014)
[10] Estimate for the Northeast Atlantic in 1989 (Cattanach et al. 1993)
[11] Estimate for the Nova Scotia Stock (Waring et al. 2014)
[12] Best estimate for the North Atlantic in 2007 (IWC 2013)
[13] Estimate for the central and northeast Atlantic in 2001 (Pike et al. 2009)
[14] Estimate for the North Atlantic (Whitehead 2002)
[15] Estimate for the North Atlantic Stock (Waring et al. 2014)
[16] Combined estimate for pygmy and dwarf sperm whales, Western North Atlantic Stock (Waring et al. 2014)
[17] Estimate for the Western North Atlantic Stock (Waring et al. 2014)
[18] Combined estimate for *Mesoplodon* spp. Western North Atlantic stocks (Waring et al. 2014)
[19] Combined estimate for the Western North Atlantic Offshore Stock and the Northern Migratory Coastal Stock (Waring et al. 2014)
[20] High tens to low hundreds of thousands in the North Atlantic (Reeves et al. 1999a)
[21] Tens to low hundreds of thousands in the North Atlantic (Reeves et al. 1999b)
[22] Estimate for both long- and short-finned pilot whales in the central and eastern North Atlantic in 1989 (IWC 2013)
[23] Estimate for the North Atlantic (Jefferson et al. 2008)
[24] Estimate for the Gulf of Maine/Bay of Fundy Stock (Waring et al. 2014)
* Killer whales in the eastern Pacific Ocean, near Washington state, are listed as endangered under the U.S. ESA but not in the Atlantic Ocean.
^ The Western North Atlantic Coastal Morphotype stocks, ranging from NJ to FL, are listed as depleted under the U.S. Marine Mammal Protection Act, as are some other stocks to the south of the proposed survey area.
† Considered a strategic stock.

General information on the taxonomy, ecology, distribution and movements, and acoustic capabilities of marine mammals are given in § 3.6.1 and § 3.7.1 of the PEIS. The proposed survey area off New Jersey is near one of the DAAs in the PEIS. The general distributions of mysticetes and odontocetes in this region of the Atlantic Ocean are discussed in § 3.6.2.1 and § 3.7.2.1 of the PEIS, respectively. Additionally, information on marine mammals in this region is included in § 4.2.2.1 of the Bureau of Ocean Energy Management (BOEM) Final PEIS for Atlantic OCS Proposed Geological and Geophysical Activities, Mid-Atlantic and South Atlantic Planning Areas (BOEM 2014). The rest of this section deals with more specific species distribution off the coast of New Jersey. For the sake of completeness, an additional six odontocetes that are expected to be rare or extralimital in the proposed survey area were included here, but were not included in the PEIS.

The main sources of information used here are the 2010 and 2013 U.S. Atlantic and Gulf of Mexico marine mammal stock assessment reports (SARs: Waring et al. 2010, 2014), the Ocean Biogeographic Information System (OBIS: IOC 2013), and the Cetacean and Turtle Assessment Program (CETAP 1982). The SARs include maps of sightings for most species from NMFS' Northeast and Southeast Fisheries Science Centers (NEFSC and SEFSC) surveys in summer 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010, and 2011. OBIS is a global database of marine species sightings. CETAP covered 424,320 km of trackline on the U.S. outer continental shelf from Cape Hatteras to Nova Scotia. Aerial and shipboard surveys were conducted over a 39-month period from 1 November 1978 to 28 January 1982. The mid-Atlantic area referred to in the following species accounts included waters south of Georges Bank down to Cape Hatteras, and from the coast out to ~1830 m depth.

(1) Mysticetes

North Atlantic Right Whale (*Eubalaena glacialis*)

The North Atlantic right whale is known to occur primarily in the continental shelf waters off the eastern U.S. and Canada, from Florida to Nova Scotia (Winn et al. 1986; Jefferson et al. 2008). There are five well-known habitats in the northwest Atlantic used annually by right whales (Winn et al. 1986; NMFS 2005). These include the winter calving grounds in coastal waters of the southeastern U.S. (Florida/Georgia); spring feeding grounds in the Great South Channel (east of Cape Cod); late winter/spring feeding grounds and nursery grounds in Massachusetts Bay and Cape Cod Bay; summer/fall feeding and nursery grounds in the Bay of Fundy; and summer/fall feeding grounds on the Nova Scotian

Shelf. In addition, Jeffreys Ledge, off the coast of northern Massachusetts, New Hampshire, and Maine, could be an important fall feeding area for right whales and an important nursery area during summer, especially in July and August (Weinrich et al. 2000). The first three habitats were designated as Critical Habitat Areas by NMFS (1994).

There is a general seasonal north-south migration of the North Atlantic population between feeding and calving areas, but right whales could be seen anywhere off the Atlantic U.S. throughout the year (Gaskin 1982). The seasonal occurrence of right whales in mid Atlantic waters is mostly between November and April, with peaks in December and April (Winn et al. 1986) when whales transit through the area on their migrations to and from breeding grounds or feeding grounds. The migration route between the Cape Cod summer feeding grounds and the Georgia/Florida winter calving grounds, known as the mid-Atlantic corridor, has not been considered to include "high use" areas, yet the whales clearly move through these waters regularly in all seasons (Reeves and Mitchell 1986; Winn et al. 1986; Kenney et al. 2001; Reeves 2001; Knowlton et al. 2002; Whitt et al. 2013).

North Atlantic right whales are found commonly on the northern feeding grounds off the north-eastern U.S. during early spring and summer. The highest abundance in Cape Cod Bay is in February and April (Winn et al. 1986; Hamilton and Mayo 1990) and from April to June in the Great South Channel east of Cape Cod (Winn et al. 1986; Kenney et al. 1995). Throughout the remainder of summer and into fall (June–November), they are most commonly seen farther north on feeding grounds in Canadian waters, with peak abundance during August, September, and early October (Gaskin 1987). Morano et al. (2012) and Mussoline et al. (2012) indicated that right whales are present in the southern Gulf of Maine year-round and that they occur there over longer periods than previously thought.

Some whales, including mothers and calves, remain on the feeding grounds through the fall and winter. However, the majority of the right whale population leaves the feeding grounds for unknown wintering habitats and returns when the cow-calf pairs return. The majority of the right whale population is unaccounted for on the southeastern U.S. winter calving ground, and not all reproductively-active females return to the area each year (Kraus et al. 1986; Winn et al. 1986; Kenney et al. 2001). Other wintering areas have been suggested, based upon sparse data or historical whaling logbooks; these include the Gulf of St. Lawrence, Newfoundland and Labrador, coastal waters of New York and between New Jersey and North Carolina, Bermuda, and Mexico (Payne and McVay 1971; Aguilar 1986; Mead 1986; Lien et al. 1989; Knowlton et al. 1992; Cole et al. 2009; Patrician et al. 2009).

Knowlton et al. (2002) provided an extensive and detailed analysis of survey data, satellite tag data, whale strandings, and opportunistic sightings along State waters of the mid-Atlantic migratory corridor[2], from the border of Georgia/South Carolina to south of New England, including waters in the proposed seismic survey area, spanning the period from 1974 to 2002. The majority of sightings (94%) along the migration corridor were within 56 km of shore, and more than half (64%) were within 18.5 km of shore (Knowlton et al. 2002). Water depth preference was for shallow waters; 80% of all sightings were in depths <27 m, and 93% were in depths <45 m (Knowlton et al. 2002). Most sightings >56 km from shore occurred at the northern end of the corridor, off New York and south of New England. North of Cape Hatteras, most sightings were reported for March–April. Sighting data analyzed by Winn et al. (1986) dating back to 1965 showed that the occurrence of right whales in the mid Atlantic, including the

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[2] Multi-year datasets for the analysis were provided by the New England Aquarium, North Atlantic Right Whale Consortium, Oregon State University, Coastwise Consulting Inc., Georgia Department of Natural Resources, University of North Carolina Wilmington, Continental Shelf Associates, CETAP, NOAA, and University of Rhode Island.

proposed survey area, peaked in April and December (Winn et al. 1986). A review of the mid-Atlantic whale sighting and tracking data archive from 1974 to 2002 showed right whale sightings off the coast of New Jersey throughout the year, except during May–June, August, and November (Beaudin Ring 2002).

The Interactive North Atlantic Right Whale Sighting Map showed 32 sightings in the shelf waters off New Jersey between 2006 and 2012 (NEFSC 2013b). Two of these sightings occurred just to the north of the proposed survey site. Three sightings were made in June, and none were made in July. However, two sightings were made during July to the far east of the proposed survey area (NEFSC 2013b). There are also at least eight sightings of right whales off New Jersey in the Ocean Biogeographic Information System (OBIS; IOC 2013), which were made during the 1978–1982 Cetacean and Turtle Assessment Program (CETAP) surveys (CETAP 1982).

Palka (2006) reviewed North Atlantic right whale density in the U.S. Navy NE Operating Area based on summer abundance surveys conducted during 1998–2004. One of the lowest whale densities (including right whales) was found in the mid-Atlantic stratum, which includes the proposed survey area. However, survey effort for this stratum was also the lowest; only two surveys were conducted. No right whales were sighted.

Whitt et al. (2013) surveyed for right whales off the coast of New Jersey using acoustic and visual techniques from January 2008 to December 2009. Whale calls were detected off New Jersey year-round and four sightings were made: one in November, one in December, one in January just to the west of the survey area, and one cow-calf pair in May. In light of these findings, Whitt et al. (2013) suggested expanding the existing critical habitat to include waters of the mid-Atlantic. NMFS (2010) previously noted that such a revision could be warranted, but no revisions have been made to the critical habitat yet.

Federal and Other Action.—In 2002, NMFS received a petition to revise and expand the designation of critical habitat for the North Atlantic right whale. The revision was declined and the critical habitat designated in 1994 remained in place (NMFS 2005). Another petition for a revision to the critical habitat was received in 2009 that sought to expand the currently designated critical feeding and calving habitat areas and include a migratory corridor as critical habitat (NMFS 2010). NMFS noted that the requested revision may be warranted, but no revisions have been made as of June 2014. The designation of critical habitat does not restrict activities within the area or mandate any specific management action. However, actions authorized, funded, or carried out by federal agencies that may have an impact on critical habitat must be consulted upon in accordance with Section 7 of the ESA, regardless of the presence of right whales at the time of impacts. Impacts on these areas that could affect primary constituent elements such as prey availability and the quality of nursery areas must be considered when analyzing whether habitat may be adversely modified.

A number of other actions have been taken to protect North Atlantic right whales, including establishing the Right Whale Sighting Advisory System designed to reduce collisions between ships and right whales by alerting mariners to the presence of the whales (see NEFSC 2012); a Mandatory Ship Reporting System implemented by the U.S. Coast Guard in the right whale nursery and feeding areas (USCG 1999, 2001; Ward-Geiger et al. 2005); recommended shipping routes in key right whale aggregation areas (NOAA 2006, 2007, 2013b); regulations to implement seasonal mandatory vessel speed restrictions in specific locations (Seasonal Management Areas or SMAs) during times when whales are likely present, including ~37 km around points near the Ports of New York/New Jersey (40.495ºN, 73.933ºW) and Philadelphia and Wilmington (38.874ºN, 75.026ºW) during 1 November–30 April (NMFS 2008); temporary Dynamic Management Areas (DMAs) in response to actual whale sightings, requiring gear modifications to traps/pots and gillnets in areas north of 40°N with unexpected right whale aggregations (NOAA 2012a); and a voluntary seasonal (April 1 to July 31) Area to be Avoided in the

Great South Channel off Massachusetts (NOAA 2013b). Furthermore, in its Final PEIS (BOEM 2014), BOEM proposed that no seismic surveys would be authorized within right whale critical habitat from 15 November to April 15, nor within the Mid-Atlantic and Southeast U.S. SMAs from 1 November to 30 April 30. Additionally, G&G seismic surveys would not be allowed in active DMAs. The proposed survey area is not in any of these areas.

North Atlantic right whales likely would not be encountered during the proposed survey.

Humpback Whale (*Megaptera novaeangliae*)

In the North Atlantic, a Gulf of Maine stock of the humpback whale is recognized off the northeastern U.S. coast as a distinct feeding stock (Palsbøll et al. 2001; Vigness-Raposa et al. 2010). Whales from this stock feed during spring, summer, and fall in areas ranging from Cape Cod to Newfoundland. In the spring, greatest concentrations of humpback whales occur in the western and southern edges of the Gulf of Maine. During summer, the greatest concentrations are found throughout the Gulf of Maine, east of Cape Cod, and near the coast from Long Island to northern Virginia. Similar distribution patterns are seen in the fall, although sightings south of Cape Cod Bay are less frequent than those near the Gulf of Maine. From December to March, there are few occurrences of humpback whales over the continental shelf of the Gulf of Maine, and in Cape Cod and Massachusetts Bay (Clapham et al. 1993; Fig. B-5a *in* DoN 2005).

GMI (2010) reported 17 sightings of humpback whales during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with sightings during every season (including 1 in spring and 4 in summer[3]). There are >40 OBIS sighting records of humpback whales for the continental shelf off New Jersey, including sightings near the proposed survey area (IOC 2013). There was one sighting of a humpback whale during the 13-day cruise in 2014.

Common Minke Whale (*Balaenoptera acutorostrata*)

Four populations of the minke whale are recognized in the North Atlantic, including the Canadian East Coast stock that ranges from the eastern U.S. coast to Davis Strait (Waring et al. 2013). Minke whales are common off the U.S. east coast over continental shelf waters, especially off New England during spring and summer (CETAP 1982). Seasonal movements in the Northwest Atlantic are apparent, with animals moving south and offshore from New England waters during the winter (Fig. B-11a *in* DoN 2005; Waring et al. 2013). There are approximately 30 OBIS sightings of minke whales off New Jersey (IOC 2013), most of which were observed in the spring and summer during CETAP surveys (CETAP 1982).

GMI (2010) reported four sightings of minke whales during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009: two during winter and two during spring. Two sightings were also reported during summer NEFSC and SEFSC surveys between 1998 and 2011 on the shelf break off New Jersey (Waring et al. 2013). Minke whales likely would not be encountered during the proposed survey.

Sei Whale (*Balaenoptera borealis*)

Two stocks of the sei whale are recognized in the North Atlantic: the Labrador Sea Stock and the Nova Scotia Stock; the latter has a distribution that includes continental shelf waters from the northeastern U.S. to areas south of Newfoundland (Waring et al. 2013). The southern portion of the Nova Scotia stock's range includes the Gulf of Maine and Georges Bank during spring and summer (Waring et

[3] GMI defined spring as 11 April–21 June and summer as 22 June–27 September.

al. 2013). Peak sightings occur in spring and are concentrated along the eastern edge of Georges Bank into the Northeast Channel and the southwestern edge of Georges Bank (Fig. B-6a *in* DoN 2005; Waring et al. 2013). Mitchell and Chapman (1977) suggested that this stock moves from spring feeding grounds on or near Georges Bank to the Scotian Shelf in June and July, eastward to Newfoundland and the Grand Banks in late summer, back to the Scotian Shelf in fall, and offshore and south in winter. During summer and fall, most sei whale sightings occur in feeding grounds in the Bay of Fundy and on the Scotian Shelf; sightings south of Cape Cod are rare (Fig. B-6a *in* DoN 2005).

There are at least three OBIS sightings of sei whales off New Jersey, and several more sightings to the south of the proposed survey area (IOC 2013). Palka (2012) reported one sighting on the shelf break off New Jersey in water depths ranging from 100–2000 m during June–August 2011 surveys. There were no sightings of sei whales during the CETAP surveys (CETAP 1982).

Fin Whale (*Balaenoptera physalus*)

Fin whales are present in U.S. shelf waters during winter, and are sighted more frequently than any other large whale at this time (DoN 2005). They occur year-round in shelf waters of New England and New Jersey (CETAP 1982; Fig. B-8a *in* DoN 2005). Winter sightings are most concentrated around Georges Bank and in Cape Cod Bay. During spring and summer, most fin whale sightings are north of 40ºN, with smaller numbers on the shelf south of there, including off New Jersey (Fig. B-8a *in* DoN 2005). During fall, almost all fin whales move out of U.S. waters to feeding grounds in the Bay of Fundy and on the Scotian Shelf, remain at Stellwagen Bank and Murray Basin (Fig. B-8a *in* DoN 2005), or begin a southward migration (Clark 1995).

GMI (2010) reported 37 sightings of fin whales during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with sightings during every season (including 11 in spring and 4 in summer). Acoustic detections were also made during all seasons (GMI 2010). Numerous sightings were also made off New Jersey during NEFSC and SEFSC summer surveys between 1995 and 2011, with two sightings on the shelf and other sightings on the shelf break and beyond (Waring et al. 2013). There are 170 OBIS sightings of fin whales off New Jersey (IOC 2013), most of which were made during the CETAP surveys (CETAP 1982).

Blue Whale (*Balaenoptera musculus*)

In the western North Atlantic, the distribution of the blue whale extends as far north as Davis Strait and Baffin Bay (Sears and Perrin 2009). Little is known about the movements and wintering grounds of the stocks (Mizroch et al. 1984). Acoustic detection of blue whales using the U.S. Navy's Sound Surveillance System (SOSUS) program has tracked blue whales throughout most of the North Atlantic, including deep waters east of the U.S. Atlantic EEZ and subtropical waters north of the West Indies (Clark 1995).

Wenzel et al. (1988) reported the occurrence of three blue whales in the Gulf of Maine in 1986 and 1987, which were the only reports of blue whales in shelf waters from Cape Hatteras to Nova Scotia. Several other sightings for the waters off the east coast of the U.S. were reported by DoN (2005). Wenzel et al. (1988) suggested that it is unlikely that blue whales occur regularly in the shelf waters off the U.S. east coast. Similarly, Waring et al. (2010) suggested that the blue whale is, at best, an occasional visitor in the U.S. Atlantic EEZ.

During CETAP surveys, the only two sightings of blue whales were made south of Nova Scotia (CETAP 1982). There are two offshore sightings of blue whales in the OBIS database to the southeast of New Jersey and several sightings to the north off New England and in the Gulf of Maine (IOC 2013). Blue whales likely would not be encountered during the proposed survey.

(2) Odontocetes

Sperm Whale (*Physeter macrocephalus*)

In the northwest Atlantic, the sperm whale generally occurs in deep water along the continental shelf break from Virginia to Georges Bank, and along the northern edge of the Gulf Stream (Waring et al. 2001). Shelf edge, oceanic waters, seamounts, and canyon shelf edges are also predicted habitats of sperm whales in the Northwest Atlantic (Waring et al. 2001). Off the eastern U.S. coast, they are also known to concentrate in regions with well-developed temperature gradients, such as along the edges of the Gulf Stream and warm core rings, which may aggregate their primary prey, squid (Jaquet 1996).

Sperm whales appear to have a well-defined seasonal cycle in the Northwest Atlantic. In winter, most historical records are in waters east and northeast of Cape Hatteras, with few animals north of 40ºN; in spring, they shift the center of their distribution northward to areas east of Delaware and Virginia, but they are widespread throughout the central area of the Mid-Atlantic Bight and southern tip of Georges Bank (Fig. B-10a in DoN 2005; Waring et al. 2013). During summer, they expand their spring distribution to include areas east and north of Georges Bank, the Northeast Channel, and the continental shelf south of New England (inshore of 100 m deep). By fall, sperm whales are most common south of New England on the continental shelf but also along the shelf edge in the Mid-Atlantic Bight (Fig. B-10a in DoN 2005; Waring et al. 2013).

There are several hundred OBIS records of sperm whales in deep waters off New Jersey and New England (IOC 2013), and numerous sightings were reported on and seaward of the shelf break during CETAP surveys (CETAP 1982) and during summer NEFSC and SEFSC surveys between 1998 and 2011 (Waring et al. 2013).

Pygmy and Dwarf Sperm Whales (*Kogia breviceps* and *K. sima*)

In the northwest Atlantic, both pygmy and dwarf sperm whales are thought to occur as far north as the Canadian east coast, with the pygmy sperm whale ranging as far as southern Labrador; both species prefer deep, offshore waters (Jefferson et al. 2008). Between 2006 and 2010, 127 pygmy and 32 dwarf sperm whale strandings were recorded from Maine to Puerto Rico, mostly off the southeastern U.S. coast; five strandings of pygmy sperm whales were reported for New Jersey (Waring et al. 2013).

There are 14 OBIS sightings of pygmy or dwarf sperm whales in offshore waters off New Jersey (IOC 2013). Several sightings of *Kogia* sp. (pygmy or dwarf sperm whales) for shelf-break waters off New Jersey were also reported during summer NEFSC and SEFSC surveys between 1995 and 2011 (Waring et al. 2013).

Cuvier's Beaked Whale (*Ziphius cavirostris*)

In the northwest Atlantic, Cuvier's beaked whale has stranded and been sighted as far north as the Nova Scotian shelf, and occurs most commonly from Massachusetts to Florida (MacLeod et al. 2006). Most sightings in the northwest Atlantic occur in late spring or summer, particularly along the continental shelf edge in the mid-Atlantic region (CETAP 1982; Waring et al. 2001, 2013). Mapping of combined beaked whale sightings in the northwest Atlantic suggests that beaked whales are rare in winter and fall, uncommon in spring, and abundant in summer in waters north of Virginia, off the shelf break and over the continental slope and areas of high relief, including the waters off New Jersey (Fig. B-13a *in* DoN 2005).

DoN mapped several sightings of Cuvier's beaked whales during the summer along the shelf break off New Jersey (Fig. B-13a *in* DoN 2005). One sighting was made off New Jersey during the CETAP surveys (CETAP 1982). Palka (2012) reported one sighting on the shelf break off New Jersey in water depths 100–2000 m during June–August 2011 surveys. There are eight OBIS sighting records of Cuvier's beaked whale in offshore waters off New Jersey (IOC 2013).

Northern Bottlenose Whale (*Hyperoodon ampullatus*)

Northern bottlenose whales are considered extremely uncommon or rare within waters of the U.S. Atlantic EEZ (Reeves et al. 1993; Waring et al. 2010), but there are known sightings off New England and New Jersey (CETAP 1982; McLeod et al. 2006; Waring et al. 2010). Two sightings of three individuals were made during the CETAP surveys; one sighting was made during May to the east of Cape Cod and the second sighting was made on 12 June along the shelf edge east of Cape May, New Jersey (CETAP 1982). Three sightings were made during summer surveys along the southern edge of Georges Bank in 1993 and 1996, and another three sightings were made in water depths 1000–4000 m at ~38–40ºN during NEFSC and SEFSC surveys between 1998 and 2006 (Waring et al. 2010). In addition, there is one OBIS sighting off New England in 2005 made by the Canadian Department of Fisheries and Oceans (IOC 2013). DoN (2005) also reported northern bottlenose whale sightings beyond the shelf break off New Jersey during spring and summer. Northern bottlenose whales likely would not be encountered during the proposed survey.

True's Beaked Whale (*Mesoplodon mirus*)

In the Northwest Atlantic, True's beaked whale occurs from Nova Scotia to Florida and the Bahamas (Rice 1998). Carwardine (1995) suggested that this species could be associated with the Gulf Stream. DoN did not report any sightings of True's beaked whale off New Jersey (Fig. B-13a *in* DoN 2005); however, several sightings of undifferentiated beaked whales were reported for shelf break waters off New Jersey during summer NEFSC and SEFSC surveys between 1995 and 2011 (Waring et al. 2013). There are no OBIS sightings of True's beaked whale off New Jersey, but there is one stranding record off North Carolina and one record off New England (IOC 2013). There are numerous other stranding records for the east coast of the U.S. (Macleod et al. 2006). True's beaked whales likely would not be encountered during the proposed survey.

Gervais' Beaked Whale (*Mesoplodon europaeus*)

Based on stranding records, Gervais' beaked whale appears to be more common in the western Atlantic than in the eastern Atlantic (Macleod et al. 2006; Jefferson et al. 2008). Off the U.S. east coast, it occurs from Cape Cod Bay, Massachusetts (Moore et al. 2004) to Florida, with a few records in the Gulf of Mexico (Mead 1989). DoN mapped two sightings of Gervais' beaked whale during summer to the south of the proposed survey area and numerous other sightings along the shelf break off the northeast coast of the U.S. (Fig. B-13a *in* DoN 2005). Palka (2012) reported three sightings in deep offshore waters during June–August 2011 surveys off the northeastern coast of the U.S. There are four OBIS stranding records of Gervais' beaked whale for Virginia, but no records for New Jersey (IOC 2013). Gervais' beaked whales likely would not be encountered during the proposed survey.

Sowerby's Beaked Whale (*Mesoplodon bidens*)

Sowerby's beaked whale occurs in cold temperate waters of the North Atlantic (Mead 1989). In the western North Atlantic, it is found from at least Massachusetts to the Labrador Sea (Mead et al. 2006; Jefferson et al. 2008). Palka (2012) reported one sighting on the shelf break off New Jersey during June–August 2011 surveys. There are also at least five OBIS sighting records in deep waters off New Jersey (IOC 2013). DoN mapped one stranding in New Jersey in fall and one in Delaware in spring, but no sightings off New Jersey (Fig. B-13a *in* DoN 2005). Sowerby's beaked whales likely would not be encountered during the proposed survey.

Blainville's Beaked Whale (*Mesoplodon densirostris*)

In the western North Atlantic, Blainville's beaked whale is found from Nova Scotia to Florida, the Bahamas, and the Gulf of Mexico (Würsig et al. 2000). There are numerous strandings records along the east coast of the U.S. (Macleod et al. 2006). DoN mapped several sightings of Blainville's beaked whale during summer along the shelf break off the northeastern coast of the U.S. (Fig. B-13a *in* DoN 2005). There is one OBIS sighting record in offshore waters to the southeast of New Jersey and one in offshore waters off New England (IOC 2013). Blainville's beaked whales likely would not be encountered during the proposed survey.

Rough-toothed Dolphin (*Steno bredanensis*)

The rough-toothed dolphin is distributed worldwide in tropical, subtropical, and warm temperate waters (Miyazaki and Perrin 1994). They are generally seen in deep, oceanic water, although they can occur in shallow coastal waters in some locations (Jefferson et al. 2008). The rough-toothed dolphin rarely ranges north of 40°N (Jefferson et al. 2008).

One sighting of 45 individuals was made south of Georges Bank seaward of the shelf edge during the CETAP surveys (CETAP 1982), and another sighting was made in the same areas during 1986 (Waring et al. 2010). In addition, two sightings were made off New Jersey to the southeast of the proposed survey area during 1979 and 1998 (Waring et al. 2010; IOC 2013). Palka (2012) reported a sighting in deep offshore waters off New Jersey during June–August 2011 surveys. Rough-toothed dolphins likely would not be encountered during the proposed survey.

Common Bottlenose Dolphin (*Tursiops truncatus*)

In the northwest Atlantic, the common bottlenose dolphin occurs from Nova Scotia to Florida, the Gulf of Mexico and the Caribbean, and south to Brazil (Würsig et al. 2000). There are regional and seasonal differences in the distribution of the offshore and coastal forms of bottlenose dolphins off the U.S. east coast. Although strandings of bottlenose dolphins are a regular occurrence along the U.S. east coast, since July 2013, an unusually high number of dead or dying bottlenose dolphins (971 as of 8 December 2013; 1175 as of 16 March 2014; 1283 as of 18 May 2014; and 1546 as of 19 October 2014) have washed up on the mid-Atlantic coast from New York to Florida (NOAA 2014b). NOAA declared an unusual mortality event (UME), the tentative cause of which is thought to be cetacean morbillivirus. As of 20 October 2014, 266 of 280 dolphins tested were confirmed positive or suspect positive for morbillivirus. NOAA personnel observed that the affected dolphins occur in nearshore waters, whereas dolphins in offshore waters >50 m deep did not appear to be affected (Environment News Service 2013), but have stated that it is uncertain exactly what populations have been affected (NOAA 2014b). In addition to morbillivirus, the bacteria *Brucella* was confirmed in 30 of 95 dolphins tested as of 20 October 2014 (NOAA 2014b). The NOAA web site is updated frequently, and it is apparent that the strandings initially had been moving south; in the 4 November update, dolphins had been reported washing up only as far south as South Carolina, and in the 8 December update, strandings were also reported in Georgia and Florida. Recently, the numbers of strandings appear to be decreasing, especially in the northern states; between 17 August and 19 October, there were 2, 3, 4, and 0 strandings in NY, NJ, DE, and MD, respectively.

Evidence of year-round or seasonal residents and migratory groups exist for the coastal form of bottlenose dolphins, with the so-called "northern migratory management unit" occurring north of Cape Hatteras to New Jersey, but only during summer and in waters <25 m deep (Waring et al. 2010). The offshore form appears to be most abundant along the shelf break and is differentiated from the coastal form by occurring in waters typically >40 m deep (Waring et al. 2010). Bottlenose dolphin records in the Northwest Atlantic suggest that they generally can occur year-round from the continental shelf to deeper waters over the abyssal plain, from the Scotian Shelf to North Carolina (Fig. B-14a *in* DoN 2005).

GMI (2010) reported 319 sightings of bottlenose dolphins during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with most sightings made during spring and summer. Palka (2012) also reported numerous sightings on the shelf break off New Jersey in water depths ranging from 100–2000 m during June–August 2011 surveys. There are also several hundred OBIS records off New Jersey, including sightings near the proposed survey area on the shelf and along the shelf edge (IOC 2013). There was one sighting of 10 bottlenose dolphins during the 13-day cruise in 2014.

Pantropical Spotted Dolphin (*Stenella attenuata*)

Pantropical spotted dolphins generally occur in deep offshore waters between 40°N and 40°S (Jefferson et al. 2008). There have been a few sightings at the southern edge of Georges Bank (Waring et al. 2010). In addition, there are at least 10 OBIS sighting records for waters off New Jersey that were made during surveys by the Canadian Wildlife Service between 1965 and 1992 (IOC 2013). Pantropical spotted dolphins likely would not be encountered during the proposed survey.

Atlantic Spotted Dolphin (*Stenella frontalis*)

In the western Atlantic, the distribution of the Atlantic spotted dolphin extends from southern New England, south to the Gulf of Mexico, the Caribbean Sea, Venezuela, and Brazil (Leatherwood et al. 1976; Perrin et al. 1994; Rice 1998). During summer, Atlantic spotted dolphins are sighted in shelf waters south of Chesapeake Bay, and near the continental shelf edge, on the slope, and offshore north of there, including the waters of New Jersey (Fig. B-15a *in* DoN 2005; Waring et al. 2014). Several sightings were also reported during summer NEFSC and SEFSC surveys between 1998 and 2011 on the shelf break off New Jersey (Waring et al. 2014). There are two OBIS sighting records northeast of the survey area and at least eight records to the southeast of the survey area (IOC 2013). There was one sighting of 12 Atlantic spotted dolphins during the 13-day cruise in 2014.

Spinner dolphin (*Stenella longirostris*)

The spinner dolphin is pantropical in distribution, with a range nearly identical to that of the pantropical spotted dolphin, including oceanic tropical and sub-tropical waters between 40ºN and 40ºS (Jefferson et al. 2008). The distribution of spinner dolphins in the Atlantic is poorly known, but they are thought to occur in deep waters along most of the U.S. coast; sightings off the northeast U.S. coast have occurred exclusively in offshore waters >2000 m (Waring et al. 2010). Several sightings were mapped by DoN (Fig. B-16 *in* DoN 2005) for offshore waters to the far east of New Jersey. There are also seven OBIS sighting records off the eastern U.S. but no records near the proposed survey area or in shallow water (IOC 2013). Spinner dolphins likely would not be encountered during the proposed survey.

Striped Dolphin (*Stenella coeruleoalba*)

In the western North Atlantic, the striped dolphin occurs from Nova Scotia to the Gulf of Mexico and south to Brazil (Würsig et al. 2000). Off the northeastern U.S. coast, striped dolphins occur along the continental shelf edge and over the continental slope from Cape Hatteras to the southern edge of Georges Bank (Waring et al. 2014). In all seasons, striped dolphin sightings have been centered along the 1000-m depth contour, and sightings have been associated with the north edge of the Gulf Stream and warm core rings (Waring et al. 2014). Their occurrence off the northeastern U.S. coast seems to be highest in the summer and lowest during the fall (Fig. B-17a *in* DoN 2005).

There are approximately 100 OBIS sighting records of striped dolphins for the waters off New Jersey to the east of the proposed survey area, mainly along the shelf break (IOC 2013). Numerous

sightings were also reported during summer NEFSC and SEFSC surveys between 1998 and 2011 off the shelf break (Waring et al. 2014).

Short-beaked Common Dolphin (*Delphinus delphis*)

The short-beaked common dolphin occurs from Cape Hatteras to Georges Bank during mid January–May, moves onto Georges Bank and the Scotian Shelf during mid summer and fall, and has been observed in large aggregations on Georges Bank in fall (Selzer and Payne 1988; Waring et al. 2014). Sightings off New Jersey have been made during all seasons (Fig. B-19a *in* DoN 2055). GMI (2010) reported 32 sightings of short-beaked common dolphins during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with sightings during fall and winter. There are over 100 OBIS sighting records near the proposed survey area off New Jersey, with most sightings near the shelf edge, but there are also several sightings in shelf waters (IOC 2013). There were 4 sightings of a total of 45 short-beaked common dolphins during the 13-day cruise in 2014.

White-beaked Dolphin (*Lagenorhynchus albirostris*)

The white-beaked dolphin is widely distributed in cold temperature and subarctic North Atlantic waters (Reeves et al. 1999a), and mainly occurs over the continental shelf, especially along the shelf edge (Carwardine 1995). It occurs in immediate offshore waters of the east coast of the North America, from Labrador to Massachusetts (Rice 1998). Off the northeastern U.S. coast, white-beaked dolphins are mainly found in the western Gulf of Maine and around Cape Cod (CETAP 1982; Fig. B-20a *in* DoN 2005; Waring et al. 2010). There are two OBIS sighting records to the east of the proposed survey area off New Jersey, and one to the south off North Carolina (IOC 2013). White-beaked dolphins likely would not be encountered during the proposed survey.

Atlantic White-sided Dolphin (*Lagenorhynchus acutus*)

The Atlantic white-sided dolphin occurs in cold temperate to subpolar waters of the North Atlantic in deep continental shelf and slope waters (Jefferson et al. 2008). In the western North Atlantic, it ranges from Labrador and southern Greenland to ~38ºN (Jefferson et al. 2008). There are seasonal shifts in Atlantic white-sided dolphin distribution off the northeastern U.S. coast, with low numbers in winter from Georges Basin to Jeffrey's Ledge and very high numbers in spring in the Gulf of Maine. In summer, Atlantic white-sided dolphins are mainly distributed northward from south of Cape Cod with the highest numbers from Cape Cod north to the lower Bay of Fundy; sightings off New Jersey appear to be sparse (Fig. B-21a *in* DoN 2005). There are over 20 OBIS sighting records in the shelf waters off New Jersey, including near the proposed survey area (IOC 2013).

Risso's Dolphin (*Grampus griseus*)

The highest densities of Risso's dolphin occur in mid latitudes ranging from 30° to 45°, and primarily in outer continental shelf and slope waters (Jefferson et al. 2013). Off the northeast U.S. coast during spring, summer, and autumn, Risso's dolphins are distributed along the continental shelf edge from Cape Hatteras to Georges Bank, but they range into oceanic waters during the winter (Waring et al. 2014). Mapping of Risso's dolphin sightings off the U.S. east coast suggests that they could occur year-round from the Scotian Shelf to the coast of the southeastern U.S. in waters extending from the continental shelf to the continental rise (DoN 2005). Off New Jersey, the greatest number of sightings occurs near the continental slope during summer (Fig. B-22a *in* DoN 2005).

There are at least 170 OBIS records near the proposed survey area off New Jersey, including shelf waters and at the shelf edge (IOC 2013). Numerous sightings were also reported during summer NEFSC

and SEFSC surveys between 1998 and 2011 for the shelf break off New Jersey (Waring et al. 2014). There was one sighting of a Risso's dolphin during the 13-day cruise in 2014.

Pygmy Killer Whale (*Feresa attenuata*)

The pygmy killer whale is pantropical/subtropical, generally occurring between 40ºN and 35ºS (Jefferson et al. 2008). There is no abundance estimate for the pygmy killer whale off the U.S. east coast because it is rarely sighted during surveys (Waring et al. 2010). One group of six pygmy killer whales was sighted off Cape Hatteras in waters >1500 m deep during a NMFS vessel survey in 1992 (Hansen et al. 1994 *in* Waring et al. 2010). There are an additional three OBIS sighting records to the southeast of the proposed survey area (Palka et al. 1991 *in* IOC 2013). Pygmy killer whales likely would not be encountered during the proposed survey.

False Killer Whale (*Pseudorca crassidens*)

The false killer whale is found worldwide in tropical and temperate waters generally between 50ºN and 50ºS (Odell and McClune 1999). It is widely distributed, but not abundant anywhere (Carwardine 1995). In the western Atlantic, it occurs from Maryland to Argentina (Rice 1998). Very few false killer whales were sighted off the U.S. northeast coast in the numerous surveys mapped by DoN (2005). There are 13 OBIS sighting records for the waters off the eastern U.S., but none are near the proposed survey area (IOC 2013). False killer whales likely would not be encountered during the proposed survey.

Killer Whale (*Orcinus orca*)

In the western North Atlantic, killer whales occur from the polar ice pack to Florida and the Gulf of Mexico (Würsig et al. 2000). Based on historical sightings and whaling records, killer whales apparently were most often found along the shelf break and offshore in the northwest Atlantic (Katona et al. 1988). They are considered uncommon or rare in waters of the U.S. Atlantic EEZ (Katona et al. 1988). Killer whales represented <0.1 % of all cetacean sightings (12 of 11,156 sightings) in CETAP surveys during 1978–1981 (CETAP 1982). Four of the 12 sightings made during the CETAP surveys were made offshore from New Jersey. Off New England, killer whales are more common in summer than in any other season, occurring nearshore and off the shelf break (Fig. B-24 *in* DoN 2005). There are 39 OBIS sighting records for the waters off the eastern U.S., but none off New Jersey (IOC 2013). Killer whales likely would not be encountered during the proposed survey.

Long- and Short-finned Pilot Whales (*Globicephala melas* and *G. macrorhynchus*)

There are two species of pilot whale, both of which could occur in the survey area. The long-finned pilot whale (*G. melas*) is distributed antitropically, whereas the short-finned pilot whale (*G. macrorhynchus*) is found in tropical, subtropical, and warm temperate waters (Olson 2009). In the northwest Atlantic, pilot whales often occupy areas of high relief or submerged banks and associated with the Gulf Stream edge or thermal fronts along the continental shelf edge (Waring et al. 1992). The ranges of the two species overlap in the shelf/shelf-edge and slope waters of the northeastern U.S. between New Jersey and Cape Hatteras, with long-finned pilot whales occurring to the north (Bernard and Reilly 1999). During winter and early spring, long-finned pilot whales are distributed along the continental shelf edge off the northeast U.S. coast and in Cape Cod Bay, and in summer and fall they also occur on Georges Bank, in the Gulf of Maine, and north into Canadian waters (Fig. B-25a *in* DoN 2005).

There are at least 200 OBIS sighting records for pilot whales for the waters off New Jersey, including sightings over the shelf; these sightings include *Globicephala* sp. and *G. melas* (IOC 2013). Numerous sightings were also reported during summer NEFSC and SEFSC surveys between 1998 and 2007 for the shelf break off New Jersey (Waring et al. 2014).

Harbor Porpoise (*Phocoena phocoena*)

The harbor porpoise inhabits cool temperate to subarctic waters of the Northern Hemisphere (Jefferson et al. 2008). There are likely four populations in the western North Atlantic: Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, Newfoundland, and Greenland (Gaskin 1984, 1992). Individuals found off the eastern U.S. coast likely would be almost exclusively from the Gulf of Maine/Bay of Fundy stock.

Harbor porpoises concentrate in the northern Gulf of Maine and southern Bay of Fundy during July–September, with a few sightings ranging as far south as Georges Bank and one off Virginia (Waring et al. 2014). In summer, sightings mapped from numerous sources extended only as far south as off northern Long Island, New York (Fig. B-26a *in* DoN 2005). During October–December and April–June, harbor porpoises are dispersed and range from New Jersey to Maine, although there are lower densities at the northern and southern extremes (DoN 2005; Waring et al. 2014). Most would be found over the continental shelf, but some are also encountered over deep waters (Westgate et al. 1998). During January–March, harbor porpoises concentrate farther south, from New Jersey to North Carolina, with lower densities occurring from New York to New Brunswick (DoN 2005; Waring et al. 2014).

GMI (2010) reported 51 sightings of harbor porpoise during surveys conducted in shallow water (<30 m) on the continental shelf off New Jersey in January 2008–December 2009, with sightings during fall and winter. There are 10 OBIS sighting records for the waters off New Jersey during March–June, most of which are from the CETAP surveys (CETAP 1982; IOC 2013). Harbor porpoises likely would not be encountered during the proposed survey.

Sea Turtles

Two species of sea turtle, the leatherback and loggerhead turtles, are common off the U.S. east coast. Kemp’s ridley and green turtles also occur in this area at much lower densities. A fifth species, the hawksbill turtle, is considered very rare in the northwest Atlantic Ocean. In fact, only one species was observed and identified during the 13-day cruise in 2014, the loggerhead turtle. Thirteen additional shelled sea turtles were also sighted, but were not identified. General information on the taxonomy, ecology, distribution and movements, and acoustic capabilities of sea turtles are given in § 3.4.1 of the PEIS. The general distribution of sea turtles in the northwest Atlantic is also discussed in § 3.4.2.1 of the PEIS and § 4.2.3.1 of the BOEM Final PEIS (BOEM 2014). The rest of this section deals specifically with their distribution off the northeastern coast of the U.S., particularly off New Jersey.

(1) Leatherback Turtle (*Dermochelys coriacea*)

Leatherback turtles commonly occur along the eastern U.S. coast and as far north as New England (Eckert 1995a), although important nesting areas occur only as far north as Florida (NMFS and USFWS 2013a). Leatherback occurrence in New England waters has been documented for many years, with most historic records during March–August focused around the Gulf of Maine and Georges and Browns Banks; in fall, they were focused more southerly in New England bays and sounds (Lazell 1980). Leatherbacks tagged off Cape Breton and mainland Nova Scotia during summer remained off eastern Canada and the northeastern U.S. coast before most began migrating south in October (James et al. 2005); foraging adults off Nova Scotia mainly originate from Trinidad (NMFS and USFWS 2013a). Some of these tags remained attached long enough to observe northward migrations, with animals leaving nesting grounds during February–March and typically arriving north of 38ºN during June, usually in areas within several hundred km of where they were observed in the previous year. Virtually all of the leatherbacks in sighting records off the northeastern U.S. occurred in summer off southern New Jersey, the southeastern tip of Long Island, and southern Nova Scotia (Fig. C-2a *in* DoN 2005).

GMI (2010) reported 12 sightings of leatherback sea turtles on the continental shelf off New Jersey during surveys conducted in January 2008–December 2009, with all sightings occurring during summer. There are over 200 OBIS sighting records for the waters off New Jersey (IOC 2013). Palka (2012) also reported several sightings off northern New Jersey south of Long Island during June–August 2011 surveys.

(2) Green Turtle (*Chelonia mydas*)

Important feeding areas for green turtles in U.S. waters are primarily located in Florida and southern Texas, but Long Island Sound and inshore waters of North Carolina appear to be important to juveniles during summer months (NMFS and USFWS 2007). Small numbers of juvenile green turtles have occurred historically in Long Island and Nantucket Sounds in New England (Lazell 1980). There are few sighting records, but DoN (Fig. C-5 *in* DoN 2005) suggested that small numbers can be found from spring to fall as far north as Cape Cod Bay, including off New Jersey. There are seven OBIS sightings of green turtles off the coast of New Jersey (IOC 2013). Palka (2012) also reported several sightings off northern New Jersey south of Long Island during June–August 2011 surveys.

(3) Loggerhead Turtle (*Caretta caretta*)

Major nesting areas for loggerheads in the western North Atlantic are located in the southeastern U.S., principally southern Florida, but also as far north as the Carolinas and occasionally Virginia; the nesting season is from May to August (Spotila 2004). Most females tagged on North Carolina nesting beaches traveled north to forage at higher latitudes (primarily off New Jersey, Maryland, and Delaware) during summer, and south to wintering grounds off the southeastern U.S. in the fall (Hawkes et al. 2007).

Some juveniles make seasonal foraging migrations into temperate latitudes as far north as Long Island, New York (Shoop and Kenney 1992 *in* Musick and Limpus 1997). Lazell (1980) reported that loggerheads were historically common in New England waters and the Gulf of Maine. Sighting records of loggerheads off the northeastern U.S. were in all seasons in continental shelf and slope waters from Cape Cod to southern Florida, with greatest concentrations in mid-continental shelf waters off New Jersey during the summer (Fig. C-3a *in* DoN 2005). There are increased stranding records of loggerheads from Cape Cod Bay and Long Island Sound in the fall (DoN 2005); loggerheads may be unable to exit these inshore habitats, which can result in hypothermia as temperatures drop in late fall (Burke et al. 1991 *in* DoN 2005).

GMI (2010) reported 69 sightings of loggerhead turtles on the continental shelf off New Jersey during surveys conducted in January 2008–December 2009; sightings occurred from spring through fall, with most sightings during summer. There are over 1000 OBIS sighting records off the coast of New Jersey, including within the proposed project area (IOC 2013). Palka (2012) also reported several sightings off northern New Jersey south of Long Island during June–August 2011 surveys. There were 16 sightings of a single loggerhead turtle during the 13-day cruise in 2014.

(4) Hawksbill Turtle (*Eretmochelys imbricata*)

The hawksbill is the most tropical of all sea turtles, generally occurring between ~30ºN and ~30ºS (Eckert 1995b). In the Atlantic Ocean, most nesting beaches are in the Caribbean Sea as far north as Cuba and the Bahamas (NMFS and USFWS 2013b). It is considered very rare and possibly extralimital in the northwest Atlantic (Lazell 1980; Eckert 1995b). Nonetheless, DoN (Fig. C-6 *in* DoN 2005) mapped two hawksbill turtle sightings off New Jersey (one during spring and one during fall) and several south of New Jersey. In addition, there is one OBIS sighting record offshore New Jersey, east of the proposed survey area (SEFSC 1992 *in* IOC 2013).

(5) Kemp's Ridley Turtle (*Lepidochelys kempii*)

Kemp's ridley turtle has a more restricted distribution than other sea turtles, with adults primarily located in the Gulf of Mexico; some juveniles also feed along the U.S. east coast, including Chesapeake Bay, Delaware Bay, Long Island Sound, and waters off Cape Cod (Spotila 2004). Nesting occurs primarily along the central and southern Gulf of Mexico coast during May–late July (Morreale et al. 2007). There have also been some rare records of females nesting on Atlantic beaches of Florida, North Carolina, and South Carolina (Plotkin 2003). After nesting, female Kemp's ridley turtles travel to foraging areas along the coast of the Gulf of Mexico, typically in waters <50 m deep from Mexico's Yucatan Peninsula to southern Florida; males tend to stay near nesting beaches in the central Gulf of Mexico year-round (Morreale et al. 2007). Only juvenile and immature Kemp's ridley turtles appear to move beyond the Gulf of Mexico into more northerly waters along the U.S. east coast.

Hatchlings are carried by the prevalent currents off the nesting beaches and do not reappear in the neritic zone until they are about two years old (Musick and Limpus 1997). Those juvenile and immature Kemp's ridley turtles that migrate northward past Cape Hatteras probably do so in April and return southward in November (Musick et al. 1994). North of Cape Hatteras, juvenile and immature Kemp's ridleys prefer shallow-water areas, particularly along North Carolina and in Chesapeake Bay, Long Island Sound, and Cape Cod Bay (Musick et al. 1994; Morreale et al. 1989; Danton and Prescott 1988; Frazier et al. 2007). There are historical summer sightings and strandings of Kemp's ridley turtles from Massachusetts into the Gulf of Maine (Lazell 1980). Occasionally, individuals can be carried by the Gulf Stream as far as northern Europe, although those individuals are considered lost to the breeding population. Virtually all sighting records of Kemp's ridley turtles off the northeastern U.S. were in summer off the coast of New Jersey (Fig. C-4a *in* DoN 2005). There are 60 OBIS sighting records off the coast of New Jersey, some within the proposed survey area (SEFSC 1992 *in* IOC 2013).

Seabirds

Two ESA-listed seabird species could occur in or near the Project area: the ***Threatened*** piping plover and the ***Endangered*** roseate tern. Neither species was observed during the 13-day cruise in 2014. General information on the taxonomy, ecology, distribution and movements, and acoustic capabilities of seabird families are given in § 3.5.1 of the PEIS.

(1) Piping Plover (*Charadrius melodus*)

The Atlantic Coast Population of the piping plover is listed as ***Threatened*** under the U.S. ESA, and the species is listed as ***Near Threatened*** on the IUCN Red List of Threatened Species (IUCN 2013). It breeds on coastal beaches from Newfoundland to North Carolina during March–August and it winters along the Atlantic Coast from North Carolina south, along the Gulf Coast, and in the Caribbean (USFWS 1996). Its marine nesting habitat consists of sandy beaches, sandflats, and barrier islands (Birdlife International 2013). Feeding areas include intertidal portions of ocean beaches, mudflats, sandflats, and shorelines of coastal ponds, lagoons, or salt marshes (USFWS 1996). Wintering plovers are generally found on barrier islands, along sandy peninsulas, and near coastal inlets (USFWS 1996).

Because it is strictly coastal, the piping plover likely would not be encountered at the proposed survey site.

(2) Roseate Tern (*Sterna dougallii*)

The Northeast Population of the roseate tern is listed as ***Endangered*** under the U.S. ESA, and the species is listed as ***Near Threatened*** on the IUCN Red List of Threatened Species (IUCN 2013). It breeds on islands along the northeast coast of the U.S from New York to Maine and north into Canada,

and historically as far south as Virginia (USFWS 1998, 2010). It is thought to migrate beginning in mid September through the eastern Caribbean and along the north coast of South America, and to winter mainly on the east coast of Brazil (USFWS 2010). During the breeding season, roseate terns forage over shallow coastal waters, especially in water depths <5 m, sometimes near the colony and at other times at distances of over 30 km. They usually forage over shallow bays, tidal inlets and channels, tide rips, and sandbars (USFWS 2010).

Because of its distribution during the breeding season, the roseate tern likely would not be encountered at the proposed survey site.

Fish, Essential Fish Habitat, and Habitat Areas of Particular Concern

(1) ESA-Listed Fish and Invertebrate Species

There are two fish species listed under the ESA as ***Endangered*** that could occur in the study area: the New York Bight distinct population segment (DPS) of the Atlantic sturgeon, and the shortnose sturgeon. There are two species that are candidates for ESA listing: the cusk and the Northwest Atlantic and Gulf of Mexico DPS of the dusky shark. There are no listed or candidate invertebrate species.

Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*)

Five DPSs of the Atlantic sturgeon are listed under the U.S. ESA, one as ***Threatened*** and four as ***Endangered***, including the New York Bight DPS, and the species is listed as ***Near Threatened*** on the IUCN Red List of Threatened Species (IUCN 2014). It is a long-lived, late maturing (11–21 years in the Hudson River), anadromous fish. Spawning adults migrate upriver in spring, beginning in April–May in the mid Atlantic. The New York Bight DPS primarily uses the Delaware and Hudson rivers for spawning. Following spawning, males can remain in the river or lower estuary until fall, and females usually exit the rivers within 4–6 weeks. Juveniles move downstream and inhabit brackish waters for a few months before moving into nearshore coastal waters (NOAA 2012b).

Shortnose Sturgeon (*Acipenser brevirostrum*)

The shortnose sturgeon is listed as ***Endangered*** throughout its range under the U.S. ESA and ***Vulnerable*** on the IUCN Red List of Threatened Species (IUCN 2014). It is an anadromous species that spawns in coastal rivers along the east coast of North America from Canada to Florida. The shortnose sturgeon prefers the nearshore marine, estuarine, and riverine habitats of large river systems, and apparently does not make long-distance offshore migrations (NOAA 2013c).

Cusk (*Brosme brosme*)

The cusk is an ESA ***Candidate Species*** throughout its range, and has not been assessed for the IUCN Red List. In the Northwest Atlantic, it occurs from New Jersey north to the Strait of Belle Isle and the Grand Banks of Newfoundland and rarely to southern Greenland. It is a solitary, benthic species found in rocky, hard bottom areas to a depth of 100 m. In U.S waters, it occurs primarily in deep water of the central Gulf of Maine (NOAA 2013d).

Dusky Shark (*Carcharhinus obscurus*)

The Northwest Atlantic and Gulf of Mexico DPS of the dusky shark is an ESA ***Candidate Species***, and the species is listed as ***Vulnerable*** on the IUCN Red List of Threatened Species (IUCN 2014). It is a coastal-pelagic species that inhabits warm temperate and tropical waters throughout the world. In the Northwest Atlantic, it is found from southern Massachusetts and Georges Bank to Florida and the northern Gulf of Mexico. The dusky shark occurs in both inshore and offshore waters, although it avoids

areas of low salinity from the surface to depths of 575 m. Along U.S. coasts, it undertakes long temperature-related migrations, moving north in summer and south in fall (NMFS 2013b).

(2) Essential Fish Habitat (EFH)

EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity". "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish. "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities (NMFS 2013c). The entire eastern sea-board from the coast to the limits of the EEZ is EFH for one or more species or life stage for which EFH has been designated.

Two fishery management councils, created by the 1976 Magnuson Fisheries Conservation and Management Act (renamed Magnuson Stevens Fisheries Conservation and Management Act in 1996) are responsible for the management of fishery resources, including designation of EFH, in federal waters of the survey area: the Mid-Atlantic Fishery Management Council (MAFMC) and the New England Fishery Management Council (NEFMC). The Highly Migratory Division of the National Marine Fisheries Service in Silver Spring, MD, manages highly migratory species (sharks, swordfish, billfish, and tunas).

The life stages and associated habitats for those species with EFH in the survey area are described in Table 4.

Two EFH areas located ~150 km northeast of the proposed survey area, the Lydonia and Oceanographer canyons, were previously protected from fishing. Bottom trawling was prohibited in these areas because of the presence of *Loligo* squid eggs, under the Fisheries Management Plan for Atlantic mackerel, butterfish, and *Illex* and *Loligo* squid. This protection was valid as of 31 July 2008 for up to three years, after which it was to be subject to review for the possibility of extension (NOAA 2008).

(3) Habitat Areas of Particular Concern

Habitat Areas of Particular Concern (HAPC) are subsets of EFH that provide important ecological functions and/or are especially vulnerable to degradation, and are designated by Fishery Management Councils. All four life stages of summer flounder have EFH within the proposed survey area, whereas HAPC have only been designated for the juvenile and adult EFH: demersal waters over the continental shelf, from the coast to the limits of the EEZ, from the Gulf of Maine to Cape Hatteras, North Carolina (NOAA 2012c). Specifically, the HAPC include "all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile EFH. If native species of submerged aquatic vegetation are eliminated then exotic species should be protected because of functional value, however, all efforts should be made to restore native species" (NOAA 2012c). No other HAPC have been designated for those species with EFH within the proposed survey area.

Fisheries

Commercial and recreational fisheries data are collected by NMFS, including species, gear type and landings mass and value, all of which are reported by state of landing (NOAA 2013e). Fisheries data from 2008 to 2013 were used in the analysis of New Jersey's commercial and recreational fisheries near the proposed study area.

(1) Commercial Fisheries

The average annual catch weights and values, fishing season, and gear types for major commercial species are summarized in Table 5. In the waters off New Jersey, commercial fishery catches are dominated by menhaden, various shellfish, and squid. Menhaden accounted for 33% of the catch weight, followed by

Table 4. Marine species with Essential Fish Habitat (EFH) overlapping the proposed survey area.

	Life stage[1] and habitat[2]				
Species	E	L/N	J	A	SA
Atlantic cod *Gadus morhua*				B	B
Atlantic haddock *Melanogrammus aeglefinus*		P	B		
Pollock *Pollachius virens*				B	
Black sea bass *Centropristis striata*	P	P	D	D	D
Bluefish *Pomatomus saltatrix*	P	P	P	P	P
Butterfish *Peprilus triacanthus*	P	P	P	P	P
Atlantic herring *Clupea harengus*			P	P	B
Atlantic mackerel *Scomber scombrus*	P	P	P	P	P
Red hake *Urophycis chuss*	P	P	B		
Silver hake *Merluccius bilinearis*	P	P	B		
Scup *Stenotomus chrysops*			D	D	
Monkfish *Lophius americanus*	P	P	B	B	B
Ocean pout *Macrozoarces americanus*	B	B	B	B	B
Summer flounder *Paralichthys dentatus*	P	P	B	B	B
Windowpane flounder *Scophthalmus acquosus*	P	P		B	B
Winter flounder *Pleuronectes americanus*	B	D/P	B	B	B
Witch flounder *Glyptocephalus cynoglossus*	P	P			B
Yellowtail flounder *Limanda ferruginea*	P				
Albacore tuna *Thunnus alalunga*			P		
Bigeye tuna *Thunnus obesus*				P	
Bluefin tuna *Thunnus thynnus*			P		
Skipjack tuna *Katsuwonus pelamis*				P	
Yellowfin tuna *Thunnus albacres*			P		
Swordfish *Xiphias gladius*			P		
Little skate *Leucoraja erinacea*			B	B	
Winter skate *Leucoraja ocellata*			B		
Basking shark *Cetorhinus maximus*			P	P	
Blue shark *Prionace glauca*		P	P	P	
Dusky shark *Carcharhinus obscurus*		P	P	P	
Common thresher shark *Alopias vulpinus*		P	P	P	
Porbeagle shark *Lamna nasus*				P	
Sandbar shark *Carcharhinus plumbeus*		B	B	B	
Scalloped hammerhead shark *Sphyrna lewini*			P	P	
Shortfin mako shark *Isurus oxyrinchus*		P	P	P	
Smooth (spiny) dogfish *Squalus acanthias*		P	P	P	
Sand tiger shark *Carcharias taurus*		P	P		
Tiger shark *Galeocerdo cuvier*			P	P	
White shark *Carcharodon carcharias*		P	P	P	
Atlantic sea scallop *Placopecten magellanicus*	B	P	B	B	B
Atlantic surfclam *Spisula solidissima*	P	P	B	B	B
Ocean quahog *Arctica islandica*	P	P	B	B	B
Northern shortfin squid *Illex illecebrosus*	P	P	D/P	D/P	D/P
Longfin inshore squid *Loligo pealeii*	B	P	D/P	D/P	D/P

Source: NOAA 2012c

[1] E = eggs; L/N = larvae for bony fish and invertebrates, neonate for sharks; J = juvenile; A = adult; SA = spawning adult

[2] P = pelagic; D = demersal; B = benthic

Table 5. Commercial fishery catches for major marine species for New Jersey waters by weight, value, season, and gear type, averaged from 2008 to 2013.

Species	Average annual landings (mt)	% total	Average annual landings (1000$)	% total	Fishing season (peak season)	Gear Type: Fixed	Gear Type: Mobile
Menhaden	24,056	34	5,328	3	Year-round (May–Oct)	Gill nets, pots, traps, pound nets	Dip nets, trawls, dredge, purse seines, tongs, grabs
Atlantic surf clam	12,324	18	16,745	10	Year-round	N/A	Dredge, tongs, grabs
Ocean quahog	6,697	10	9,245	6	Year-round (spring–fall)	N/A	Dredge
Sea scallop	5,524	8	101,497	63	Year-round (Mar–Oct)	Gill nets, long lines, pots, traps, pound nets	Dredge, trawls
Northern shortfin squid	4,593	7	3,424	2	Year-round (Jun–Oct)	N/A	Dredge, trawls
Shellfish	3,607	5	1,464	1	Year-round (May–Oct)	Gill nets, long lines, pots, traps, pound nets, weirs	Trawls, cast nets, dip nets, diving, dredge, fyke net, hand lines, Scottish seine
Blue crab	2,768	4	7,718	5	Year-round (May–Oct)	Lines trot with bait, pots, traps	Dredge, hand lines, trawls
Atlantic herring	2,284	3	574	<1	Year-round (Jan–Feb)	Gill nets, pound nets	Trawls, fyke net
Atlantic mackerel	2,007	3	769	<1	Fall–spring (Jan–Apr)	Gill nets, pound nets	Dredge, trawls
Longfin squid	1,533	2	3,278	2	Year-round (Jan–Mar; Jul–Nov)	Gill nets, pound nets	Dredge, trawls
Monkfish (Goosefish)	1,144	2	3,199	2	Year-round (Oct–Mar; May–Jun)	Gill nets, long lines, pots, traps, pound nets	Dredge, trawls
Skate	1,036	1	667	<1	Year-round (Nov–Jan; May–Jun)	Gill nets, pots, traps, pound nets	Dredge, trawls
Summer flounder	953	1	4,527	3	Year-round	Gill nets, pots, traps, pound nets	Dredge, hand lines, trawls, rod and reel
Scup	669	1	831	1	Year-round (Jan–Apr)	Gill nets, pots, traps, pound nets	Dredge, trawls, hand lines
Spiny dogfish shark	554	1	247	<1	Fall–spring (Nov–Jan; May)	Gill nets, long lines, pots, traps, pound nets	Dredge, trawls, hand lines
Bluefish	422	1	452	<1	Year-round (Apr–Nov)	Gill nets, pots, traps, pound nets	Dredge, hand lines, trawls
Total	70,172	100	159,964	100			

Source: NOAA 2013g

Atlantic surf clam (17%), ocean quahog (9%), sea scallop (7%), northern shortfin squid (6%), shellfish (5%), and blue crab (4%). Numerous other fish and invertebrate species accounted for the remaining proportion of catch weight. In 2010 (the only such dataset available in NOAA 2013g), most finfish by weight (68.8%) were caught within 5.6 km from shore; that catch was almost all (98.1%) accounted for by menhaden. Fish dominating the offshore (5.6–370 km from shore) finfish catch by weight were American mackerel (20.1% of total finfish weight), American herring (17.7%), skates (12.8%), and summer flounder (8.8%). Most finfish by value (73.3%) were caught between 5.6 and 370 km from shore; dominant fish by value were summer flounder (25.7% of total finfish value), goosefish/anglerfish (15.2%), yellowfin tuna (6.8%), and bigeye tuna (6.4%). Most shellfish and squid were captured between 5.6 and 370 km from shore, both by weight (73.6% of total shellfish and squid catch) and value (89.1%).

During 2002–2006 (the last year reported), commercial catch in the EEZ along the U.S east coast has only been landed by U.S. and Canadian vessels, with the vast majority of the catch (>99%) taken by U.S. vessels (Sea Around Us Project 2011). Typical commercial fishing vessels in the New Jersey area include trawlers, gill netters, lobster/crab boats, dredgers, longliners, and purse seiners.

(2) Recreational Fisheries

In 2013, marine recreational fishers caught over 5 million fish for harvest or bait, and >17.8 million fish in catch and release programs in New Jersey waters. These catches were taken by over 900,000 recreational fishers during more than 4 million trips. The majority of the trips (87%) occurred within 5.6 km from shore. The periods with the most boat-based trips (including charter, party, and private/rental boats) were July–August (1.03 million trips or 44% of total), followed by 1.03 million trips or 44%), and September–October (445,923 or 19%). Most shore-based trips (from beaches, marshes, docks, and/or piers; DoN 2005) occurred in July–August (600,400 or 32%), then September–October (442,464 or 23%), and May–June (370,832 or 20%).

In 2004, there were eight recreational fishing tournaments around New Jersey between May and November, all of which were within 150 km (~80 nm) from shore (DoN 2005). Of the 'hotspots' (popular fishing sites commonly visited by recreational anglers) mapped by DoN (2005), most are to the north or south of the proposed survey area; however, there are several hotspots located within or very near the northwestern corner of the survey area. As of April 2014, 11 tournaments were scheduled in 2014 for central New Jersey ports of call (Table 6). No detailed information about locations is given in the sources cited. As of 10 October 2014, lists of 2015 tournaments were not available (D. Kaldunski, AmericanFishingContests.com, pers. comm.). As of 13 November 2014, one tournament is scheduled for 15–21 August 2015 out of Cape May, New Jersey (InTheBite 2014).

In 2013, at least 75 species of fish were targeted by recreational fishers off New Jersey. Species with 2013 recreational catch numbers exceeding one million include summer flounder (33% of total catch), black sea bass (12%), Atlantic croaker (7%), bluefish (7%), striped searobin (7%), striped bass (6%), and spot (5%). Other notable species or species groups representing at least 1% each of the total catch included unidentified sea robin, tautog, smooth dogfish, Atlantic menhaden, little skate, spiny dogfish, clearnose skate, tilefish, scup, cunner, red hake, unidentified skate, northern searobin, and weakfish. Most of these species/species groups were predominantly caught within 5.6 km from shore (on average 90% of total catch); summer flounder, skates/rays, and cunner were caught roughly equally within and beyond 5.6 km from shore, and red hake were mainly taken beyond 5.6 km from shore (80%).

Recreational SCUBA Diving

Wreck diving is a popular form of recreation in the waters off New Jersey. A search for shipwrecks in New Jersey waters was made using NOAA's automated wreck and obstruction information system (NOAA 2014a). Results of the search are plotted in Figure 2 together with the survey lines. There are over 900 shipwrecks/obstructions in New Jersey waters, most (58%) of which are listed by NOAA (2014b) as unidentified. Only one shipwreck, a known dive site, is in or near the survey area (Fig. 2): the *Lillian* (Galiano 2009; Fisherman's Headquarters 2014; NOAA 2014a).

Table 6. Fishing tournaments off New Jersey, June–mid August 2014.

Dates	Tournament name	Port/ waters	Marine species/groups targeted	Source
1 Feb–14 Dec	Kayak Wars	Statewide/ all legal	Barred sand/calico/spotted bay/white sea bass; bonefish; bonito; cabezon; California barracuda; coho/king/pink salmon; corvina; dorado (mahi mahi); greenling; halibut; leopard/mako/ sevengill/thresher shark; lingcod; opaleye; rock sole; rockfish; saltwater perch; sanddab; sculpin; sheepshead; spiny dogfish; starry flounder; sturgeon; cutthroat trout; whitefish; yellowtail	1
1 Apr–30 Nov	Jersey Shore Beach N Boat Fishing Tournament	Beach Haven/out to 37 km	Black drum; bluefish; fluke; northern kingfish; sea/striped bass; tog; weakfish	1
1 May–30 Nov	Manasquan River MTC Monthly and Mako Tournament	Brielle/N/A	White/blue marlin; pelagic sharks; bigeye/albacore/yellowfin tuna	2
Spring–Fall	Annual Striper Derby – Spring Lake Live Liners Fishing Club	Spring Lake/ any NJ waters	Striped bass	1
6 Jun–27 Jul	Manasquan River Marlin & Tuna Club Bluefin Tournament	Manasquan/ Atlantic Ocean	Bluefin tuna	1
27 Jun–6 Jul	Manasquan River Marlin & Tuna Club Jack Meyer Trolling Tournament	Manasquan/ Atlantic Ocean	Unlisted	1
3–7 Jul	Manasquan River MTC Jack Meyer Memorial Tournament	Brielle/ N/A	White/blue marlin; bigeye/ albacore/yellowfin tuna	2
4 Jul	World Cup Blue Marlin Championship	Statewide/ offshore	Blue marlin	1
12–13 Jul	Manasquan River Marlin & Tuna Club Ladies & Juniors	Manasquan/ Atlantic Ocean	Mako shark	1
23–26 Jul	Beach Haven Marlin & Tuna Club White Marlin Invitational	Beach Haven/ offshore	White marlin	1, 3
31 Jul–3 Aug	Manasquan River Marlin & Tuna Club Fluke Tournament	Manasquan/ Atlantic Ocean	Mako shark	1

Sources: 1: American Fishing Contests (2014); 2: NOAA (2014c); 3: InTheBite (2014)

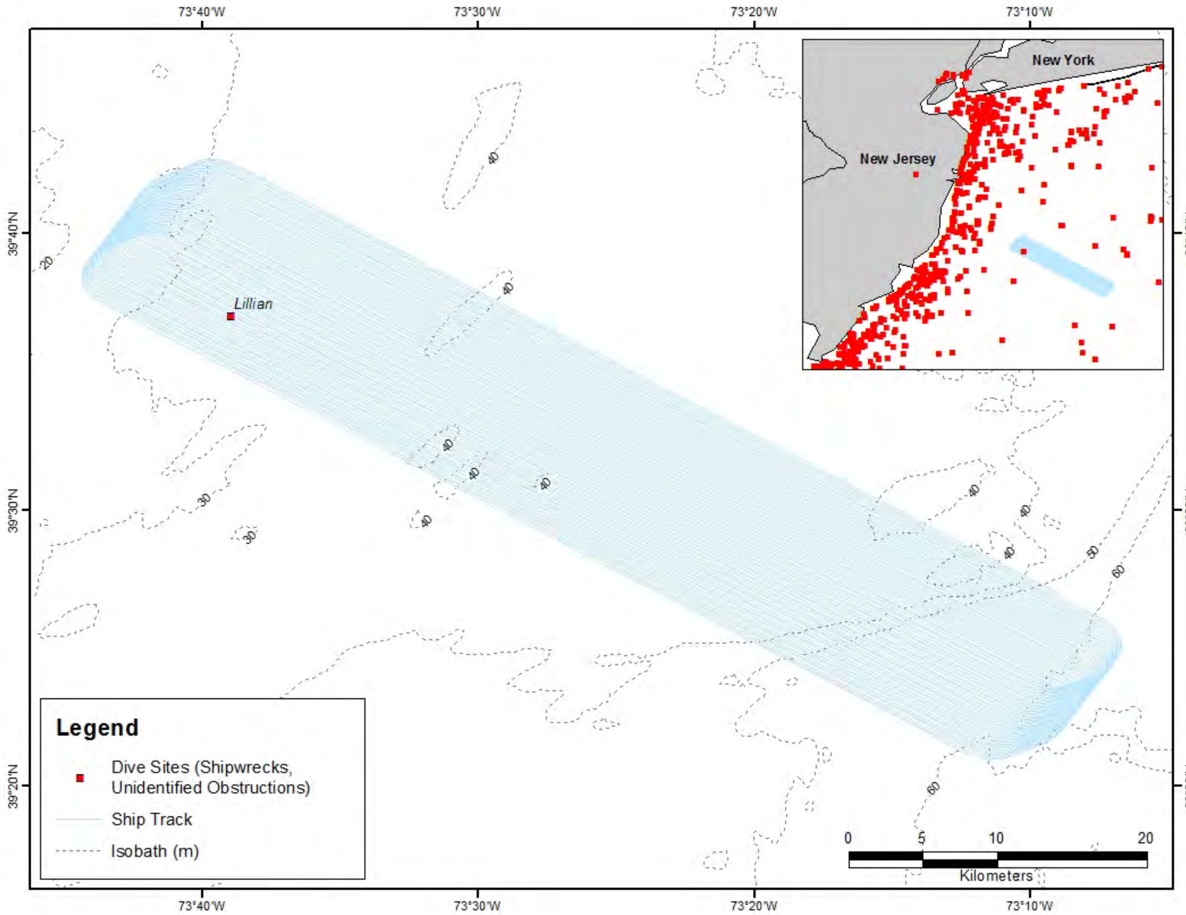

Figure 2. Potential dive sites (shipwrecks or unidentified obstructions) in New Jersey waters. Source: NOAA (2014b).

IV. Environmental Consequences

Proposed Action

The PEIS presented analyses of potential impacts from acoustic sources in general terms and for specific analysis areas. The proposed survey and effects analysis differ from those in the NW Atlantic DAA presented in the PEIS in that different sources were used, the survey areas covered a different range of depths, and different modeling methods were used. The following section includes site-specific details of the proposed survey, summary effects information from the PEIS, and updates to the effects information from recent literature. Analysis conducted for the proposed 2015 survey remains the same as described in the 2014 NSF Final EA for the 2014 survey, except for the smaller size of the airgun array. Seismic effects literature is updated in this Draft Amended EA, and additional effects literature given in the 2014 NMFS EA (Appendix E of the 1 July 2014 Final EA) is incorporated into this Draft Amended EA by reference as if fully set forth herein. In the conclusions of this section, we also refer to conclusions of the Final EA, FONSI, IHA, and Biological Opinion issued by NMFS for the New Jersey survey in 2014, and to observations made during the brief survey conducted in 2014. The effects are fully consistent with those set forth in the 2014 NSF Final EA and FONSI, and 2014 NMFS Final EA, FONSI,

IHA, and Biological Opinion, and EFH concurrence letter, and which are incorporated herein by reference.

(1) Direct Effects on Marine Mammals and Sea Turtles and Their Significance

The material in this section includes a brief summary of the anticipated potential effects (or lack thereof) of airgun sounds on marine mammals and sea turtles, and reference to recent literature that has become available since the PEIS was released in 2011. A more comprehensive review of the relevant background information, as well as information on the hearing abilities of marine mammals and sea turtles, appears in § 3.4.4.3, § 3.6.4.3, § 3.7.4.3, and Appendix E of the PEIS.

Estimates of the numbers of marine mammals that could be affected by the proposed seismic survey scheduled to occur during June–August 2015 are provided in (e) below, along with a description of the rationale for NSF's estimates of the numbers of individuals exposed to received sound levels ≥160 dB re 1 μPa_{rms}. Although the PEIS included modeling for the NW Atlantic DAA, it was done for a different energy source level and survey parameters (e.g., survey water depths and source tow depth), and modeling methods were different from those used by L-DEO (see PEIS, Appendix B, for further modeling details regarding the NW Atlantic DAA). Acoustic modeling for the proposed action was conducted by L-DEO, consistent with past EAs and determined to be acceptable by NMFS to use in the calculation of estimated takes under the MMPA (e.g., NMFS 2013d,e), including for the 2014 survey.

(a) Summary of Potential Effects of Airgun Sounds

As noted in the PEIS (§ 3.4.4.3, § 3.6.4.3, and § 3.7.4.3), the effects of sounds from airguns could include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, and at least in theory, temporary or permanent hearing impairment, or non-auditory physical or physiological effects (Richardson et al. 1995; Gordon et al. 2004; Nowacek et al. 2007; Southall et al. 2007). Permanent hearing impairment (PTS), in the unlikely event that it occurred, would constitute injury, but temporary threshold shift (TTS) is not considered an injury (Southall et al. 2007; Le Prell 2012). Rather, the onset of TTS has been considered an indicator that, if the animal is exposed to higher levels of that sound, physical damage is ultimately a possibility. Recent research has shown that sound exposure can cause cochlear neural degeneration, even when threshold shifts and hair cell damage are reversible (Liberman 2013). These findings have raised some doubts as to whether TTS should continue to be considered a non-injurious effect. Although the possibility cannot be entirely excluded, it is unlikely that the project would result in any cases of temporary or permanent hearing impairment, or any significant non-auditory physical or physiological effects. If marine mammals encounter the survey while it is underway, some behavioral disturbance could result, but this would be localized and short-term.

***Tolerance*.—**Numerous studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers (e.g., Nieukirk et al. 2012). Several studies have shown that marine mammals at distances more than a few kilometers from operating seismic vessels often show no apparent response. That is often true even in cases when the pulsed sounds must be readily audible to the animals based on measured received levels and the hearing sensitivity of that mammal group. Although various baleen whales and toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to airgun pulses under some conditions, at other times mammals of all three types have shown no overt reactions. The relative responsiveness of baleen and toothed whales are quite variable.

***Masking*.—**Masking effects of pulsed sounds (even from large arrays of airguns) on marine mammal calls and other natural sounds are expected to be limited, although there are very few specific data on this. Because of the intermittent nature and low duty cycle of seismic pulses, animals can emit and receive

sounds in the relatively quiet intervals between pulses. However, in exceptional situations, reverberation occurs for much or all of the interval between pulses (e.g., Simard et al. 2005; Clark and Gagnon 2006), which could mask calls. Situations with prolonged strong reverberation are infrequent. However, it is common for reverberation to cause some lesser degree of elevation of the background level between airgun pulses (e.g., Gedamke 2011; Guerra et al. 2011, 2013), and this weaker reverberation presumably reduces the detection range of calls and other natural sounds to some degree. Guerra et al. (2013) reported that ambient noise levels between seismic pulses were elevated because of reverberation at ranges of 50 km from the seismic source. Based on measurements in deep water of the Southern Ocean, Gedamke (2011) estimated that the slight elevation of background levels during intervals between pulses reduced blue and fin whale communication space by as much as 36–51% when a seismic survey was operating 450–2800 km away. Based on preliminary modeling, Wittekind et al. (2013) reported that airgun sounds could reduce the communication range of blue and fin whales 2000 km from the seismic source. Klinck et al. (2012) also found reverberation effects between airgun pulses. Nieukirk et al. (2012) and Blackwell et al. (2013) noted the potential for masking effects from seismic surveys on large whales.

Some baleen and toothed whales are known to continue calling in the presence of seismic pulses, and their calls usually can be heard between the seismic pulses (e.g., Nieukirk et al. 2012). Cerchio et al. (2014) suggested that the breeding display of humpback whales off Angola could be disrupted by seismic sounds, as singing activity declined with increasing received levels. In addition, some cetaceans are known to change their calling rates, shift their peak frequencies, or otherwise modify their vocal behavior in response to airgun sounds (e.g., Di Iorio and Clark 2010; Castellote et al. 2012; Blackwell et al. 2013). The hearing systems of baleen whales are undoubtedly more sensitive to low-frequency sounds than are the ears of the small odontocetes that have been studied directly (e.g., MacGillivray et al. 2014). The sounds important to small odontocetes are predominantly at much higher frequencies than are the dominant components of airgun sounds, thus limiting the potential for masking. In general, masking effects of seismic pulses are expected to be minor, given the normally intermittent nature of seismic pulses. We are not aware of any information concerning masking of hearing in sea turtles.

***Disturbance Reactions*.—**Disturbance includes a variety of effects, including subtle to conspicuous changes in behavior, movement, and displacement. Based on NMFS (2001, p. 9293), NRC (2005), and Southall et al. (2007), we believe that simple exposure to sound, or brief reactions that do not disrupt behavioral patterns in a potentially significant manner, do not constitute harassment or "taking". By potentially significant, we mean, 'in a manner that might have deleterious effects to the well-being of individual marine mammals or their populations'.

Reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, and many other factors (Richardson et al. 1995; Wartzok et al. 2004; Southall et al. 2007; Weilgart 2007; Ellison et al. 2012). If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or population (e.g., New et al. 2013). However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and populations could be significant (e.g., Lusseau and Bejder 2007; Weilgart 2007). Given the many uncertainties in predicting the quantity and types of impacts of noise on marine mammals, it is common practice to estimate how many marine mammals would be present within a particular distance of industrial activities and/or exposed to a particular level of industrial sound. In most cases, this approach likely overestimates the numbers of marine mammals that would be affected in some biologically important manner.

The sound criteria used to estimate how many marine mammals could be disturbed to some biologically important degree by a seismic program are based primarily on behavioral observations of a few species. Detailed studies have been done on humpbacks, gray whales, bowheads, and sperm whales. Less detailed data are available for some other species of baleen whales and small toothed whales, but for many species, there are no data on responses to marine seismic surveys.

Baleen Whales

Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable. Whales are often reported to show no overt reactions to pulses from large arrays of airguns at distances beyond a few kilometers, even though the airgun pulses remain well above ambient noise levels out to much longer distances. However, baleen whales exposed to strong noise pulses from airguns often react by deviating from their normal migration route and/or interrupting their feeding and moving away. In the cases of migrating gray and bowhead whales, the observed changes in behavior appeared to be of little or no biological consequence to the animals. They simply avoided the sound source by displacing their migration route to varying degrees, but within the natural boundaries of the migration corridors (Malme et al. 1984; Malme and Miles 1985; Richardson et al. 1995).

Responses of *humpback whales* to seismic surveys have been studied during migration, on summer feeding grounds, and on Angolan winter breeding grounds; there has also been discussion of effects on the Brazilian wintering grounds. Off Western Australia, avoidance reactions began at 5–8 km from the array, and those reactions kept most pods ~3–4 km from the operating seismic boat; there was localized displacement during migration of 4–5 km by traveling pods and 7–12 km by more sensitive resting pods of cow-calf pairs (McCauley et al. 1998, 2000). However, some individual humpback whales, especially males, approached within distances of 100–400 m. Studies examining the behavioral responses of humpback whales to airguns are currently underway off eastern Australia (Cato et al. 2011, 2012, 2013).

In the Northwest Atlantic, sighting rates were significantly greater during non-seismic periods compared with periods when a full array was operating, and humpback whales were more likely to swim away and less likely to swim towards a vessel during seismic vs. non-seismic periods (Moulton and Holst 2010). On their summer feeding grounds in southeast Alaska, there was no clear evidence of avoidance, despite the possibility of subtle effects, at received levels up to 172 re 1 μPa on an approximate rms basis (Malme et al. 1985). It has been suggested that South Atlantic humpback whales wintering off Brazil may be displaced or even strand upon exposure to seismic surveys (Engel et al. 2004), but data from subsequent years, indicated that there was no observable direct correlation between strandings and seismic surveys (IWC 2007).

There are no data on reactions of *right whales* to seismic surveys. However, Rolland et al. (2012) suggested that ship noise causes increased stress in right whales; they showed that baseline levels of stress-related fecal hormone metabolites decreased in North Atlantic right whales with a 6-dB decrease in underwater noise from vessels. Wright et al. (2011) also reported that sound could be a potential source of stress for marine mammals.

Results from *bowhead whales* show that their responsiveness can be quite variable depending on their activity (migrating vs. feeding). Bowhead whales migrating west across the Alaskan Beaufort Sea in autumn, in particular, are unusually responsive, with substantial avoidance occurring out to distances of 20–30 km from a medium-sized airgun source (Miller et al. 1999; Richardson et al. 1999). However, more recent research on bowhead whales corroborates earlier evidence that, during the summer feeding season, bowheads are not as sensitive to seismic sources (e.g., Miller et al. 2005). Nonetheless, Robertson et al. (2013) showed that bowheads on their summer feeding grounds showed subtle but statis-

tically significant changes in surfacing–respiration–dive cycles during exposure to seismic sounds, including shorter surfacing intervals, shorter dives, and decreased number of blows per surface interval.

Bowhead whale calls detected in the presence and absence of airgun sounds have been studied extensively in the Beaufort Sea. Bowheads continue to produce calls of the usual types when exposed to airgun sounds on their summering grounds, although numbers of calls detected are significantly lower in the presence than in the absence of airgun pulses; Blackwell et al. (2013) reported that calling rates in 2007 declined significantly where received SPLs from airgun sounds were 116–129 dB re 1 µPa. Thus, bowhead whales in the Beaufort Sea apparently decrease their calling rates in response to seismic operations, although movement out of the area could also contribute to the lower call detection rate (Blackwell et al. 2013).

A multivariate analysis of factors affecting the distribution of calling bowhead whales during their fall migration in 2009 noted that the southern edge of the distribution of calling whales was significantly closer to shore with increasing levels of airgun sound from a seismic survey a few hundred kilometers to the east of the study area (i.e., behind the westward-migrating whales; McDonald et al. 2010, 2011). It was not known whether this statistical effect represented a stronger tendency for quieting of the whales farther offshore in deeper water upon exposure to airgun sound, or an actual inshore displacement of whales.

Reactions of migrating and feeding (but not wintering) *gray whales* to seismic surveys have been studied. Off St. Lawrence Island in the northern Bering Sea, it was estimated, based on small sample sizes, that 50% of feeding gray whales stopped feeding at an average received pressure level of 173 dB re 1 µPa on an (approximate) rms basis, and that 10% of feeding whales interrupted feeding at received levels of 163 dB re 1 μPa_{rms} (Malme et al. 1986, 1988). Those findings were generally consistent with the results of experiments conducted on larger numbers of gray whales that were migrating along the California coast (Malme et al. 1984; Malme and Miles 1985), and western Pacific gray whales feeding off Sakhalin Island, Russia (e.g., Gailey et al. 2007; Johnson et al. 2007; Yazvenko et al. 2007a,b).

Various species of *Balaenoptera* (blue, sei, fin, and minke whales) have occasionally been seen in areas ensonified by airgun pulses; sightings by observers on seismic vessels off the U.K. from 1997 to 2000 suggest that, during times of good sightability, sighting rates for mysticetes (mainly fin and sei whales) were similar when large arrays of airguns were shooting vs. silent, although there was localized avoidance (Stone and Tasker 2006). Singing fin whales in the Mediterranean moved away from an operating airgun array, and their song notes had lower bandwidths during periods with versus without airgun sounds (Castellote et al. 2012).

During seismic surveys in the Northwest Atlantic, baleen whales as a group showed localized avoidance of the operating array (Moulton and Holst 2010). Sighting rates were significantly lower during seismic operations compared with non-seismic periods. Baleen whales were seen on average 200 m farther from the vessel during airgun activities vs. non-seismic periods, and these whales more often swam away from the vessel when seismic operations were underway compared with periods when no airguns were operating (Moulton and Holst 2010). Blue whales were seen significantly farther from the vessel during single airgun operations, ramp up, and all other airgun operations compared with non-seismic periods (Moulton and Holst 2010). Similarly, fin whales were seen at significantly farther distances during ramp up than during periods without airgun operations; there was also a trend for fin whales to be sighted farther from the vessel during other airgun operations, but the difference was not significant (Moulton and Holst 2010). Minke whales were seen significantly farther from the vessel during periods with than without seismic operations (Moulton and Holst 2010). Minke whales were also

more likely to swim away and less likely to approach during seismic operations compared to periods when airguns were not operating (Moulton and Holst 2010).

Data on short-term reactions by cetaceans to impulsive noises are not necessarily indicative of long-term or biologically significant effects. It is not known whether impulsive sounds affect reproductive rate or distribution and habitat use in subsequent days or years. However, gray whales have continued to migrate annually along the west coast of North America with substantial increases in the population over recent years, despite intermittent seismic exploration (and much ship traffic) in that area for decades. The western Pacific gray whale population did not seem affected by a seismic survey in its feeding ground during a previous year, and bowhead whales have continued to travel to the eastern Beaufort Sea each summer, and their numbers have increased notably, despite seismic exploration in their summer and autumn range for many years.

Toothed Whales

Little systematic information is available about reactions of toothed whales to sound pulses. However, there are recent systematic studies on sperm whales, and there is an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies. Seismic operators and marine mammal observers on seismic vessels regularly see dolphins and other small toothed whales near operating airgun arrays, but in general there is a tendency for most delphinids to show some avoidance of operating seismic vessels (e.g., Stone and Tasker 2006; Moulton and Holst 2010; Barry et al. 2012). In most cases, the avoidance radii for delphinids appear to be small, on the order of 1 km or less, and some individuals show no apparent avoidance.

During seismic surveys in the Northwest Atlantic, delphinids as a group showed some localized avoidance of the operating array (Moulton and Holst 2010). The mean initial detection distance was significantly farther (by ~200 m) during seismic operations compared with periods when the seismic source was not active; however, there was no significant difference between sighting rates (Moulton and Holst 2010). The same results were evident when only long-finned pilot whales were considered.

Preliminary findings of a monitoring study of *narwhals* (*Monodon monoceros*) in Melville Bay, Greenland (summer and fall 2012) showed no short-term effects of seismic survey activity on narwhal distribution, abundance, migration timing, and feeding habits (Heide-Jørgensen et al. 2013a). In addition, there were no reported effects on narwhal hunting. These findings do not seemingly support a suggestion by Heide-Jørgensen et al. (2013b) that seismic surveys in Baffin Bay may have delayed the migration timing of narwhals, thereby increasing the risk of narwhals to ice entrapment.

The *beluga*, however, is a species that (at least at times) shows long-distance (10s of km) avoidance of seismic vessels (e.g., Miller et al. 2005). Captive bottlenose dolphins and beluga whales exhibited changes in behavior when exposed to strong pulsed sounds similar in duration to those typically used in seismic surveys, but the animals tolerated high received levels of sound before exhibiting aversive behaviors (e.g., Finneran et al. 2000, 2002, 2005).

Most studies of *sperm whales* exposed to airgun sounds indicate that the sperm whale shows considerable tolerance of airgun pulses; in most cases the whales do not show strong avoidance (e.g., Stone and Tasker 2006; Moulton and Holst 2010), but foraging behavior can be altered upon exposure to airgun sound (e.g., Miller et al. 2009). There are almost no specific data on the behavioral reactions of *beaked whales* to seismic surveys. Most beaked whales tend to avoid approaching vessels of other types (e.g., Würsig et al. 1998) and/or change their behavior in response to sounds from vessels (e.g., Pirotta et al. 2012). However, some northern bottlenose whales remained in the general area and continued to produce high-frequency clicks when exposed to sound pulses from distant seismic surveys (e.g., Simard

et al. 2005). In any event, it is likely that most beaked whales would also show strong avoidance of an approaching seismic vessel, although this has not been documented explicitly.

The limited available data suggest that *harbor porpoises* show stronger avoidance of seismic operations than do Dall's porpoises. Thompson et al. (2013) reported decreased densities and reduced acoustic detections of harbor porpoise in response to a seismic survey in Moray Firth, Scotland, at ranges of 5–10 km (SPLs of 165–172 dB re 1 μPa, SELs of 145–151 dB $\mu Pa^2 \cdot s$); however, animals returned to the area within a few hours. The apparent tendency for greater responsiveness in the harbor porpoise is consistent with their relative responsiveness to boat traffic and some other acoustic sources (Richardson et al. 1995; Southall et al. 2007).

Odontocete reactions to large arrays of airguns are variable and, at least for delphinids, seem to be confined to a smaller radius than has been observed for the more responsive of the mysticetes and some other odontocetes. A ≥170 dB disturbance criterion (rather than ≥160 dB) is considered appropriate for delphinids, which tend to be less responsive than the more responsive cetaceans.

Sea Turtles

The limited available data indicate that sea turtles will hear airgun sounds and sometimes exhibit localized avoidance (see PEIS, § 3.4.4.3). Based on available data, it is likely that sea turtles will exhibit behavioral changes and/or avoidance within an area of unknown size near a seismic vessel. To the extent that there are any impacts on sea turtles, seismic operations in or near areas where turtles concentrate are likely to have the greatest impact. There are no specific data that demonstrate the consequences to sea turtles if seismic operations with large or small arrays of airguns occur in important areas at biologically important times of year.

Hearing Impairment and Other Physical Effects.**—**Temporary or permanent hearing impairment is a possibility when marine mammals are exposed to very strong sounds. TTS has been demonstrated and studied in certain captive odontocetes and pinnipeds exposed to strong sounds. However, there has been no specific documentation of TTS let alone permanent hearing damage, i.e., PTS, in free-ranging marine mammals exposed to sequences of airgun pulses during realistic field conditions.

Additional data are needed to determine the received sound levels at which small odontocetes would start to incur TTS upon exposure to repeated, low-frequency pulses of airgun sound with variable received levels. To determine how close an airgun array would need to approach in order to elicit TTS, one would (as a minimum) need to allow for the sequence of distances at which airgun pulses would occur, and for the dependence of received SEL on distance in the region of the seismic operation (e.g., Breitzke and Bohlen 2010; Laws 2012). At the present state of knowledge, it is also necessary to assume that the effect is directly related to total received energy, although there is recent evidence that auditory effects in a given animal are not a simple function of received acoustic energy. Frequency, duration of the exposure and occurrence of gaps within the exposure can also influence the auditory effect (Finneran and Schlundt 2010, 2011; Finneran et al. 2010a,b; Finneran 2012; Ketten 2012; Finneran and Schlundt 2011, 2013; Kastelein et al. 2013a).

The assumption that, in marine mammals, the occurrence and magnitude of TTS is a function of cumulative acoustic energy (SEL) is probably an oversimplification (Finneran 2012). Popov et al. (2011) examined the effects of fatiguing noise on the hearing threshold of Yangtze finless porpoises when exposed to frequencies of 32–128 kHz at 140–160 dB re 1 μPa for 1–30 min. They found that an exposure of higher level and shorter duration produced a higher TTS than an exposure of equal SEL but of lower level and longer duration. Kastelein et al. (2012a,b; 2013b) also reported that the equal-energy model is not valid for predicting TTS in harbor porpoises or harbor seals.

Recent data have shown that the SEL required for TTS onset to occur increases with intermittent exposures, with some auditory recovery during silent periods between signals (Finneran et al. 2010b; Finneran and Schlundt 2011). Schlundt et al. (2013) reported that the potential for seismic surveys using airguns to cause auditory effects on dolphins could be lower than previously thought. Based on behavioral tests, Finneran et al. (2011) and Schlundt et al. (2013) reported no measurable TTS in bottlenose dolphins after exposure to 10 impulses from a seismic airgun with a cumulative SEL of ~195 dB re 1 $\mu Pa^2 \cdot s$; results from auditory evoked potential measurements were more variable (Schlundt et al. 2013).

Recent studies have also shown that the SEL necessary to elicit TTS can depend substantially on frequency, with susceptibility to TTS increasing with increasing frequency above 3 kHz (Finneran and Schlundt 2010, 2011; Finneran 2012). When beluga whales were exposed to fatiguing noise with sound levels of 165 dB re 1 µPa for durations of 1–30 min at frequencies of 11.2–90 kHz, the highest TTS with the longest recovery time was produced by the lower frequencies (11.2 and 22.5 kHz); TTS effects also gradually increased with prolonged exposure time (Popov et al. 2013a). Popov et al. (2013b) also reported that TTS produced by exposure to a fatiguing noise was larger during the first session (or naïve subject state) with a beluga whale than TTS that resulted from the same sound in subsequent sessions (experienced subject state). Therefore, Supin et al. (2013) reported that SEL may not be a valid metric for examining fatiguing sounds on beluga whales. Similarly, Nachtigall and Supin (2013) reported that false killer whales are able to change their hearing sensation levels when exposed to loud sounds, such as warning signals or echolocation sounds.

It is inappropriate to assume that onset of TTS occurs at similar received levels in all cetaceans (*cf.* Southall et al. 2007). Some cetaceans could incur TTS at lower sound exposures than are necessary to elicit TTS in the beluga or bottlenose dolphin. Based on the best available information, Southall et al. (2007) recommended a TTS threshold for exposure to single or multiple pulses of 183 dB re 1 $\mu Pa^2 \cdot s$. Tougaard et al. (2013) proposed a TTS criterion of 165 dB re 1 $\mu Pa^2 \cdot s$ for porpoises based on data from two recent studies. Gedamke et al. (2011), based on preliminary simulation modeling that attempted to allow for various uncertainties in assumptions and variability around population means, suggested that some baleen whales whose closest point of approach to a seismic vessel is 1 km or more could experience TTS.

There is no specific evidence that exposure to pulses of airgun sound can cause PTS in any marine mammal, even with large arrays of airguns. However, given the likelihood that some mammals close to an airgun array might incur at least mild TTS, there has been further speculation about the possibility that some individuals occurring very close to airguns might incur PTS (e.g., Richardson et al. 1995, p. 372*ff*; Gedamke et al. 2011). In terrestrial animals, exposure to sounds sufficiently strong to elicit a large TTS induces physiological and structural changes in the inner ear, and at some high level of sound exposure, these phenomena become non-recoverable (Le Prell 2012). At this level of sound exposure, TTS grades into PTS. Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage, but repeated or (in some cases) single exposures to a level well above that causing TTS onset might elicit PTS (e.g., Kastak and Reichmuth 2007; Kastak et al. 2008).

Current NMFS policy regarding exposure of marine mammals to high-level sounds is that cetaceans and pinnipeds should not be exposed to impulsive sounds with received levels ≥180 dB and 190 dB re 1 μPa_{rms}, respectively (NMFS 2000). These criteria have been used in establishing the exclusion (shut-down) zones planned for the proposed seismic survey. However, those criteria were established before there was any information about minimum received levels of sounds necessary to cause auditory impairment in marine mammals.

Recommendations for science-based noise exposure criteria for marine mammals, frequency-weighting procedures, and related matters were published by Southall et al. (2007). Those recommendations were never formally adopted by NMFS for use in regulatory processes and during mitigation programs associated with seismic surveys, although some aspects of the recommendations have been taken into account in certain environmental impact statements and small-take authorizations. In December 2013, NOAA made available for public comment new draft guidance for assessing the effects of anthropogenic sound on marine mammals (NOAA 2013a), taking at least some of the Southall et al. recommendations into account. The new acoustic guidance and procedures could account for the now-available scientific data on marine mammal TTS, the expected offset between the TTS and PTS thresholds, differences in the acoustic frequencies to which different marine mammal groups are sensitive (e.g., M-weighting or generalized frequency weightings for various groups of marine mammals, allowing for their functional bandwidths), and other relevant factors. At the time of preparation of this Draft Amended EA, the date of release of the final guidelines and how they would be implemented are unknown.

Nowacek et al. (2013) concluded that current scientific data indicate that seismic airguns have a low probability of directly harming marine life, except at close range. Several aspects of the planned monitoring and mitigation measures for this project are designed to detect marine mammals occurring near the airgun array, and to avoid exposing them to sound pulses that might, at least in theory, cause hearing impairment (see § II and § IV[2], below). Also, many marine mammals and (to a limited degree) sea turtles show some avoidance of the area where received levels of airgun sound are high enough such that hearing impairment could potentially occur. In those cases, the avoidance responses of the animals themselves would reduce or (most likely) avoid any possibility of hearing impairment.

Non-auditory physical effects could also occur in marine mammals exposed to strong underwater pulsed sound. Possible types of non-auditory physiological effects or injuries that might (in theory) occur in mammals close to a strong sound source include stress, neurological effects, bubble formation, and other types of organ or tissue damage. It is possible that some marine mammal species (i.e., beaked whales) could be especially susceptible to injury and/or stranding when exposed to strong transient sounds.

There is no definitive evidence that any of these effects occur even for marine mammals in close proximity to large arrays of airguns. However, Gray and Van Waerebeek (2011) have suggested a cause-effect relationship between a seismic survey off Liberia in 2009 and the erratic movement, postural instability, and akinesia in a pantropical spotted dolphin based on spatially and temporally close association with the airgun array. Additionally, a few cases of strandings in the general area where a seismic survey was ongoing have led to speculation concerning a possible link between seismic surveys and strandings (e.g., Castellote and Llorens 2013).

Non-auditory effects, if they occur at all, would presumably be limited to short distances and to activities that extend over a prolonged period. Marine mammals that show behavioral avoidance of seismic vessels, including most baleen whales, some odontocetes, and some pinnipeds, are especially unlikely to incur non-auditory physical effects. The brief duration of exposure of any given mammal and the planned monitoring and mitigation measures would further reduce the probability of exposure of marine mammals to sounds strong enough to induce non-auditory physical effects.

Sea Turtles

There is substantial overlap in the frequencies that sea turtles detect vs. the frequencies in airgun pulses. We are not aware of measurements of the absolute hearing thresholds of any sea turtle to waterborne sounds similar to airgun pulses. In the absence of relevant absolute threshold data, we cannot estimate how far away an airgun array might be audible. Moein et al. (1994) and Lenhardt (2002) reported TTS for loggerhead turtles exposed to many airgun pulses (see PEIS). This suggests that sounds

from an airgun array might cause temporary hearing impairment in sea turtles if they do not avoid the (unknown) radius where TTS occurs. However, exposure duration during the proposed survey would be much less than during the aforementioned studies. Also, recent monitoring studies show that some sea turtles do show localized movement away from approaching airguns. At short distances from the source, received sound level diminishes rapidly with increasing distance. In that situation, even a small-scale avoidance response could result in a significant reduction in sound exposure.

The PSVOs stationed on the *Langseth* would also watch for sea turtles, and airgun operations would be shut down if a turtle enters the designated EZ.

(b) Possible Effects of Other Acoustic Sources

The Kongsberg EM 122 MBES, Knudsen Chirp 3260 SBP, and Teledyne OS75 75-kHz ADCP would be operated from the source vessel during the proposed survey, but not during transits. Information about this equipment was provided in § 2.2.3.1 of the PEIS (MBES, SBP) or § II of this Draft Amended EA (ADCP). A review of the anticipated potential effects (or lack thereof) of MBESs, SBPs, and pingers on marine mammals and sea turtles appears in § 3.4.4.3, § 3.6.4.3, § 3.7.4.3, and Appendix E of the PEIS.

There has been some recent attention given to the effects of MBES on marine mammals, as a result of a report issued in September 2013 by an IWC independent scientific review panel (ISRP) linking the operation of a MBES to a mass stranding of melon-headed whales (*Peponocephala electra*; Southall et al. 2013) off Madagascar. During May–June 2008, ~100 melon-headed whales entered and stranded in the Loza Lagoon system in northwest Madagascar at the same time that a 12-kHz MBES survey was being conducted ~65 km away off the coast. In conducting a retrospective review of available information on the event, an independent scientific review panel concluded that the Kongsberg EM 120 MBES was the most plausible behavioral trigger for the animals initially entering the lagoon system and eventually stranding. The independent scientific review panel, however, identified that an unequivocal conclusion on causality of the event was not possible because of the lack of information about the event and a number of potentially contributing factors. Additionally, the independent review panel report indicated that this incident was likely the result of a complicated confluence of environmental, social, and other factors that have a very low probability of occurring again in the future, but recommended that the potential be considered in environmental planning. The proposed survey design and environmental context of the proposed survey are quite different from the mass melon-headed whale stranding described by the ISRP. It should be noted that this event is the first known marine mammal mass stranding closely associated with the operation of a MBES. It is noted that leading scientific experts knowledgeable about MBES have expressed concerns about the independent scientific review panel analyses and findings (Bernstein 2013).

There is no available information on marine mammal behavioral response to MBES sounds (Southall et al. 2013) or sea turtle responses to MBES systems. Much of the literature on marine mammal response to sonars relates to the types of sonars used in naval operations, including Low-Frequency Active (LFA) sonars (e.g., Miller et al. 2012; Sivle et al. 2012) and Mid-Frequency Active (MFA) sonars (e.g., Tyack et al. 2011; Melcón et al. 2012; Miller et al. 2012; DeRuiter et al. 2013a,b; Goldbogen et al. 2013). However, the MBES sounds are quite different from naval sonars. Ping duration of the MBES is very short relative to naval sonars. Also, at any given location, an individual marine mammal would be in the beam of the MBES for much less time given the generally downward orientation of the beam and its narrow fore-aft beamwidth; naval sonars often use near-horizontally-directed sound. In addition, naval sonars have higher duty cycles. These factors would all reduce the sound energy received from the MBES relative to that from naval sonars.

Risch et al. (2012) found a reduction in humpback whale song in the Stellwagen Bank National Marine Sanctuary during Ocean Acoustic Waveguide Remote Sensing (OAWRS) activities that were carried out approximately 200 km away. The OAWRS used three frequency-modulated (FM) pulses centered at frequencies of 415, 734, and 949 Hz with received levels in the sanctuary 88–110 dB re 1 µPa. Deng et al (2014) measured the spectral properties of pulses transmitted by three 200-kHz echo sounders, and found that they generated weaker sounds at frequencies below the center frequency (90–130 kHz). These sounds are within the hearing range of some marine mammals, and the authors suggested that they could be strong enough to elicit behavioural responses within close proximity to the sources, although they would be well below potentially harmful levels.

Despite the aforementioned information that has recently become available, this Draft Amended EA is in agreement with the assessment presented in § 3.4.7, 3.6.7, and 3.7.7 of the PEIS that operation of MBESs, SBPs, and pingers is not likely to impact mysticetes or odontocetes, and is not expected to affect sea turtles, (1) given the lower acoustic exposures relative to airguns and (2) because the intermittent and/or narrow downward-directed nature of these sounds would result in no more than one or two brief ping exposures of any individual marine mammal or sea turtle given the movement and speed of the vessel. Also, for sea turtles, the associated frequency ranges are above their known hearing range.

(c) Other Possible Effects of Seismic Surveys

Other possible effects of seismic surveys on marine mammals and/or sea turtles include masking by vessel noise, disturbance by vessel presence or noise, and injury or mortality from collisions with vessels or entanglement in seismic gear.

Vessel noise from the *Langseth* could affect marine animals in the proposed survey area. Sounds produced by large vessels generally dominate ambient noise at frequencies from 20 to 300 Hz (Richardson et al. 1995). Ship noise, through masking, can reduce the effective communication distance of a marine mammal if the frequency of the sound source is close to that used by the animal, and if the sound is present for a significant fraction of time (e.g., Richardson et al. 1995; Clark et al. 2009; Jensen et al. 2009; Hatch et al. 2012). In order to compensate for increased ambient noise, some cetaceans are known to increase the source levels of their calls in the presence of elevated noise levels from shipping, shift their peak frequencies, or otherwise change their vocal behavior (e.g., Parks et al. 2011; 2012; Castellote et al. 2012; Melcón et al. 2012: Tyack and Janik 2013).

Baleen whales are thought to be more sensitive to sound at these low frequencies than are toothed whales (e.g., MacGillivray et al. 2014), possibly causing localized avoidance of the proposed survey area during seismic operations. Reactions of gray and humpback whales to vessels have been studied, and there is limited information available about the reactions of right whales and rorquals (fin, blue, and minke whales). Reactions of humpback whales to boats are variable, ranging from approach to avoidance (Payne 1978; Salden 1993). Baker et al. (1982, 1983) and Baker and Herman (1989) found humpbacks often move away when vessels are within several kilometers. Humpbacks seem less likely to react overtly when actively feeding than when resting or engaged in other activities (Krieger and Wing 1984, 1986).

Many odontocetes show considerable tolerance of vessel traffic, although they sometimes react at long distances if confined by ice or shallow water, if previously harassed by vessels, or have had little or no recent exposure to ships (Richardson et al. 1995). Dolphins of many species tolerate and sometimes approach vessels. Some dolphin species approach moving vessels to ride the bow or stern waves (Williams et al. 1992). There are few data on the behavioral reactions of beaked whales to vessel noise, though they seem to avoid approaching vessels (e.g., Würsig et al. 1998) or dive for an extended period when approached by a vessel (e.g., Kasuya 1986). Based on a single observation, Aguilar-Soto et al. (2006) suggest foraging efficiency of Cuvier's beaked whales may be reduced by close approach of vessels.

The PEIS concluded that project vessel sounds would not be at levels expected to cause anything more than possible localized and temporary behavioral changes in marine mammals or sea turtles, and would not be expected to result in significant negative effects on individuals or at the population level. In addition, in all oceans of the world, large vessel traffic is currently so prevalent that it is commonly considered a usual source of ambient sound.

Another concern with vessel traffic is the potential for striking marine mammals or sea turtles. Information on vessel strikes is reviewed in § 3.4.4.4 and § 3.6.4.4 of the PEIS. The PEIS concluded that the risk of collision of seismic vessels or towed/deployed equipment with marine mammals or sea turtles exists but is extremely unlikely, because of the relatively slow operating speed (typically 7–9 km/h) of the vessel during seismic operations, and the generally straight-line movement of the seismic vessel. There has been no history of marine mammal vessel strikes with the *Langseth*, or its predecessor, R/V *Maurice Ewing* over the last ~23 years, including those conducted off NJ.

Entanglement of sea turtles in seismic gear is also a concern. There have been reports of turtles being trapped and killed between the gaps in tail-buoys offshore from West Africa (Weir 2007); however, these tailbuoys are significantly different than those used on the *Langseth*. In April 2011, a dead olive ridley turtle was found in a deflector foil of the seismic gear on the *Langseth* during equipment recovery at the conclusion of a survey off Costa Rica, where sea turtles were numerous. Such incidents are possible, but this is the first case of sea turtle entanglement in seismic gear for the *Langseth*, which has been conducting seismic surveys since 2008, or for R/V *Maurice Ewing*, during 2003–2007. Towing the hydrophone streamer or other equipment during the proposed survey is not expected to significantly interfere with sea turtle movements, including migration. Although sea turtles were observed during the 2014 survey, no such effects were detected nor were strandings reported during survey activities.

(d) Mitigation Measures

Several mitigation measures are built into the proposed seismic survey as an integral part of the planned activities. These measures include the following: ramp ups; typically two, however a minimum of one dedicated observer maintaining a visual watch during all daytime airgun operations; two observers for 30 min before and during ramp ups; PAM during the day and night to complement visual monitoring (unless the system and back-up systems are damaged during operations); and power downs (or if necessary shut downs) when mammals or turtles are detected in or about to enter designated EZ. These mitigation measures are described in § 2.4.4.1 of the PEIS and summarized earlier in this document, in § II(3). The fact that the 4-airgun subarray, because of its design, would direct the majority of the energy downward, and less energy laterally, is also an inherent mitigation measure.

Previous and subsequent analysis of the potential impacts takes account of these planned mitigation measures. It would not be meaningful to analyze the effects of the planned activities without mitigation, as the mitigation (and associated monitoring) measures are a basic part of the activities, and would be implemented under the Proposed Action or Alternative Action. The same monitoring and mitigation measures proposed for the 2014 survey are proposed for the 2015 survey.

(e) Potential Numbers of Cetaceans Exposed to Received Sound Levels ≥160 dB

All anticipated takes would be “takes by harassment” as described in § I, involving temporary changes in behavior. The mitigation measures to be applied would minimize the possibility of injurious takes. (However, as noted earlier and in the PEIS, there is no specific information demonstrating that injurious “takes” would occur even in the absence of the planned mitigation measures.) In the sections below, we describe methods to estimate the number of potential exposures to sound levels >160 dB re 1 μPa_{rms}, and present estimates of the numbers of marine mammals that could be affected during the proposed seismic

program. The estimates are based on consideration of the number of marine mammals that could be disturbed appreciably by ~4900 km of seismic surveys off the coast of New Jersey. The main sources of distributional and numerical data used in deriving the estimates are described in the next subsection.

Basis for Estimating Exposure.—The estimates are based on a consideration of the number of marine mammals that could be within the area around the operating airgun array where the received levels (RLs) of sound >160 dB re 1 μPa_{rms} are predicted to occur (see Table 1). The estimated numbers are based on the densities (numbers per unit area) of marine mammals expected to occur in the area in the absence of a seismic survey. To the extent that marine mammals tend to move away from seismic sources before the sound level reaches the criterion level and tend not to approach an operating airgun array, these estimates are likely to overestimate the numbers actually exposed to the specified level of sounds. The overestimation is expected to be particularly large when dealing with the higher sound-level criteria, e.g., 180 dB re 1 μPa_{rms}, as animals are more likely to move away before RL reaches 180 dB than they are to move away before it reaches (for example) 160 dB re 1 μPa_{rms}. Likewise, they are less likely to approach within the ≥180 dB re 1 μPa_{rms} radius than they are to approach within the considerably larger ≥160 dB radius.

We used densities calculated from the U.S. Navy's "OPAREA Density Estimates" (NODE) database (DoN 2007). The cetacean density estimates are based on the NMFS-NEFSC aerial surveys conducted between 1998 and 2004; all surveys from New Jersey to Maine were conducted in summer (June–August). Density estimates were derived using density surface modeling of the existing line-transect data, which uses sea surface temperature, chlorophyll *a*, depth, longitude, and latitude to allow extrapolation to areas/seasons where survey data were not collected. For some species, there were not enough sightings to be able to produce a density surface, so densities were estimated using traditional line-transect analysis. The models and analyses have been incorporated into a web-based Geographic Information System (GIS) developed by Duke University's Department of Defense Strategic Environmental Research and Development Program (SERDP) team in close collaboration with the NMFS SERDP team (Read et al. 2009). We used the GIS to obtain densities in a polygon the size of the survey area for the 19 cetacean species in the model. The GIS provides minimum, mean, and maximum estimates for four seasons, and we have used the mean estimates for summer (June–August). Mean densities were used because the minimum and maximum estimates are for points within the polygon, whereas the mean estimate is for the entire polygon.

The estimated numbers of individuals potentially exposed presented below are based on the 160-dB re 1 μPa_{rms} criterion for all cetaceans. It is assumed that marine mammals exposed to airgun sounds that strong could change their behavior sufficiently to be considered "taken by harassment". Table 7 shows the density estimates calculated as described above and the estimates of the number of different individual marine mammals that potentially could be exposed to ≥160 dB re 1 μPa_{rms} during the seismic survey if no animals moved away from the survey vessel. The *Requested Take Authorization* is given in the far right column of Table 7. For species for which densities were not available but for which there were sighting records near the survey area, we have included a *Requested Take Authorization* for the mean group size for the species from Palka (2012).

It should be noted that the following estimates of exposures to various sound levels assume that the proposed survey would be completed; in fact, the ensonified areas calculated using the planned number of line-kilometers ***have been increased by 25%*** to accommodate lines that may need to be repeated, equipment testing, etc. As is typical during offshore ship surveys, inclement weather and equipment malfunctions are likely to cause delays and may limit the number of useful line-kilometers of seismic operations that can be undertaken. Also, any marine mammal sightings within or near the designated EZ would result in the shut down of seismic operations as a mitigation measure. Thus, the following estimates of the numbers of marine mammals potentially exposed to 160-dB re 1 μPa_{rms} sounds are precautionary and

TABLE 7. Densities and estimates of the possible numbers of individuals that could be exposed to $\geq$160 dB re 1 µPa_{rms} during the proposed seismic survey in the northwest Atlantic off New Jersey during June–August 2015. The proposed sound source consists of an 4-airgun subarray with a total discharge volume of ~700 in^3. Species in italics are listed under the ESA as endangered. The column of numbers in boldface shows the numbers of Level B "takes" for which authorization is requested.

Species	Reported Density (#/1000 km^2) Read et al. (2009)[1]	Correction Factor[2]	Estimated Density (#/1000 km^2)	Ensonified Area (km^2)	Calculated Take[3]	% of Regional Pop'n[4]	Requested Level B Take Authorization
Mysticetes							
North Atlantic right whale	*0*		*0*	*2037*	*0*	*0*	***0***
Humpback whale	*0*		*0*	*2037*	*0*	*0.01*	***1[5]***
Minke whale	0		0	2037	0	0	**0**
Sei whale	*0.161*		*0.161*	*2037*	*0*	*0.01*	***1[5]***
Fin whale	*0.002*		*0.002*	*2037*	*0*	*<0.01*	***1[5]***
Blue whale	*0*		*0*	*2037*	*0*	*0*	***0***
Odontocetes							
Sperm whale	*7.06*		*7.06*	*2037*	*14*	*0.11*	***14***
Pygmy/dwarf sperm whale	0.001		0.001	2037	0	0.05	**2[5]**
Beaked whales[6]	0.124		0.124	2037	0	0.02	**3[5]**
Rough-toothed dolphin	0		0	2037	0	0	**0**
Bottlenose dolphin	111.3		111.3	2037	227	0.26	**227**
Pantropical spotted dolphin	0		0	2037	0	0	**0**
Atlantic spotted dolphin	36.11		36.11	2037	74	0.16	**74**
Spinner dolphin[7]	0		0	2037	0	0	**0**
Striped dolphin	0		0	2037	0	0.08	**46[5]**
Short-beaked common dolphin	0		0	2037	0	0.01	**18[5]**
White-beaked dolphin[7]	0		0	2037	0	0	**0**
Atlantic white-sided dolphin	0		0	2037	0	0.03	**15[5]**
Risso's dolphin	13.60		13.60	2037	28	0.15	**28**
Pygmy killer whale[7]	0		0	2037	0	N/A	**0**
False killer whale[7]	0		0	2037	0	N/A	**0**
Killer whale [7]	0		0	2037	0	N/A	**0**
Pilot whale	0.184		0.184	2037	0	<0.01	**9[5]**
Harbor porpoise	0		0	2037	0	0	**0**

[1] Densities are the mean values for the survey area, calculated from the SERDP model of Read et al. (2009)
[2] No correction factors were applied for these calculations
[3] Calculated take is estimated density (reported density x correction factor) multiplied by the 160-dB ensonified area (including the 25% contingency)
[4] Requested takes expressed as percentages of the larger regional populations, where available, for species that are at least partly pelagic; where not available (most odontocetes–see Table 3), 2013 SAR population estimates were used; N/A means not available
[5] Requested take authorization was increased to group size from Palka (2012) for species for which densities were zero but that have been sighted near the proposed survey area
[6] May include Cuvier's, True's, Gervais', Sowerby's, or Blainville's beaked whales, or the northern bottlenose whale
[7] Atlantic waters not included in the SERDP model of Read et al. (2009)

probably overestimate the actual numbers of marine mammals that could be involved. These estimates assume that there would be no weather, equipment, or mitigation delays, which is highly unlikely. For the 2014 survey, NMFS added an additional 25% to the estimated take to account for the turnover of marine mammals in the survey area. NSF has traditionally not included this factor into take calculations and therefore has not included it here.

Consideration should be given to the hypothesis that delphinids are less responsive to airgun sounds than are mysticetes, as referenced in both the PEIS and "Summary of Potential Airgun Effects" of this document. The 160-dB (rms) criterion currently applied by NMFS, on which the following estimates are based, was developed based primarily on data from gray and bowhead whales. The estimates of "takes by harassment" of delphinids given below are thus considered precautionary. As noted previously, in December 2013, NOAA made available for public comment new draft guidance for assessing the effects of anthropogenic sound on marine mammals (NOAA 2013a), although at the time of preparation of this Draft Amended EA, the date of release of the final guidelines and how they would be implemented are unknown. Available data suggest that the current use of a 160-dB criterion may be improved upon, as behavioral response may not occur for some percentage of odontocetes and mysticetes exposed to received levels >160 dB, while other individuals or groups may respond in a manner considered as taken to sound levels <160 dB (NMFS 2013a). It has become evident that the context of an exposure of a marine mammal to sound can affect the animal's initial response to the sound (NMFS 2013a).

Potential Number of Marine Mammals Exposed.—The number of different individuals that could be exposed to airgun sounds with received levels ≥160 dB re 1 μPa_{rms} on one or more occasions can be estimated by considering the total marine area that would be within the 160-dB radius around the operating seismic source on at least one occasion, along with the expected density of animals in the area. The number of possible exposures (including repeated exposures of the same individuals) can be estimated by considering the total marine area that would be within the 160-dB radius around the operating airguns, including areas of overlap. During the proposed survey, the transect lines are closely spaced relative to the 160-dB distance. Thus, the area including overlap is 35.5 times the area excluding overlap, so a marine mammal that stayed in the survey area during the entire survey could be exposed ~36 times, on average. However, it is unlikely that a particular animal would stay in the area during the entire survey. The numbers of different individuals potentially exposed to ≥160 dB re 1 μPa_{rms} were calculated by multiplying the expected species density times the anticipated area to be ensonified to that level during airgun operations excluding overlap. The area expected to be ensonified was determined by entering the planned survey lines into a MapInfo GIS, using the GIS to identify the relevant areas by "drawing" the applicable 160-dB buffer (see Table 1) around each seismic line, and then calculating the total area within the buffers.

Applying the approach described above, ~1630 km^2 (~2037 km^2 including the 25% contingency) would be within the 160-dB isopleth on one or more occasions during the proposed survey. Because this approach does not allow for turnover in the mammal populations in the area during the course of the survey, the actual number of individuals exposed may be underestimated, although the conservative (i.e., probably overestimated) line-kilometer distances used to calculate the area may offset this. Also, the approach assumes that no cetaceans would move away or toward the trackline as the *Langseth* approaches in response to increasing sound levels before the levels reach 160 dB. Another way of interpreting the estimates that follow is that they represent the number of individuals that are expected (in the absence of a seismic program) to occur in the waters that would be exposed to ≥160 dB re 1 μPa_{rms}.

The estimate of the number of individual cetaceans that could be exposed to seismic sounds with received levels ≥160 dB re 1 μPa_{rms} during the proposed survey is 343 (Table 7). That total includes 14 cetaceans listed as ***Endangered*** under the ESA, all sperm whales (0.11% of the regional population). Most (96%) of the cetaceans potentially exposed are delphinids; the bottlenose dolphin, Atlantic spotted dolphin, and Risso's dolphin are estimated to be the most common delphinid species in the area, with estimates of 227 (0.26% of the regional population), 74 (0.16%), and 28 (0.15%) exposed to ≥160 dB re 1 μPa_{rms}, respectively.

As part of the IHA process in 2014, NMFS reviewed the take estimates presented in Table 7 of the July 2014 Final EA (Table 6 in the Draft EA), which were based on an 8-airgun subarray with a volume of ~1400 in^3. As part of NMFS's analyses process, however, they revised the take calculations for most species based upon the best available density information from SERDP SDSS and other sources and most recent population estimates from the 2013 SAR. These included some additional takes for blue, fin, humpback, minke, sei, and north Atlantic right whales; beaked whales; harbor porpoise; and gray, harbor, and harp seals, and other species. The IHA issued by NOAA on 1 July 2014 therefore included slightly different estimates of the possible numbers of marine mammals exposed to sound levels ≥160 dB re 1 mPa during the proposed seismic survey than those presented in Table 7. For all but two of the species for which take has been issued, the takes remain less than 1% of the species' regional population or stock. Additionally, in the 2014 Biological Opinion, a different methodology to analyze for multiple exposures of endangered species was presented. NMFS does not provide specific guidance or requirements for IHA Applicants or for Section 7 ESA consultation for the development of take estimates and multiple exposure analysis, therefore variation in methodologies and calculations are likely to occur. The analysis presented in this NSF Draft Amended EA and the Final EA dated 1 July 2014, however, is a methodology that has been used successfully for past NSF seismic surveys to generate take estimates and multiple exposures for the MMPA and ESA processes. Although NSF did not, and has not historically, estimated take for sea turtles, the Biological Opinion and ITS included analysis and take estimates for sea turtles (Appendix C of the 1 July 2014 Final EA). NSF and LDEO would adhere to the requirements of the Incidental Take Statement (ITS) and the IHA and associated take levels issued.

(f) Conclusions for Marine Mammals and Sea Turtles

The proposed seismic project would involve towing a 4-airgun subarray, with a total discharge volume of 700 in^3, that introduces pulsed sounds into the ocean. Routine vessel operations, other than the proposed seismic operations, are conventionally assumed not to affect marine mammals sufficiently to constitute "taking".

Cetaceans.—In § 3.6.7 and 3.7.7, the PEIS concluded that airgun operations with implementation of the proposed monitoring and mitigation measures could result in a small number of Level B behavioral effects in some mysticete and odontocete species in the NW Atlantic DAA; that Level A effects were highly unlikely; and that operations were unlikely to adversely affect ESA-listed species. The information from recent literature summarized in sections (a) to (c) above complements, and does not affect the outcome of the effects assessment as presented in the PEIS.

In this analysis, estimates of the numbers of marine mammals that could be exposed to airgun sounds during the proposed program have been presented, together with the requested "take authorization". The estimated numbers of animals potentially exposed to sound levels sufficient to cause appreciable disturbance are very low percentages of the regional population sizes (Table 7). The estimates are likely overestimates of the actual number of animals that would be exposed to and would react to the seismic sounds. The reasons for that conclusion are outlined above. The relatively short-term exposures are unlikely to result in any long-term negative consequences for the individuals or their populations. Therefore, no significant impacts on cetaceans would be anticipated from the proposed activities. In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, Protected Species Observers (PSOs) and other crew members have seen no seismic sound-related marine mammal injuries or mortality, including during 2014 survey activities. For the 2014 survey, NMFS issued a Final EA and a FONSI. NMFS also issued an IHA on 1 July 2014, therefore, the proposed activity meets the criteria that the proposed activities, "must not cause serious physical injury or death of marine mammals, must have negligible impacts on the species and stocks, must "take" no more than

small numbers of those species or stocks, and must not have an unmitigable adverse impact on the availability of the species or stocks for legitimate subsistence uses." In the Biological Opinion dated 1 July 2014, NMFS determined that the level of incidental take was not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat**.** The issuance of the Final EA, FONSI, IHA, and Biological Opinion by NMFS in July 2014 further verifies that significant impacts would not be anticipated from the proposed activities, especially given that the activities would be using the smaller 700-in^3 source, rather than the larger size source also analyzed and authorized by NMFS in 2014. Observations from the brief 2014 survey support this conclusion (Ingram et al. 2014).

Sea Turtles.—In § 3.4.7, the PEIS concluded that with implementation of the proposed monitoring and mitigation measures, no significant impacts of airgun operations are likely to sea turtle populations in any of the analysis areas, and that any effects are likely to be limited to short-term behavioral disturbance and short-term localized avoidance of an area of unknown size near the active airguns. Five species of sea turtle—the leatherback, loggerhead, green, hawksbill, and Kemp's ridley—could be encountered in the proposed survey area. Only foraging or migrating individuals would occur. Given the proposed activities, no significant impacts on sea turtles would be anticipated. In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, Protected Species Observers (PSOs) and other crew members have seen no seismic sound-related sea turtle injuries or mortality, including during 2014 survey activities. In their July 2014 Final EA, FONSI, and Biological Opinion, NMFS determined that the level of incidental take was not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat**.** The Biological Opinion further verifies that significant impacts would not be anticipated from the proposed activities. Observations from the brief 2014 survey support this conclusion (Ingram et al. 2014).

(2) Direct Effects on Invertebrates, Fish, Fisheries, and EFH and Their Significance

Effects of seismic sound on marine invertebrates (crustaceans and cephalopods), marine fish, and their fisheries are discussed in § 3.2.4 and § 3.3.4 and Appendix D of the PEIS. Relevant new studies on the effects of sound on marine invertebrates, fish, and fisheries that have been published since the release of the PEIS are summarized below.

(a) Effects of Sound on Fish and Invertebrates

Morley et al. (2013) considered invertebrates important when examining the impacts of anthropogenic noise. Although their review focused on terrestrial invertebrates, they noted that invertebrates, because of their short life cycle, can provide model systems for evaluating the effects of noise on individual fitness and physiology, thereby providing data that can be used to draw stronger, ecologically valid conclusions.

Solé et al. (2013) exposed four cephalopod species to low-frequency sound (50–400 Hz sweeps) with received levels of 157 ± 5 dB re 1 μPa, and peak levels up to 175 dB re 1 μPa. Besides exhibiting startle responses, all four species examined received damage to the statocyst, which is the organ responsible for equilibrium and movement. The animals showed stressed behavior, decreased activity, and loss of muscle tone. When the shore crab *Carcinus maenas* was initially exposed to ship-noise playbacks, it consumed more oxygen, indicating a higher metabolic rate and potentially more stress; however, there were no changes in physiological responses to repeated exposure (Wale et al. 2013). Heavier crabs were more responsive than lighter crab (Wale et al. 2013). Celi et al. (2013) exposed red swamp crayfish (*Procambarus clarkia*) to linear sweeps with a frequency range of 0.1 to 25 kHz and a

peak amplitude of 148 dB re 1 μPa rms at 12 kHz for 30 min. They found that the noise exposure caused changes in the haemato-immunological parameters (indicating stress) and reduced agonistic behaviors.

Fewtrell and McCauley (2012) exposed squid (*Sepioteuthis australis*), pink snapper (*Pagrus auratus*), and trevally (*Pseudocaranx dentex*) to pulses from a single airgun. The received sound levels ranged from 120 to 184 dB re 1 dB re 1 $\mu Pa^2 \cdot s$ SEL. Increases in alarm responses were seen in the squid and fish at SELs >147–151 dB re 1 $\mu Pa^2 \cdot s$; the fish swam faster and formed more cohesive groups in response to the airgun sounds, and squid were seen to discharge ink or change their swimming pattern or vertical position in the water column.

Significant developmental delays and body abnormalities in scallop larvae exposed to seismic pulses were reported by de Soto et al. (2013). Their experiment used larvae enclosed in 60-ml flasks suspended in a 2-m diameter by 1.3-m water depth tank and exposed to a playback of seismic sound at a distance of 5–10 cm. Other studies conducted in the field have shown no effects on Dungeness crab larvae or snow crab embryos (Pearson et al. 1994; DFOC 2004 *in* NSF PEIS). Moreover, a major annual scallop-spawning period occurs in the Mid-Atlantic Bight during late summer to fall (August–October), although MacDonald and Thompson (1988 in NMFS 2004) reported scallop spawning off New Jersey during September–November. The timing of the proposed survey would not coincide with the time when scallops are spawning.

Bui et al. (2013) examined the behavioral responses of Atlantic salmon (*Salmo salar L.*) to light, sound, and surface disturbance events. They reported that the fish showed short-term avoidance responses to the three stimuli. Salmon that were exposed to 12 Hz sounds and/or surface disturbances increased their swimming speeds.

Peña et al. (2013) used an omnidirectional fisheries sonar to determine the effects of a 3D seismic survey off Vesterålen, northern Norway, on feeding herring (*Clupea harengus*). They reported that herring schools did not react to the seismic survey; no significant changes were detected in swimming speed, swim direction, or school size when the drifting seismic vessel approached the fish from a distance of 27 km to 2 km over a 6 h period. Peña et al. (2013) attributed the lack of response to strong motivation for feeding, the slow approach of the seismic vessel, and an increased tolerance to airgun sounds.

Miller and Cripps (2013) used underwater visual census to examine the effect of a seismic survey on a shallow-water coral reef fish community in Australia. The census took place at six sites on the reef prior to and after the survey. When the census data collected during the seismic program were combined with historical data, the analyses showed that the seismic survey had no significant effect on the overall abundance or species richness of reef fish. This was in part attributed to the design of the seismic survey, which reduced the impacts of seismic sounds on the fish communities by exposing them to relatively low SELs (<187 dB re 1 $\mu Pa^2 \cdot s$).

Hastings and Miksis-Olds (2012) measured the hearing sensitivity of caged reef fish following exposure to a seismic survey in Australia. When the auditory evoked potentials (AEP) were examined for fish that had been in cages as close as 45 m from the pass of the seismic vessel and at water depth of 5 m, there was no evidence of temporary threshold shift (TTS) in any of the fish examined, even though the cumulative SELs had reached 190 dB re 1 $\mu Pa^2 \cdot s$.

Two spawning stocks that migrate inshore/offshore off New Jersey are the summer flounder and black sea bass. Summer flounder normally inhabit shallow coastal and estuarine waters in summer and move offshore in 60–150 m depth in fall and winter. They spawn in fall and winter (September–December) (MAFMC 1988), after the proposed seismic survey period. Black sea bass normally inhabit shallow waters in summer and move offshore and south in 75–165 m depth in fall and winter (MAFMC 1996). Spawning in the Middle Atlantic Bight population occurs primarily on the inner continental shelf

from May to July during inshore migrations (NMFS 1999), largely before the survey's proposed timing. Therefore, spawning of at least two important species would not be affected to any great degree.

(b) Effects of Sound on Fisheries

Handegard et al. (2013) examined different exposure metrics to explain the disturbance of seismic surveys on fish. They applied metrics to two experiments in Norwegian waters, during which fish distribution and fisheries were affected by airguns. Even though the disturbance for one experiment was greater, the other appeared to have the stronger SEL, based on a relatively complex propagation model. Handegard et al. (2013) recommended that simple sound propagation models should be avoided and that the use of sound energy metrics like SEL to interpret disturbance effects should be done with caution. In this case, the simplest model (exposures per area) best explained the disturbance effect.

Hovem et al. (2012) used a model to predict the effects of airgun sounds on fish populations. Modeled SELs were compared with empirical data and were then compared with startle response levels for cod. Their preliminary analyses indicated that seismic surveys should occur at a distance of 5–10 km from fishing areas, in order to minimize potential effects on fishing.

In their introduction, Løkkeborg et al. (2012) described three studies in the 1990s that showed effects on fisheries. Results of their study off Norway in 2009 indicated that fishes reacted to airgun sound based on observed changes in catch rates during seismic shooting; gillnet catches increased during the seismic shooting, likely a result of increased fish activity, whereas longline catches decreased overall (Løkkeborg et al. 2012).

(c) Conclusions for Invertebrates, Fish, and Fisheries

This newly available information does not affect the outcome of the effects assessment as presented in the PEIS. The PEIS concluded that there could be changes in behavior and other non-lethal, short-term, temporary impacts, and injurious or mortal impacts on a small number of individuals within a few meters of a high-energy acoustic source, but that there would be no significant impacts of NSF-funded marine seismic research on populations and associated EFH. The PEIS also concluded that seismic surveys could cause temporary, localized reduced fish catch to some species, but that effects on commercial and recreation fisheries were not significant.

Most commercial fish catches by weight (almost all menhaden) and most recreational fishing trips off the coast of New Jersey (87% in 2013 occur in waters within 5.6 km from shore, although the highest-value fish (e.g., flounder and tuna) are caught farther offshore. The closest distance between the proposed survey and shore is >25 km, so interactions between the proposed survey and recreational and some commercial fisheries would be relatively limited. Also, most of the recreational fishery "hotspots" described in § III are to the north or south of the proposed survey area; however, there are several hotspots located within or very near the northwestern corner of the survey area. Two possible conflicts are the *Langseth*'s streamer entangling with fixed fishing gear and temporary displacement of fishers within the survey area, although the survey area is relatively small (12 x 50 km). Fishing activities could occur within the survey area; however, a safe distance would need to be kept from the *Langseth* and the towed seismic equipment. Conflicts would be avoided and, therefore, impacts would be negligible, through communication with the fishing community and publication of a Notice to Mariners about operations in the area. No fisheries activities except vessels in transit were observed in the survey area during the 13 days that the Langseth was there in July 2014.

Survey activities are proposed to take place ~25–85 km off the coast of New Jersey. The area of the proposed survey is relatively small, ~600 km^2. If we were to make a comparison of that survey area to blocks in New York City, it would essentially be equivalent to an area of 8 by 22 city blocks. The overall

area of NJ marine waters from shore to the EEZ encompasses ~210,768 km^2. Thus the proposed survey area represents less than one half percent (0.28%) of the area of waters from the NJ shore to the EEZ (600 km^2/210,768 km^2). The survey area plus the largest mitigation zone (8.15 km) would represent less than one percent (0.88%) of the area of waters from the NJ shore to the EEZ (1159 km^2/210,768 km^2). The seismic survey is proposed to take place for ~30 days within the June to August timeframe in 2015, not over the entire time that would be allowable under the IHA. As noted previously, fishing activities would not be precluded from operating in the proposed survey area. Any impacts to fish species would occur very close to the survey vessel and would be temporary. No fish kills or injuries were observed during 2014 survey activities (Ingram et al. 2014).

Given the proposed activities, no significant impacts on marine invertebrates, marine fish, their EFH, and their fisheries would be anticipated. In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, Protected Species Observers (PSOs) and other crew members have seen no seismic sound-related fish or invertebrate injuries or mortality. Furthermore, past seismic surveys in the proposed survey area (2002, 1998, 1995, 1990) did not result in noticeable effects on commercial or recreational fish catches, based on a review of multi-year NMFS fish catch data in the months when seismic surveys were undertaken. The issuance of the Final EA, FONSI, IHA, and Biological Opinion by NMFS in July 2014 further verifies that significant impacts would not be anticipated from the proposed activities. Observations from the brief 2014 survey support this conclusion (Ingram et al. 2014).

NSF consulted in 2014, and will do so again in 2015, with the NMFS Greater Atlantic Regional Fisheries Office under the Magnuson-Stevens Act for EFH (see below "Coordination with Other Agencies and Processes" for further details). The NMFS Greater Atlantic Regional Fisheries Office concluded that the proposed activities may at some level adversely affect EFH, however, no specific conservation measures were identified for the proposed activities.

(3) Direct Effects on Seabirds and Their Significance

Effects of seismic sound and other aspects of seismic operations (collisions, entanglement, and ingestion) on seabirds are discussed in § 3.5.4 of the PEIS. The PEIS concluded that there could be transitory disturbance, but that there would be no significant impacts of NSF-funded marine seismic research on seabirds or their populations. Given the proposed activities, no significant impacts on seabirds would be anticipated. In decades of seismic surveys carried out by the *Langseth* and its predecessor, the R/V *Ewing*, Protected Species Observers (PSOs) and other crew members have seen no seismic sound-related seabird injuries or mortality. Furthermore, NSF received concurrence from USFWS in 2014 (Appendix F of the 1 July 2014 Final EA), and will seek concurrence again in 2015, that the proposed activities "may affect" but "are not likely to adversely affect" species under their jurisdiction (Appendix F of the 1 July 2014 Final EA). Observations from the July 2014 survey support this conclusion (Ingram et al. 2014).

(4) Indirect Effects on Marine Mammals, Sea Turtles, and Their Significance

The proposed seismic operations would not result in any permanent impact on habitats used by marine mammals or sea turtles, or to the food sources they use. The main impact issue associated with the proposed activities would be temporarily elevated noise levels and the associated direct effects on marine mammals and sea turtles, as discussed above.

During the proposed seismic survey, only a small fraction of the available habitat would be ensonified at any given time. Disturbance to fish species and invertebrates would be short-term, and fish would return to their pre-disturbance behavior once the seismic activity ceased. Thus, the proposed

survey would have little impact on the abilities of marine mammals or sea turtles to feed in the area where seismic work is planned. No other indirect effects on other species would be anticipated.

(5) Direct Effects on Recreational SCUBA Divers and Dive Sites and Their Significance

No significant impacts on dive sites, including shipwrecks, would be anticipated. Airgun sounds would have no effects on solid structures. The only potential effects could be temporary displacement of fish and invertebrates from the structures.

Significant impacts on, or conflicts with, divers or diving activities would be avoided through communication with the diving community before and during the survey and publication of a Notice to Mariners about operations in the area. In particular, dive operators with dives scheduled on the shipwreck *Lillian* during the survey would be contacted directly. That dive site represents only a very small percentage of the recreational dive sites in New Jersey waters. No dive vessels were observed in the survey area during the ~14 days that the Langseth was there in July 2014.

(6) Cumulative Effects

The results of the cumulative impacts analysis in the PEIS indicated that there would not be any significant cumulative effects to marine resources from the proposed NSF-funded marine seismic research. However, the PEIS also stated that, "A more detailed, cruise-specific cumulative effects analysis would be conducted at the time of the preparation of the cruise-specific EAs, allowing for the identification of other potential activities in the area of the proposed seismic survey that may result in cumulative impacts to environmental resources." Here we focus on activities that could impact animals specifically in the proposed survey area (research activities, vessel traffic, and commercial fisheries). Additionally, the 2014 NMFS EA Cumulative Effects Section on Climate Change is incorporated into this Draft Amended EA by reference as if fully set forth herein.

(a) Past and future research activities in the area

Most recently, as part of the Integrated Ocean Drilling Program (IODP), the liftboat *Kayd* conducted scientific research and drilling on Expedition 313, New Jersey Shallow Shelf, at several sites off New Jersey during 30 April–17 July 2008. In the more distant past, there have been other scientific drilling activities in the vicinity. There have also been numerous prior seismic surveys, all of which were 2-D, ranging from poor quality, low resolution data collected in 1978 to the most recent, excellent quality, high resolution but shallow penetration data from 2002. These include surveys with a 6-airgun, 1350-in^3 array in 1990; with a single, 45-in^3 GI Gun in 1995 and 1998; and with two 45-in^3 GI Guns in 2002. No seismic sound-related marine mammal, fish, or seabird injuries or mortality were observed by crew or scientists during these past seismic surveys in the proposed survey area. Other scientific research activities may be conducted in this region in the future; however, no other marine geophysical surveys are proposed at this specific site using the *Langseth* in the foreseeable future. At the present time, the proponents of the survey are not aware of other similar research activities planned to occur in the proposed survey area during the June–August 2015 timeframe, but research activities planned by other entities are possible, although unlikely.

In 2014, the *Langseth* also supported an NSF-proposed 2-D seismic survey off the coast of North Carolina to study the U.S. mid-Atlantic margin. That cruise lasted ~34 days and collected ~5000 km of track lines in September/October 2014. Additionally, the *Langseth* conducted a 2-D seismic survey (~2700 km) for ~3 weeks in August/September 2014, and may conduct a similar survey in 2015, for the USGS in support of the delineation of the U.S. Extended Continental Shelf (ECS) along the east coast. Separate EAs were prepared for those activities, and neither project would overlap with the proposed survey area.

(b) Vessel traffic

Based on data available through the Automated Mutual-Assistance Vessel Rescue (AMVER) system managed by the U.S. Coast Guard, 15–49 commercial vessels per month travelled through the proposed survey area during the months of June and July from 2008 to 2013, and for each month in 2012 and 2013 (2013 data are available for January–June, the most recent data available as of October 2014). Over 50 commercial vessels per month were recorded during this time closer to shore (particularly around New York City), to the immediate west and northwest of the proposed survey area (USCG 2013).

Live vessel traffic information is available from MarineTraffic (2014), including vessel names, types, flags, positions, and destinations. Various types of vessels were in the general vicinity of the proposed survey area when MarineTraffic (2014) was accessed on 10 and 15 October and 14 November 2014, including fishing vessels (22), pleasure craft (11), tug/towing vessels (9), cargo vessels (16), tankers (7), and research/survey, military, and dredger vessels (1 of each). There was also one unidentified ship type, with a U.S.A. flag. All but the majority of cargo vessels, the military vessel, the tankers, and two pleasure craft were U.S.A.-flagged. During the 13 days in July 2014 that the *Langseth* was in the survey area, there was limited merchant vessel activity; most merchant traffic was lining up for "safety fairway" to the west of the survey area.

The total transit distance (~5200 km) by L-DEO's vessel *Langseth* would be minimal relative to total transit length for vessels operating in the proposed survey area during June–August 2015. Thus, the projected increases in vessel traffic attributable to implementation of the proposed activities would constitute only a negligible portion of the total existing vessel traffic in the analysis area, and only a negligible increase in overall ship disturbance effects on marine mammals.

(c) Marine Mammal Disease

As discussed in § III, since July 2013, an unusually high number of dead or dying bottlenose dolphins have washed up on the mid-Atlantic coast from New York to Florida. NOAA noted that the triggers for disease outbreaks are unknown, but that contaminants and injuries may reduce the fitness of dolphin populations by stressing the immune system. Morbillivirus outbreaks can also be triggered by a drop in the immunity of bottlenose dolphin populations if they have not been exposed to the disease over time, and natural immunity wanes (NOAA 2013b). The last morbillivirus mortality event occurred in 1987–1988, when more than 740 bottlenose dolphins died along the mid-Atlantic coast from New Jersey to Florida (NOAA 2013b). During that mortality event, fungal, bacterial, and mixed bacterial and fungal pneumonias were common in the lungs of 79 dolphins that were examined, and the frequent occurrence of the fungal and bacterial infections in dolphins that also were infected by morbillivirus was consistent with morbillivirus-induced immunosuppression resulting in secondary infections (Lipscomb et al. 1994). Dr. Teri Knowles of NOAA noted that if the current outbreak evolves like the one in 1987–1988, "we're looking at mortality being higher and morbillivirus traveling southwards and continuing until May 2014." In fact, as of mid October 2014 it is still continuing, although recently, the number of strandings appear to be decreasing, especially in the northern states; between 17 August and 19 October, there were 2, 3, 4, and 0 strandings in NY, NJ, DE, and MD, respectively. Dr. Knowles also speculated that environmental factors, such as heavy metal pollution and sea surface temperature changes, could also play a role in the current outbreak (National Geographic Daily News 2013). It seems unlikely that the short-term behavioral disturbance that could be caused by the proposed seismic survey, especially for dolphins, would contribute to the development or continuation of a morbillivirus outbreak. Although NSF has contacted the NMFS Greater Atlantic Regional Fisheries Office Marine Mammal Response Coordinator, strandings from the proposed activities would not be anticipated. Therefore, the proposed activities would not be anticipated to increase the level of coordination necessary for stranding networks and

associated budgets or impact the NJ Animal Health Diagnostic Laboratory budget, which has been involved with funding efforts related to the recent bottlenose dolphin morbillivirus mortality event.

(d) Fisheries

The commercial and recreational fisheries in the general area of the proposed survey are described in § III. No fisheries activities except vessels in transit were observed in the survey area during the 13 days that the Langseth was there in July 2014. The primary contributions of fishing to potential cumulative impacts on marine mammals and sea turtles involve direct removal of prey items, noise, potential entanglement (Reeves et al. 2003), and the direct and indirect removal of prey items. In U.S. waters, numerous cetaceans (mostly delphinids) and pinnipeds suffer serious injury or mortality each year from fisheries; for example, for the species assessed by Waring et al. (2013), average annual fishery-related mortality during 2006–2010 in U.S. Atlantic waters included 164 common dolphins, 212 Atlantic white-sided dolphins, 791 harbor porpoises, and 1466 harbor, gray, and harp seals. There may be some localized avoidance by marine mammals of fishing vessels near the proposed seismic survey area. L-DEO's operations in the proposed survey area are also limited (duration of ~1 month), and the combination of L-DEO's operations with the existing commercial and recreational fishing operations in the region is expected to produce only a negligible increase in overall disturbance effects on marine mammals and sea turtles.

(e) Military Activity

The proposed survey is located within the U.S. Navy's Atlantic City Range Complex (ACRC). The Boston, Narragansett Bay, and Atlantic City range complexes are collectively referred to as the Northeast Range Complexes. The types of activities that could occur in the ACRC would include the use of active sonar, gunnery events with both inert and explosive rounds, bombing events with both inert and explosive bombs, and other similar events. The ACRC includes special use airspace, Warning Area W-107. The ACRC is an active area, but there is typically relatively limited activity that occurs there. There has only been limited activity in the past, and there were no conflicts during the 2014 survey. L-DEO and NSF are coordinating, and would continue to coordinate, with the U.S. Navy to ensure there would be no conflicts in 2015.

(f) Oil and Gas Activities

Oil and gas activities are managed by BOEM. If BOEM were interested in oil and gas development activities in the survey area, BOEM would need to prepare the appropriate analyses under NEPA, followed by other consultation processes under such federal statutes as the MMPA, ESA, EFH, and CZMA. The proposed survey site is outside of the BOEM Atlantic Outer Continental Shelf Proposed Geological and Geophysical (G&G) Activities in the Mid-Atlantic and South Atlantic Planning Areas (BOEM 2014). The current BOEM mid-Atlantic and South Atlantic activities would be the preliminary surveys that are necessary for BOEM and industry to determine resource potential, and to provide siting information for renewable energy and marine minerals activities; lease sales in those areas have not yet been considered. The final BOEM Record of Decision for the proposed action was issued in July 2014.

Whereas it is theoretically possible that the oil and gas industry may be interested in the architecture of the passive margin area in the survey region for application to other locations (see Appendix B, page C-15, of the 1 July 2014 Final EA), there are no known interests for G&G activities, including oil and gas exploration, in or around the proposed survey site. The proposed seismic survey is not related to nor would it lead to offshore drilling; the proposed activities would evaluate sea level change as described here and in the 2014 Final EA and there are no additional activities proposed beyond those by the PIs or NSF (i.e., there are no proposed oil and gas exploration activities associated with the proposed activities).

Seismic surveys in support of research activities have occurred in the survey area in the recent past (2002, 1998, 1995, 1990). Additionally, NJDEP conducted a seismic survey (boomer/sparker source) in 1985 off the coast of New Jersey (Waldner and Hall 1991). Oil and gas activities in the proposed survey area have not resulted from these similar research seismic surveys. Therefore, it would not be logical to assume that the proposed research seismic survey would result in oil and gas development.

Given the potential distance from any future BOEM G&G activities in the region and separation in time with the proposed activities, no cumulative effects would be anticipated.

(7) Unavoidable Impacts

Unavoidable impacts to the species of marine mammals, sea turtles, seabirds, fish, and invertebrates occurring in the proposed survey area would be limited to short-term, localized changes in behavior of individuals. For cetaceans, some of the changes in behavior may be sufficient to fall within the MMPA definition of "Level B Harassment" (behavioral disturbance; no serious injury or mortality). TTS, if it occurs, would be limited to a few individuals, would be a temporary phenomenon that does not involve injury, and would be unlikely to have long-term consequences for the few individuals involved. No long-term or significant impacts would be expected on any of these individual marine mammals, sea turtles, seabirds, fish, and invertebrates or on the populations to which they belong. Effects on recruitment or survival would be expected to be (at most) negligible.

(8) Public Involvement and Coordination with Other Agencies and Processes

For the 2014 survey, NSF posted the Draft Environmental Assessment (Draft EA) on the NSF website for a 30 day public comment period from 3 February to 3 March 3, 2014, but received no comments during the open comment period. As noted below, public comments were received during the NMFS IHA process in June 2014, and although not received as part of the NSF NEPA process, NSF considered the responses with respect to the information included in the Draft EA and refinements were made and additional information included in the Final EA. The new information included in the 2014 Final EA and in this NSF Draft Amended EA remain consistent with the conclusions in the PEIS. This Draft Amended EA will also be posted on the NSF website for a 30 day public comment period.

This Draft Amended EA was prepared by LGL on behalf of L-DEO and NSF pursuant to NEPA. Potential impacts to endangered species and critical habitat were also assessed in the document; therefore, it will be used to coordinate and support other consultations with federal agencies as required and noted below.

Endangered Species Act (ESA)

For 2014 survey activities, NSF engaged in formal consultation with NMFS and informal consultation with USFWS pursuant to Section 7 of the ESA. NSF received concurrence from USFWS that the proposed activities "may affect" but "are not likely to adversely affect" species under their jurisdiction (Appendix F of the 1 July 2014 Final EA). Mitigation measures would include power-downs/shut-downs for foraging endangered or threatened seabirds. NMFS issued a Biological Opinion and an Incidental Take Statement (Appendix C of the 1 July 2014 Final EA) on 1 July 2014 for the proposed activities and consultation was concluded. For operational purposes and coordination with monitoring and mitigation measures required under the IHA, the Exclusion Zone for sea turtles and foraging seabirds was expanded to the 177db isopleth.

NSF will consult under ESA Section 7 again with NMFS and USFWS for proposed 2015 activities.

Marine Mammal Protection Act (MMPA)

For 2014 survey activities, L-DEO submitted to NMFS an IHA pursuant to the MMPA. On 17 March 2014, NMFS issued in the Federal Register a Notice of Intent to issue an IHA for the survey and 30-day public comment period. In response to public comment request, NMFS extended the public comment period an additional 30 days, for a total of 60 days. As noted above, public comments were received as part of the IHA process (Appendix G of the 1 July 2014 Final EA) and, although not received as part of the NSF NEPA process, NSF considered the responses with respect to the information included in the Draft EA. NMFS prepared a separate EA for its federal action of issuing an IHA; NMFS's EA (Appendix E of the 1 July 2014 Final EA) is hereby incorporated by reference in this NSF Draft Amended EA as appropriate and where indicated. NMFS issued an IHA on 1 July 2014 (Appendix D of the 1 July 2014 Final EA). The IHA stipulated monitoring and mitigation measures, including additional mitigation measures beyond those proposed in the NSF Draft EA and IHA Application, such as an expanded Exclusion Zone (177-dB isopleth) and a one minute shot interval for the 40-in^3 mitigation airgun.

As required by NMFS, L-DEO will submit a new IHA application to NMFS for the proposed 2015 activities. NSF and LDEO would adhere to the IHA requirements for the proposed action.

NMFS Marine Mammal Stranding Program

Although marine mammal strandings were not anticipated as a result of the 2014 survey activities, during ESA Section 7 and MMPA consultation with NMFS it was recommended that the NMFS Greater Atlantic Regional Fisheries Office Marine Mammal Response Coordinator be contacted regarding the proposed activity. Both NMFS and NSF made contact with that coordinator. NSF and NMFS will contact the NMFS Greater Atlantic Regional Fisheries Office Marine Mammal Response Coordinator again regarding proposed 2015 activities. Should any marine mammal strandings occur during the survey, NMFS and the NMFS Greater Atlantic Regional Fisheries Office Marine Mammal Response Coordinator would be contacted. No strandings associated with seismic activities were reported during 2014 survey operations.

Magnuson Stevens Act - Essential Fish Habitat (EFH)

The Magnuson Stevens Act requires that a federal action agency consult with NMFS for actions that "may adversely affect" EFH. Although adverse effects on EFH, including a reduction in quantity or quality of EFH, were not anticipated by the 2014 survey activities, NSF contacted the EFH Regional Coordinator of the NOAA Greater Atlantic Regional Fisheries Office regarding the proposed activities. The EFH Regional Coordinator concluded in a letter dated 18 June 2014, however, that some level of adverse effects to EFH may occur as a result of the proposed activities (Appendix H of the 1 July 2014 Final EA). Additional research and monitoring to gain a better understanding of the potential effects that seismic surveys may have on EFH, federal managed species, their prey, and other NOAA trust resources was recommended for future NSF activities. No project-specific EFH conservation recommendations were provided, however, and consultation was concluded.

NSF will consult again with the Regional Coordinator of the NOAA Greater Atlantic Regional Fisheries Office regarding the proposed 2015 survey activities.

Coastal Zone Management Act (CZMA)

For the 2014 survey, per the requirements of the CZMA, NSF reviewed the New Jersey Coastal Management Program (CMP) Federal Consistency Listings and determined that the proposed activity was unlisted. NSF contacted NOAA's Office of Ocean and Coastal Resource Management (OCRM) to

discuss CZMA implications regarding the proposed project. NSF, OCRM, and the New Jersey Department of Environmental Protection (NJDEP) engaged in several conversations regarding the proposed activity. On 20 May, OCRM received by email NJDEP's request for approval to review the NSF assistance to Rutgers as an unlisted activity under Subpart F and for OCRM to concur that the operation of the vessel was subject to Subpart C (Appendix I of the 1 July 2014 Final EA). OCRM submitted a letter to NSF requesting information about the proposed project (Appendix J of the 1 July 2014 Final EA). NSF provided a response to OCRM per request, also noting NSF's position that the proposed activities were applicable to Subpart F and that the NJDEP request to review was untimely (Appendix K of the 1 July 2014 Final EA). NSF further set forth its position that the operation of the vessel was pursuant to a cooperative agreement that had been approved years ago, and, thus, the time for consistency review had passed. In response to the NJDEP request, OCRM concluded in its letter dated 18 June 2014 that the proposed project falls under Subpart F, not Subpart C, of the regulations implementing CZMA and determined that the NJDEP request to review the project under Subpart F was untimely (Appendix L of the 1 July 2014 Final EA). No further action was required by NSF or the PIs under CZMA for 2014 activities.

NSF has contacted the NJDEP and OCRM regarding CZMA obligations for proposed 2015 survey activities and will comply as appropriate.

Alternative Action: Another Time

An alternative to issuing the IHA for the period requested, and to conducting the Project then, is to issue the IHA for another time, and to conduct the project at that alternative time. The proposed dates for the cruise (~34 days in June–August) are the dates when the personnel and equipment essential to meet the overall project objectives are available; if the date of the cruise were changed, for example to late spring or early fall, it is likely that the *Langseth* would not be available and, thus, the purpose and need of the proposed activities could not be met. If the IHA is issued for another period, it could result in significant delay and disruption not only of this cruise, but also of additional studies that are planned on the *Langseth* for 2015 and beyond.

The weather in the mid-Atlantic Ocean was taken into consideration when planning the proposed activities. The mid-Atlantic Ocean off New Jersey can be challenging to operate during certain times of year, precluding the ability to safely tow seismic gear. Whereas conducting the survey at an alternative time is a viable alternative if the *Langseth*, personnel, and essential equipment are available, because of the weather conditions, it would not be viable to conduct a seismic survey in winter months off the coast of New Jersey.

Marine mammals and sea turtles are expected to be found throughout the proposed survey area and throughout the time during which the project would occur. Some marine mammal species are expected to occur in the area year-round, so altering the timing of the proposed project likely would result in no net benefits for those species. Some migratory species are expected to be farther north at the time of the survey, so the survey timing is beneficial for those species (see § III, above). In particular, migration of the North Atlantic right whale occurs mostly between November and April, and the survey is timed to avoid those months. Accordingly, the alternative action would likely result in either a failure to meet the purpose and need of the proposed activities or it would raise the risk of causing impacts to species such as the North Atlantic right whale.

No Action Alternative

An alternative to conducting the proposed activities is the "No Action" alternative, i.e. do not issue an IHA and do not conduct the operations. If the research were not conducted, the "No Action" alternative would result in no disturbance to marine mammals or sea turtles attributable to the proposed activities, however valuable data about the marine environment would be lost. Research that would contribute to the understanding of the response of nearshore environments to changes in elevation of global sea level would be lost and greater understanding of Earth processes would not be gained. The "No Action" alternative could also, in some circumstances, result in significant delay of other studies that would be planned on the *Langseth* for 2015 and beyond, depending on the timing of the decision. Not conducting this cruise (no action) would result in less data and support for the academic institutions involved. Data collection would be an essential first step for a much greater effort to analyze and report information for the significant topics indicated. The field effort would provide material for years of analyses involving multiple professors, students, and technicians. The lost opportunity to collect valuable scientific information would be compounded by lost opportunities for support of research infrastructure, training, and professional career growth. The research goals and objectives cannot be achieved using existing scientific data. Existing seismic profiles occur at intervals too coarse to achieve the proposed scientific goals of this project. Both the larger spacing and the limitations inherent in processing 2-D seismic data preclude identification of key features of the past margin such as river or delta channels and shoreline adjustments. Only dense and 3-D seismic acquisition and processing can provide continuity of imaging to enable confident identification of these features, whose distributions are expected to evolve throughout the time period recorded in the sediments targeted. The no Action Alternative would not meet the purpose and need for the proposed activities.

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APPENDIX A:

ACOUSTIC MODELING OF SEISMIC ACOUSTIC SOURCES AND SCALING FACTORS FOR SHALLOW WATER[4]

For the proposed survey off New Jersey, a smaller energy source than the full airgun array available on the R/V *Langseth* would be sufficient to collect the desired geophysical data. Previously conducted calibration studies of the *Langseth*'s airgun arrays, however, can still inform the modeling process used to develop mitigation radii for the currently proposed survey.

Acoustic Source Description

This 3-D seismic data acquisition project would use two airgun subarrays that would be fired alternately as the ship progresses along track (one subarray would be towed on the port side and the other on the starboard side). Each airgun subarray would consist of four airguns (total volume 700 in^3). The subarrays would use subsets of the linear arrays or "strings" composed of Bolt 1500LL and Bolt 1900LLX airguns that are carried by the R/V *Langseth* (Figure A1): four airguns in one string would be fired simultaneously, and the other six airguns on the string would be inactive. The subarray tow depth would be either 4.5 m (desired tow depth) or 6 m (in case of weather degradation). The subarray would be fired roughly every 5.4 s. At each shot, a brief (~0.1 s) pulse of sound would be emitted, with silence in the intervening periods. This signal attenuates as it moves away from the source, decreasing in amplitude and increasing in signal duration.

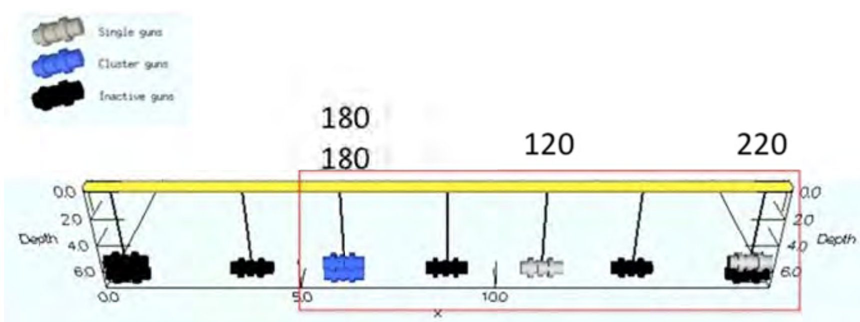


FIGURE A1. Four-airgun subset of one string that would be used as a 700-in^3 subarray for the proposed survey (individual volumes are indicated).

Four-Airgun Subarray Specifications

Energy Source	1950-psi Bolt airguns with volumes 120–220 in^3, arranged in one string of four operating airguns
Towing depth of energy source	4.5 m or 6 m
Source output (downward), 4.5 m	0-pk is 240.4 dB re 1 μPa·m; pk-pk is 246.3 dB re 1 μPa·m
Source output (downward), 6 m	0-pk is 240.4 dB re 1 μPa·m; pk-pk is 246.7 dB re 1 μPa·m
Air discharge volume	~700 in^3
Dominant frequency components	0–188 Hz

Because the actual source originates from 4 airguns rather than a single point source, the highest sound levels measurable at any location in the water is less than the nominal source level. In addition, the

[4] Helene Carton, Ph.D., L-DEO.

effective source level for sound propagating in near-horizontal directions would be substantially lower than the nominal source level applicable to downward propagation because of the directional nature of the sound from the airgun array.

Modeling and Scaling Factors

Propagation measurements were obtained in shallow water for the *Langseth*'s 18-gun, 3300-in^3 (2-string) array towed at 6 m depth, in both crossline (athwartship) and inline (fore and aft) directions. Results were presented in Diebold et al. (2010), and part of their Figures 5 and 8 are reproduced here (Figure A2). The crossline measurements, which were obtained at ranges ~2 km to ~14.5 km, are shown along with the 95th percentile fit (Figure A1, top panel). This allows extrapolation for ranges <2 km and >14.5 km, providing 150 dB SEL, 170 dB SEL and 180 dB SEL distances of 15.28 km, 1097 m, and 294 m, respectively. Note that the short ranges were better sampled in inline direction including by the 6-km long MCS streamer (Figure A2, bottom panel). The measured 170-dB SEL level is at 370-m distance in inline direction, well under the extrapolated value of 1097 m in crossline direction, and the measured 180-dB SEL level is at 140-m distance in inline direction, also less than the extrapolated value of 294 m in crossline direction. Overall, received levels are ~5 dB lower inline than they are crossline, which results from the directivity of the array (the 2-string array being spatially more extended in fore and aft than athwartship directions). Mitigation radii based on the crossline measurements are thus the more conservative ones and are therefore proposed to be used as the basis for the mitigation zone for the proposed activity.

The empirically derived crossline measurements obtained for the 18-gun, 3300-in^3 array in shallow water in the Gulf of Mexico, described above, are used to derive the mitigation radii for the proposed New Jersey margin 3-D survey that would take place in June–August 2015 (Figure A3). The entire survey area would be located in shallow water (<100 m). The source for this survey would be a 4-gun, 700-in^3 subset of 1 string at 4.5- or 6-m tow depth. The differences in array volumes, airgun configuration and tow depth are accounted for by scaling factors calculated based on the deep-water L-DEO model results (shown in Figures A4 to A6).

The scaling procedure uses radii obtained from L-DEO models. Specifically, from L-DEO modeling, 150-, 170-, and 180-dB SEL isopleths for the 18-gun, 3300-in^3 array towed at 6-m depth have radii of 4500, 450, and 142 m, respectively, in deep water (Figure A3). Similarly, the 150-, 170-, and 180-dB SEL isopleths for the 4-gun, 700-in^3 subset of 2 strings array towed at 4.5 m depth have radii of 1544, 155, and 49 m, respectively, in deep water (Figure A4). Taking the ratios between both sets of deep-water radii yields scaling factors of 0.3431–0.3451. These scaling factors are then applied to the empirically derived shallow water radii for the 3300-in^3 array at 6-m tow depth, to derive radii for the suite of proposed airgun subsets. For example, when applying the scaling ratios for the 4-gun, 700-in^3 array at 4.5-m tow depth, the distances obtained are 5.24 km for 150 dB SEL (proxy for SPL 160 dB rms), 378 m for 170 dB SEL (SPL 180 dB rms), and 101 m for 180 dB SEL (SPL 190 dB rms).

The same procedure is applied for the suite of arrays:

(1) 4-gun 700 in^3 array, subset of 1 string at 4.5 m tow depth (Figure A4)

(2) 4-gun 700 in^3 array, subset of 1 string at 6 m tow depth (Figure A5)

(3) Single 40 in^3 mitigation gun at 6 m tow depth (Figure A6)

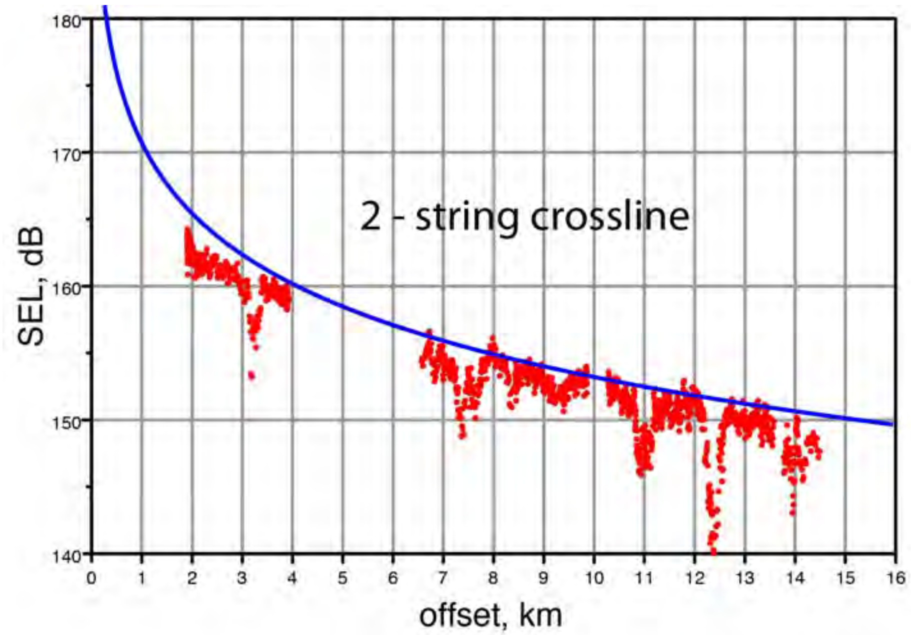


Figure 5a. Sound Exposure Levels for the crossline (side aspect) arrivals recorded along the spiral track at the shallow water calibration site, with a 95th percentile fit (using the methods described by Tolstoy et al., 2009).

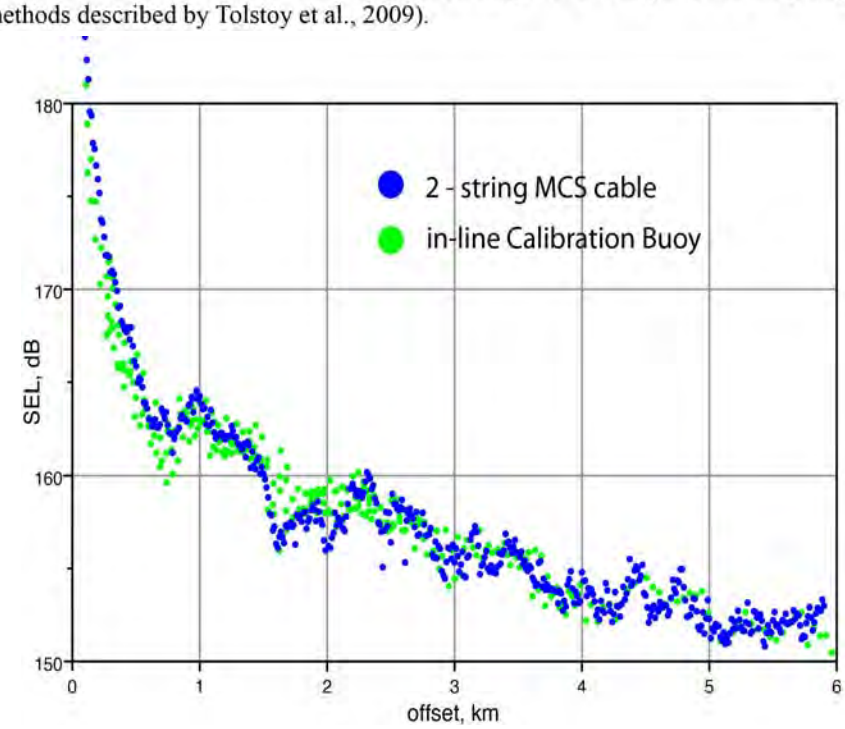
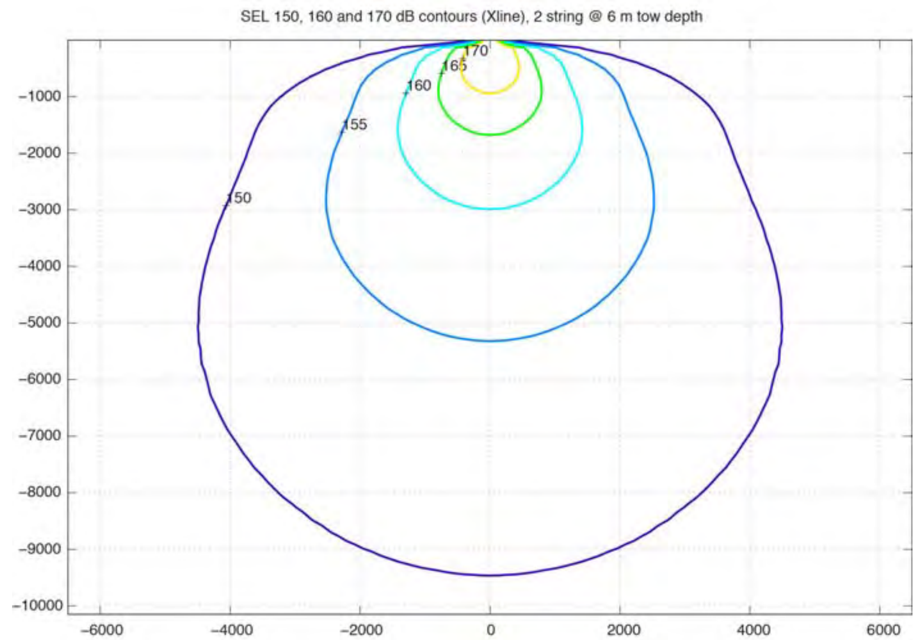


FIGURE A2. R/V *Langseth* Gulf of Mexico calibration results for the 18-gun, 3300-in^3, 2-string array at 6-m depth obtained at the shallow site (Diebold et al. 2010).



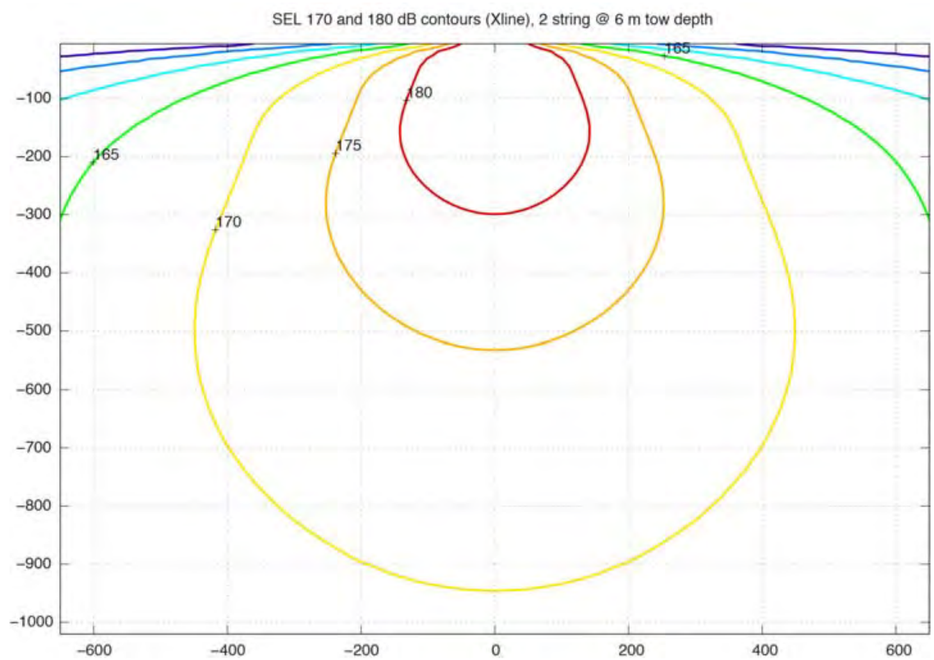


FIGURE A3. Deep-water model results for the 18-gun, 3300-in^3, 2-string array at 6-m tow depth, the configuration that was used to collect calibration measurements presented in Figure 2. The 150-dB SEL, 170-dB SEL, and 180-dB SEL (proxies for SPLs of 160, 180, and 190 dB rms[5]) distances can be read at 4500 m, 450 m, and 142 m.

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[5] Sound sources are primarily described in sound pressure level (SPL) units. SPL is often referred to as rms or "root mean square" pressure, averaged over the pulse duration. Sound exposure level (SEL) is a measure of the received energy in a pulse and represents the SPL that would be measured if the pulse energy were spread evenly across a 1-s period.

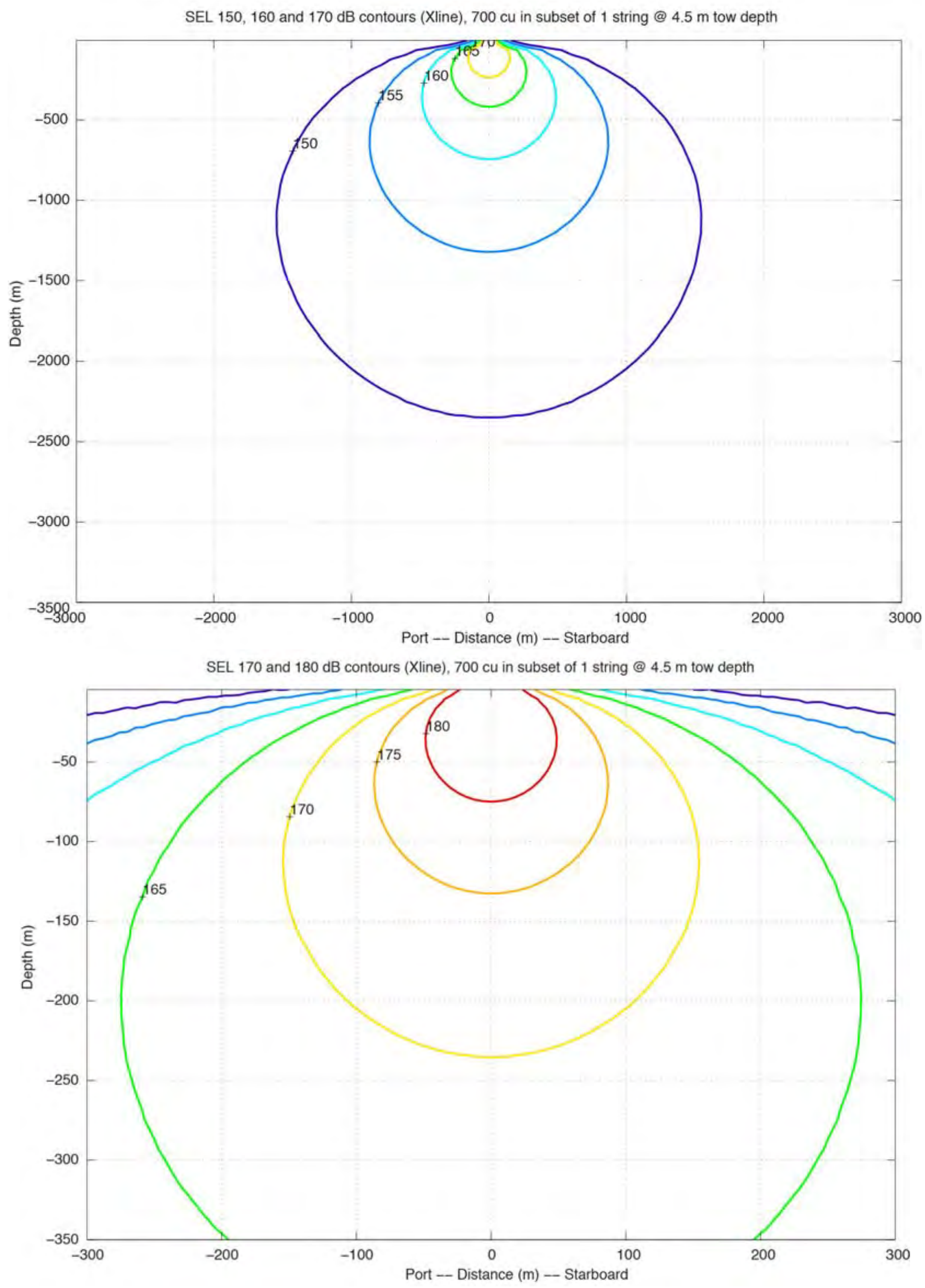

FIGURE A4. Deep-water model results for the 4-gun, 700-in^3 subset of 1-string array at 4.5-m tow depth that could be used for the NJ margin 3D survey. The 150-dB SEL, 170-dB SEL, and 180-dB SEL distances can be read at 1544 m, 155 m, and 49 m, respectively.

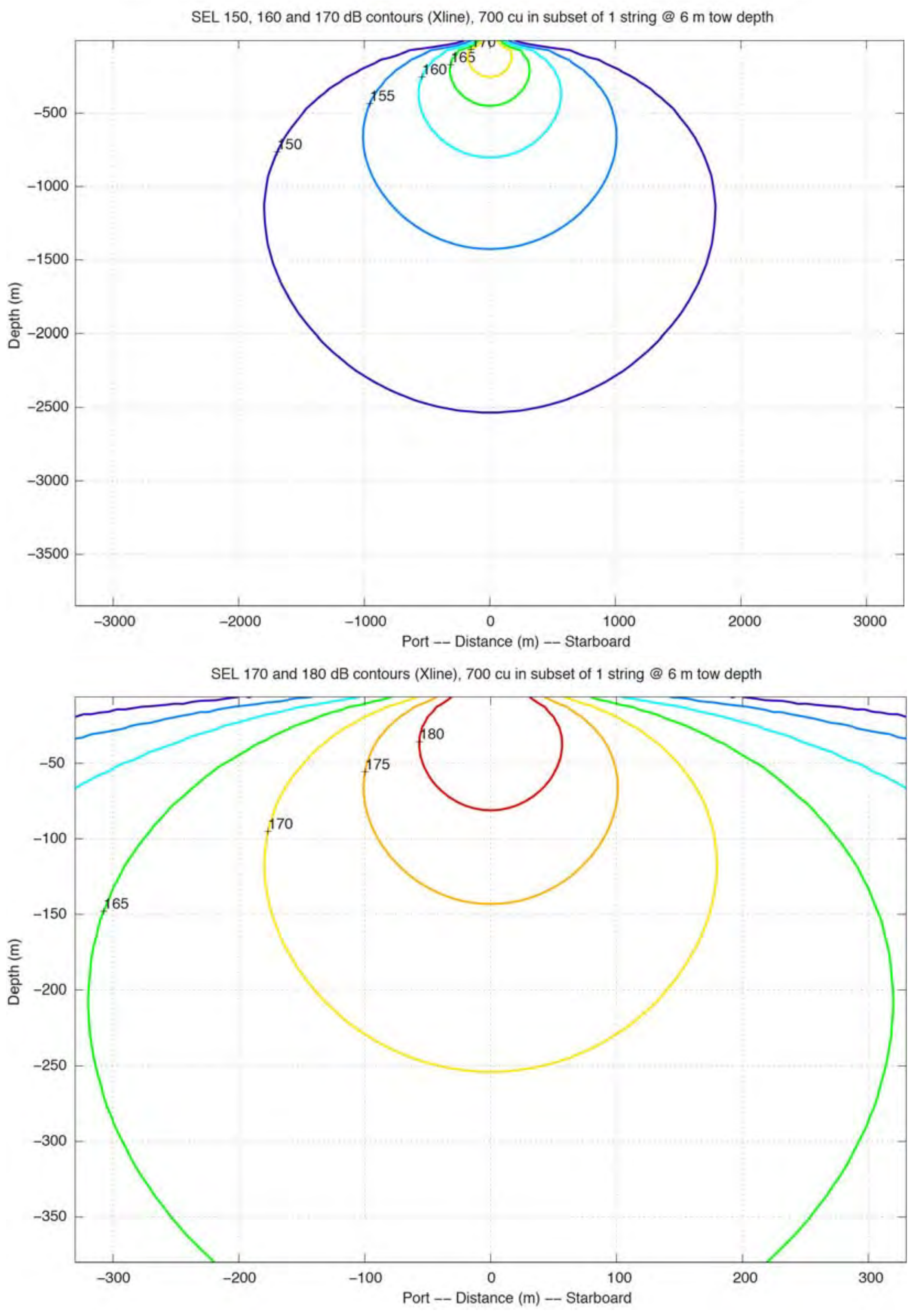

FIGURE A5. Deep-water model results for the 4-gun, 700-in^3 subset of 1-string array at 6m tow depth that could be used for the NJ margin 3-D survey. The 150-dB SEL, 170-dB SEL, and 180-dB SEL distances can be read at 1797 m, 180 m, and 57 m, respectively.

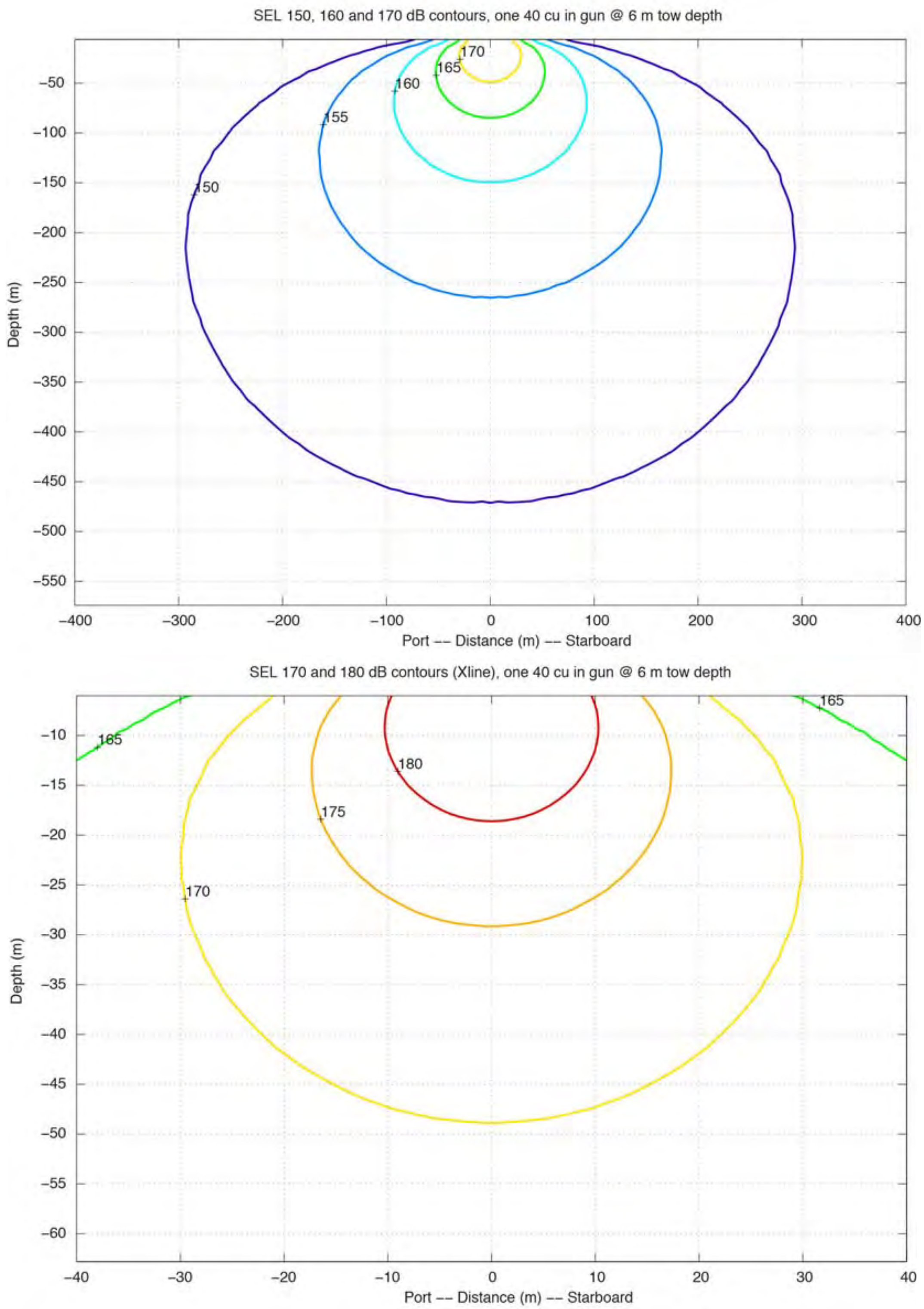

FIGURE A6. Deep-water model results for the single 40-in^3 Bolt airgun at 6-m tow depth. The 150-dB SEL, 170-dB SEL, and 180-dB SEL distances can be read at 293 m, 30 m, and 10 m, respectively.

The derived shallow water radii are presented in Table A1. The final values are reported in Table A2.

TABLE A1. Table summarizing scaling procedure applied to empirically derived shallow-water radii to derive shallow-water radii for various array subsets that could be used during the New Jersey margin 3D survey.

Calibration Study: 18-gun, 3300-in^3 @ 6-m depth	**Deep water radii (m)** (from L-DEO model results)		**Shallow Water Radii (m)** (Based on empirically-derived crossline Measurements)
	150 dB SEL: 4500		15280
	170 dB SEL: 450		1097
	180 dB SEL: 142		294
Proposed Airgun sources	**Deep water radii** (from L-DEO model results)	**Scaling factor** *[Deep-water radii for 18-gun 3300-in^3 array @ 6 m depth]*	**Shallow water radii (m)** *[Scaling factor **x** shallow water radii for 18-gun 3300 in^3 array @ 6 m depth]*
Source #1: 4-gun, 700-in^3 @ 4.5-m depth	150 dB SEL: 1544 m	0.3431	5240
	170 dB SEL: 155 m	0.3444	378
	180 dB SEL: 49 m	0.3451	101
Source #2: 4-gun, 700-in^3 @ 6-m depth	150 dB SEL: 1797 m	0.3993	6100
	170 dB SEL: 180 m	0.4000	439
	180 dB SEL: 57 m	0.4014	118
Source #3: Single 40-in^3 @ 6-m depth	150 dB SEL: 293 m	0.0651	995
	170 dB SEL: 30 m	0.0667	73
	180 dB SEL: 10 m	0.0704	21

TABLE A2. Predicted distances in meters to which sound levels ≥ 180 and 160 dB re 1 μPa$_{rms}$ would be received during the proposed 3-D survey off New Jersey, using a 4-gun, 700-in^3 subset of 1 string at 4.5- or 6-m tow depth and the 40-in^3 airgun during power-downs. Radii are based on Figures A2 to A6 and scaling described in the text and Table A1, assuming that received levels on an rms basis are, numerically, 10 dB higher than the SEL values.

		Predicted RMS Radii (m)	
Source and Volume	Water Depth	180 dB	160 dB
4-airgun subarray (700 in^3) @ 4.5 m	<100 m	378	5240
4-airgun subarray (700 in^3) @ 6 m	<100 m	439	6100
Single Bolt airgun (40 in^3) @ 6 m	<100 m	73	995

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CESAR A. PERALES
SECRETARY OF STATE

February 3, 2015

Holly Smith
National Science Foundation
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Room 725
Arlington, Virginia 22230

Re: F-2015-0082 (DA)
National Science Foundation
Draft Amended Environmental Assessment of a
Marine Geophysical Survey
Received Consistency Determination and Began Review

Dear Ms. Smith:

Thank you for providing the National Science Foundation's (NSF) consistency determination. The Department of State received the consistency determination and supporting documentation regarding the consistency of the above-referenced proposal with the New York State Coastal Management Program on January 16th, 2015. The State's 60-day review period pursuant to 15 CFR 930.41 began on that date.

The above-referenced proposal would occur in Federal waters offshore from New York and includes seismic survey activity. The Department appreciates NSF's determination submission pursuant to 15 CFR 930.33(c) and its recognition of New York's interest in the foreseeable effects of activities occurring offshore on the uses and resources of New York's coastal zone. NSF's coordination efforts prior to submission are also acknowledged.

At this time, the following necessary data and information is needed: please provide the location of the proposed activity in shapefile format, other GIS format may be acceptable in consultation with DOS. This information is necessary for the DOS to adequately assess the effects of the proposal on New York's coastal resources, and to provide comprehensive data and information sufficient to support NSF's consistency statement. Additional necessary information may be requested.

The Department anticipates being able to advise NSF of its concurrence with or objection to the consistency determination on or before March 16th, 2015. If you have any questions or need any assistance regarding this matter, please contact me at (518) 474-6000.

Sincerely,

Jeffrey Zappieri
Supervisor Consistency Review Unit
Office of Planning and Development

JZ/REM

NATIONAL SCIENCE FOUNDATION
4201 WILSON BOULEVARD
ARLINGTON, VIRGINIA 22230

February 19, 2015

Jeffrey Zappieri
Office of Planning and Development
State of New York
Department of State
One Commerce Plaza
99 Washington Avenue
Albany, NY 12231-0001

RE: F-2015-0082 (DA) National Science Foundation Draft Amended Environmental Assessment of a Marine Geophysical Survey Received Consistency Determination and Began Review

Dear Mr. Zappieri:

NSF received via email on February 17, 2015, your letter dated February 3, 2015, which requested additional data as part of the consistency review for the proposed NSF marine geophysical survey off the coast of New Jersey in summer 2015. The data requested was the location of the proposed activity in shapefile format. The New York Department of State (NYDOS) requested the information as necessary for the NYDOS to adequately assess the effects of the proposal on New York's coastal resources, and to provide comprehensive data and information sufficient to support NSF's consistency statement.

The requested shapefiles will be conveyed as electronic attachments to this letter via email. Please contact us if you have any questions about the shapefiles or the Consistency Determination.

Sincerely,

Holly Smith
Environmental Compliance Officer

Attachments: Proposed NJ survey site location shapefiles

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March 13th, 2015

Holly Smith
National Science Foundation
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4201 Wilson Blvd.
Room 725
Arlington, Virginia 22230

Re: F-2015-0082 (DA)
National Science Foundation
Draft Amended Environmental Assessment of a
Marine Geophysical Survey
Request for Extension of Review Period

Dear Ms. Smith:

On January 16th, 2015 the Department of State (DOS) received the National Science Foundation's (NSF) consistency determination, together with supporting documentation, regarding the consistency of the above-referenced activity with the New York State Coastal Management Program. The State's 60-day review period pursuant to 15 CFR 930.41 began on that date.

Pursuant to 15 CFR 930.41(b), the DOS requests a fifteen (15) day extension of time to the DOS review and decision-making period in order to fully consider and review all project materials received with appropriate personnel.

With this 15-day extension, the DOS will notify NSF of its concurrence with or objection to the consistency determination on or before March 31st, 2015. We would appreciate your confirmation of this extension to the review period as soon as possible.

Sincerely,

Jeffrey Zappieri
Supervisor Consistency Review Unit
Office of Planning and Development

NATIONAL SCIENCE FOUNDATION
4201 WILSON BOULEVARD
ARLINGTON, VIRGINIA 22230

March 13, 2015

Jeffrey Zappieri
Office of Planning and Development
New York Department of State
99 Washington Avenue, Suite 1010
Albany, NY 12231-0001

Re: F-2015-0082 (DA) National Science Foundation
Draft Amended Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off New Jersey
Request for Extension of Review Period

Dear Mr. Zappieri:

The National Science Foundation (NSF) is in receipt of a letter dated March 13, 2015, from the New York Department of State (NYDOS) requesting a 15 day extension for the consistency review of the above-referenced activity pursuant to 15 C.F.R. 930.41(b) of the Coastal Zone Management Act. NSF acknowledges that the state wishes the additional 15 days to complete its review of the NSF proposed project that was originally scheduled to be completed during the summer of 2014. Based on your letter, we understand that your office intends to respond to NSF's Consistency Determination by March 31, 2015. NSF welcomes, however, earlier notification so that our offices can maximize the time available within the 90 day notice period to resolve any potential differences. Finally, as NSF has noted since October 2014, we are open to a dialogue about the proposed project with NYDOS and encourage your office to contact us if you have any questions regarding the Consistency Determination.

Thank you for your assistance on this matter and we look forward to receiving NYDOS's response.

Sincerely,

Holly Smith

Holly Smith
Environmental Compliance Officer

cc:
Gregory Capobianco, NYDOS
Michael Snyder, NYDOS
Jeff Herter, NYDOS
Rosa Mendez, NYDOS
Kari Gathen, NYDOS
Sarah Mesrobian, NSF
Kerry Kehoe, National Oceanic Atmospheric Administration Office of Ocean and Coastal Resource Management

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March 31, 2015

Holly Smith
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Arlington, VA 22230

Re: F-2015-0082 (DA)
National Science Foundation - Marine Geophysical Survey in the Atlantic Ocean off the coast of New Jersey and New York
Concurrence with Consistency Determination

Dear Ms. Smith,

On January 16, 2015, the National Science Foundation (NSF) submitted the above referenced direct federal agency activity and consistency determination to the Department of State (DOS) following a consultation on October 30, 2014 (15 CFR §§ 930.33(a), 930.34(a), 930.36(a)).[1] DOS has completed its review of the consistency determination and data and information for the proposed activity (hereinafter also referred to as "the proposal" or "the survey") and pursuant to 15 CFR § 930.41(a) concurs with the consistency determination for the activity under the enforceable coastal policies of the New York State Coastal Management Plan (CMP). DOS has included several recommendations to modify the proposed activity (Section IV) to reduce the likelihood of reasonably foreseeable effects on New York's coastal resources and uses.

I. Statutory Framework for Consistency Review

Pursuant to the 15 CFR part 930 subpart C consistency provisions of the Coastal Zone Management Act (CZMA), federal agency activities within or outside the coastal zone that affect

[1] The proposal is an unlisted activity (15 CFR § 930.34(c)) located in federal waters offshore of New York. NSF determined, following the consultation with DOS, that the proposal would have reasonably foreseeable effects on New York's coastal uses and resources. "Federal agency activities and development projects outside of the coastal zone, are subject to Federal agency review to determine whether they affect any coastal use or resource." (15 CFR § 930.33(c)).

the coastal uses or resources of New York State shall be undertaken in a manner consistent to the maximum extent practicable with the enforceable policies of the New York State CMP.[2] Federal agency activities include any federal agency activity or actions performed by or on behalf of a federal agency in exercise of its statutory responsibilities.[3] Under the regulatory framework of 15 CFR Part 930 subpart C, New York State has 60 days to concur with, conditionally concur with,[4] or object to the consistency determination submitted by a federal agency.[5] DOS requested, and NSF granted, a 15 day extension pursuant to 15 CFR § 930.35(c) and the decision is due on or before March 31, 2015.

II. Subject of the Review

The proposed activity would use a 3-D seismic reflection survey to map sequences to supplement previous sediment core drill sites and analyze the seafloor spatial/temporal evolution for the purposes of: establishing changes on the stratigraphic record; providing greater understanding of the response of nearshore environments to changes in elevation of global sea level; and determining the amplitudes and timing of global sea-level changes during the mid-Cenozoic era.[6]

The survey is proposed to occur in federal waters approximately 50-72 nautical miles outside of New York State waters, for 30 days between June and August 2015 on the NSF-owned R/V *Marcus G. Langseth* (operated by Columbia University's Lamont-Doherty Earth Observatory and hereinafter "R/V *Langseth*"). The proposed activity includes deploying two pairs of subarrays with a total of four airguns to fire alternately with a total volume of 700 in^3 and sound pressure level between 160 and 180-dB re 1 µParms. The proposed receiving system consists of four 3000-m hydrophone streamers at 75-m spacing, or, a combination of two 3000-m hydrophone streamers and a Geometrics P-Cable system. The airgun array will be towed along a total of 4900 km of 3-D survey lines, including turns, to be conducted in an area of 12 x 50 km with a line spacing of 150 m in two 6-m wide trace-track patterns. Additionally, a multibeam echosounder and a sub-bottom profiler will be operated continuously but not during transit. Monitoring and mitigation measures are proposed including use of protected species visual observers, passive acoustic monitoring, exclusion zones for each airgun source and tow depths, speed or course alterations, power or shut downs, and ramp-up procedures. These measures are designed to address impacts to federally-listed species.

NSF submitted a Draft Amended Environmental Assessment (draft EA or EA), prepared for NSF and dated December 18, 2014, along with its consistency determination. DOS relied on the information submitted in the consistency determination and EA during its review of the proposal. DOS also relied on information included in the Programmatic Environmental Impact Statement (PEIS) prepared for NSF in June 2011 and submitted with this consistency

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[2] 15 CFR § 930.32(a)(1).
[3] 15 C.F.R. §§ 930.31(c); 930.33(a); and 930.36(a).
[4] 15 C.F.R. § 930.4.
[5] 15 C.F.R. § 930.41(a).
[6] See Letter to Mr. Jeffrey Zappieri from Holly Smith, National Science Foundation, January 16, 2015.

determination. The EA tiers to the PEIS and was prepared to update information and reference the PEIS. The PEIS was prepared for all NSF-funded marine seismic research and is divided by detailed analysis areas (DAAs). The Northwest Atlantic DAA is the subject of the proposed seismic survey.

Additionally, the proposed location of the seismic survey is within the offshore planning area (OPA) identified in the DOS Offshore Atlantic Ocean Study (hereinafter "the study"), released by DOS in July 2013 (Figure 1).[7] The purpose of the study was to identify connections between offshore areas and New York's coastal uses and resources. The study identified and mapped commercial and recreational fishing, wildlife viewing, diving, and other uses occurring throughout the 43,470 km^2 area of the OPA. Also, the study identified and mapped marine mammals, sea turtles, sea birds, finfish, crustaceans and other wildlife important to recreation and commercial interests of New York occurring throughout the OPA. The proposed location of the survey will occupy 970 km^2 (including buffer zone) of the OPA. DOS therefore relied in part on available data from the study, as well as supplemental information on the seasonality and locations of uses and fish stocks within the survey area obtained through recent correspondence with representatives of the commercial fishing industry.

III. **Analysis**

A. **Reasonably Foreseeable Effects**

To determine whether a federal activity will affect the coastal uses or resources of New York State the reasonably foreseeable effects on any coastal use or resource of the State are assessed.[8] Federal regulations define coastal effects to include both reasonably foreseeable direct effects which result from the activity and occur at the same time and place as the activity, and reasonably foreseeable indirect (cumulative and secondary) effects which result from the activity and are later in time or farther removed in distance, but are still reasonably foreseeable.[9] In its 2000 Final Rule amending the federal consistency regulations the National Oceanic and Atmospheric Administration (NOAA) did not define "reasonably foreseeable" but explained that Congressional intent was for coastal effects to be construed broadly and that the reasonably foreseeable effects test is a fact-specific inquiry. NOAA further clarified that "the effect on a

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[7] See New York Department of State Offshore Atlantic Ocean Study, July 2013 (Offshore Atlantic Study) available at http://docs.dos.ny.gov/communitieswaterfronts/ocean_docs/NYSDOS_Offshore_Atlantic_Ocean_Study.pdf. The seismic survey is an unlisted activity (15 CFR § 930.34(c) and NSF submitted this federal agency activity to DOS for federal consistency review following a consultation process. (15 CFR §§ 930.33(a); 930.34(a)). DOS is not representing the Offshore Atlantic Study area as comprising the boundaries of a geographic location description, as offshore seismic surveys are not a listed activity in the NYS CMP. (15 CFR § 930.34(b), "In the event the State agency chooses to describe Federal agency activities that occur outside of the coastal zone, which the State agency believes will have reasonably foreseeable coastal effects, it shall also describe the geographic location of such activities…"). Instead, references to the Offshore Atlantic Study in this decision is a planning area for the purposes of identifying data sets of coastal resources and uses important to New York's coastal zone.

[8] 15 C.F.R. § 930.33(a)(1).

[9] 15 C.F.R. § 930.11(g).

resource or use while that resource or use is outside of the coastal zone could result in effects felt within the coastal zone".[10]

DOS has determined that the seismic survey as proposed, to be conducted on behalf of NSF in collaboration with Rutgers University, will have reasonably foreseeable direct and indirect effects on the coastal uses and resources of New York. The reasonably foreseeable effects analysis is presented in two sections: a description of New York's affected coastal resources and uses and an analysis of the specific enforceable coastal policies.

The described reasonably foreseeable effects of the proposed activity are of concern to DOS given their potential implications for the State's commercial fishing industry. However, the available information to evaluate the effects on New York's coastal uses and resources in the context of the enforceable policies of the New York CMP does not warrant an objection to NSF's consistency determination. DOS is making recommendations to NSF to reduce the likelihood of known reasonably foreseeable effects.

B. **Coastal Uses and Resources**

Due to the location of the proposed activity within areas of known commercial fishing use and commercial fish stocks, there are reasonably foreseeable direct and indirect effects on New York's coastal zone. The survey location overlaps with areas of New York commercial fishing uses which include the following gear types: pots, dredge, and bottom trawl. Distribution of the various New York commercial fishing uses in relation to the proposed location of the seismic survey are depicted in Figure 2 of the appendix. The distributions of important commercial species also overlap with the proposed seismic survey location. Representative examples are depicted in relation to the seismic survey in Figures 3 and 4 of the appendix.

C. **Coastal Policies**

Policy 10: Further develop commercial finfish, shellfish, and crustacean resources in the coastal area by encouraging the construction of new, or improvement of existing on-shore commercial fishing facilities, increasing marketing of the state's seafood products, maintaining adequate stocks, and expanding aquaculture facilities.

The proposed seismic survey will have reasonably foreseeable direct and indirect effects on New York's commercial fishing uses and resources, respectively, as described below. The available information to evaluate these effects in the context of policy 10 does not warrant an objection to NSF's consistency determination.

<u>Commercial Fishing Activity</u>

Reasonably foreseeable direct effects of the proposed activity include displacement of commercial fishers from traditional fishing areas in the proposed survey location due to the R/V *Langseth's* equipment. As depicted in Figure 2, New York's commercial fishers are active in the proposed area. Entanglement of equipment is foreseeable, particularly for mobile fishing gear such as dredge and trawl, as is displacement of the fishing community given the overlap of the

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[10] 65 Fed. Reg 77130 (Dec. 8, 2000)

commercial fishing uses and the towed seismic equipment. The seismic survey equipment includes an airgun array that is towed behind the vessel along with a receiving system that consists of hydrophone streamers and various cables, lines, and other objects associated with the airgun array. The towed hydrophone streamers are approximately 3 km long (almost 2 mi).

While DOS has information demonstrating the presence of commercial fishing activity in this area and a reasonably foreseeable effect on this activity, available information to evaluate these effects in the context of policy 10 does not warrant an objection to NSF's consistency determination. To reduce the likelihood of the reasonably foreseeable direct effects of entanglement and use displacement and minimize the disruption to New York's commercial fishery, DOS instead recommends that NSF adjust their activities, as further outlined in Section IV below.

Commercial Fish Stocks Important to NY Fishers

Reasonably foreseeable indirect effects include temporary impacts on biological resources (fish stocks) important to New York's commercial fishing industry. Many fish stocks of high economic value to New York can be found in the vicinity of the proposed activity during summer months. Stocks such as longfin squid (*Loligo pealeii*), summer flounder or "fluke" (*Paralichthys dentatus*), scup (*Stenotomus chrysops*), and silver hake or "whiting" (*Merluccius bilinearis*) move from inshore waters in the warm months to offshore waters in the cooler winter months.[11] This movement places them directly in or in the near vicinity of the survey at the time of the proposed activity (see Figures 3 and 4). These species ranked second, sixth, seventh, and tenth, respectively, in terms of the economic value of their landings for New York in 2013.[12] Fish migration and movement occur in this location for other important commercial fish stocks, including Atlantic mackerel (*Scomber scombrus*), butterfish (*Peprilus triacanthus*), monkfish or "goosefish" (*Lophius americanus*), weakfish (*Cynoscion regalis*), winter flounder (*Pseudopleuronectes americanus*), and yellowtail flounder (*Limanda ferruginea*). DOS has been made aware of the concerns for these other stocks by members of New York's commercial fishing industry. Due to the cumulative economic value of these fisheries, adverse effects to these populations would be expected to result in a reasonably foreseeable effect on New York's commercial fishing industry.

The known or suspected impacts of the proposed activity on these species are attributable to the noise originating with the seismic component of the survey. The PEIS indicates that cephalopods such as squid are known to sense low frequency sound and that airgun sounds overlap the known sound detection range of some marine invertebrates.[13] Also, Fewtrell and McCauley observed altered behavior in squid in response to air gun sounds.[14] Behavioral

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[11] Cornell Cooperative Extension. 2012. New York Commercial Fisherman Ocean Use Mapping. Prepared for the New York State Department of State.
http://docs.dos.ny.gov/communitieswaterfronts/ocean_docs/Cornell_Report_NYS_Commercial_Fishing.pdf

[12] National Ocean Economics Program. "Top Ten Commercial Fish Species Search". http://oceaneconomics.org/LMR/topTen.asp Data from National Marine Fisheries Service.

[13] PEIS pp. 3-7 - 3-9.

[14] See Fewtrell, J.L. & McCauley, R.D. (2012), Impact of air gun noise on the behavior of marine fish and squid. Marine Pollution Bulletin, 64, 984-993.

changes include avoidance of the area of seismic sound and will temporarily displace this important species from a traditional fishing ground for longfin squid. Further, the draft EA referenced a study in which cephalopods received damage to the statocyst, the organ responsible for equilibrium and movement, showed stressed behavior, decreased activity, and loss of muscle tone.[15]

Seismic sounds also may have pathological and behavioral effects on schooling, pelagic target species of New York's commercial fishers such as scup, Atlantic mackerel and butterfish. The PEIS indicates the possibility of injury or mortality to fish close to airguns, more probable for fish with swim bladders such as butterfish.[16] Mortality can occur from swim bladders expanding and contracting with ambient pressure changes caused by seismic sound. Behavioral effects include avoidance and changes in schooling patterns. Fewtrell and McCauley observed the behavior of two species of schooling, pelagic fish, pinksnapper (*Pagrus auratus*) and trevally (*Pseudocaranx dentex*), in response to airgun sound. Their observations included alarm behaviors and changes in schooling patterns of the fish.[17] Of significance for migrating species, a study of pelagic fish found that abundance in areas further away from the airgun sounds increased and suggested that migrating fish would not enter the area of seismic activity.[18] Also, studies of the effect of seismic sound on fish catch found decreases in catch rate of fishes.[19]

While these reasonably foreseeable indirect effects on fish stocks important to New York's commercial fishery are of concern to DOS, available information to evaluate these effects in the context of policy 10 does not warrant an objection to NSF's consistency determination. Therefore, to reduce the likelihood of the reasonably foreseeable indirect effects of physiological and behavioral impacts on these fish stocks, DOS instead recommends that NSF adjust their activities, as further outlined in Section IV below.

IV. Recommendations for Modification of the Proposed Activity

As discussed, DOS possesses sufficient data to demonstrate reasonably foreseeable effects on New York's coastal uses and resources. However, the available information to evaluate these effects in the context of the New York CMP does not warrant an objection to NSF's consistency determination. DOS therefore instead makes the below recommendations to reduce the likelihood of the reasonably foreseeable effects. DOS's concurrence with NSF's consistency determination is not a conditional concurrence on NSF adhering to these recommendations.

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[15] Draft Amended Environmental Assessment at p.50.
[16] PEIS at p. 3-45.
[17] Fewtrell, J.L. & McCauley, R.D. (2012), Impact of air gun noise on the behavior of marine fish and squid. Marine Pollution Bulletin, 64, 984-993.
[18] Løkkeborg, S.; Ona, E.; Vold, A.; & Salthaug, A., 2012. Sounds from seismic air guns: gear and species specific effects on catch rates and fish distribution, Canadian Journal of Fisheries and Aquatic Sciences, 69, 1278-1291.
[19] Popper, A.N. & Hastings, M.C., 2009. The effects of anthropogenic sources of sound on fishes. Journal of Fish Biology 75, 455-489.

1. With respect to the proposed activity's location, the potential for overlap and entanglement of survey and fishing gear creates reasonably foreseeable effects on New York's commercial fishing activity. DOS recommends that the location of the seismic survey, including the deployment of all gear associated with the R/V *Langseth* and the conducting of noise associated with the survey methodology, avoid, to the maximum extent practicable, overlap with New York's commercial fishing use when fishers are in those areas. Consultation with the New York fishing industry in advance of the survey work would provide the necessary information to identify when and where commercial fishers will be in the area so that the proposed activity may avoid entangling fishing gear or displacing fishing activity. This would help address the above identified reasonably foreseeable effect on New York's coastal uses.

2. With respect to the proposed activity's timing and the scale of operations, the coincidence of the proposed activity and fish stocks commercially important to New York creates reasonably foreseeable effects based on the available scientific knowledge. DOS recognizes that NSF will limit the scale of the seismic survey. While the R/V *Langseth* is capable of deploying up to 36 airguns on 4 subarrays with a total discharge volume of 6,600 in^3, the proposed project would operate at less than an 1/8 of the R/V *Langseth's* capacity and deploy only two pairs of subarrays for a total of 4 airguns to fire alternately with a total volume of 700 in^3.[20] Additionally, proposed mitigation measures to address marine mammal and sea turtle impacts may reduce the described effects on fish resources. However, no mitigation is proposed to specifically address the presence of species important to New York commercial fishing activities within the area of the seismic survey. Notwithstanding the project scale and the mitigation that will occur, due to the location and proposed timing of the activity there are reasonably foreseeable effects commercial fish stocks important to New York. These stocks occur frequently and in high density in the proposed location of the seismic survey each year during the time of the proposed activity. Commercially important target species are less concentrated in the proposed location during the fall months (October and later). Therefore, DOS recommends that the proposed activity be confined to operation during the fall months to reduce the likelihood of reasonably foreseeable effects on fish stocks commercially important to New York.

V. **Conclusion**

Pursuant to 15 CFR §§ 930.4(a)(1), DOS concurs with NSF's consistency determination for the proposed 3-D seismic survey. DOS appreciates the opportunity to engage in the consultation process and requests NSF comply with the recommended modifications for this proposed activity in Section IV.

Please contact Jeffrey Zappieri at (518) 473-6000 with questions and arrangements for further consultation as needed.

Sincerely,

Gregory Capobianco
Office of Planning and Development
New York State Department of State

cc: Steve Heins, New York State Department of Environmental Conservation
Kerry Kehoe, National Oceanic and Atmospheric Administration
John Scotti, Cornell Cooperative Extension

Appendix

Figure 1: Location of proposed activity within New York's Offshore Planning Area

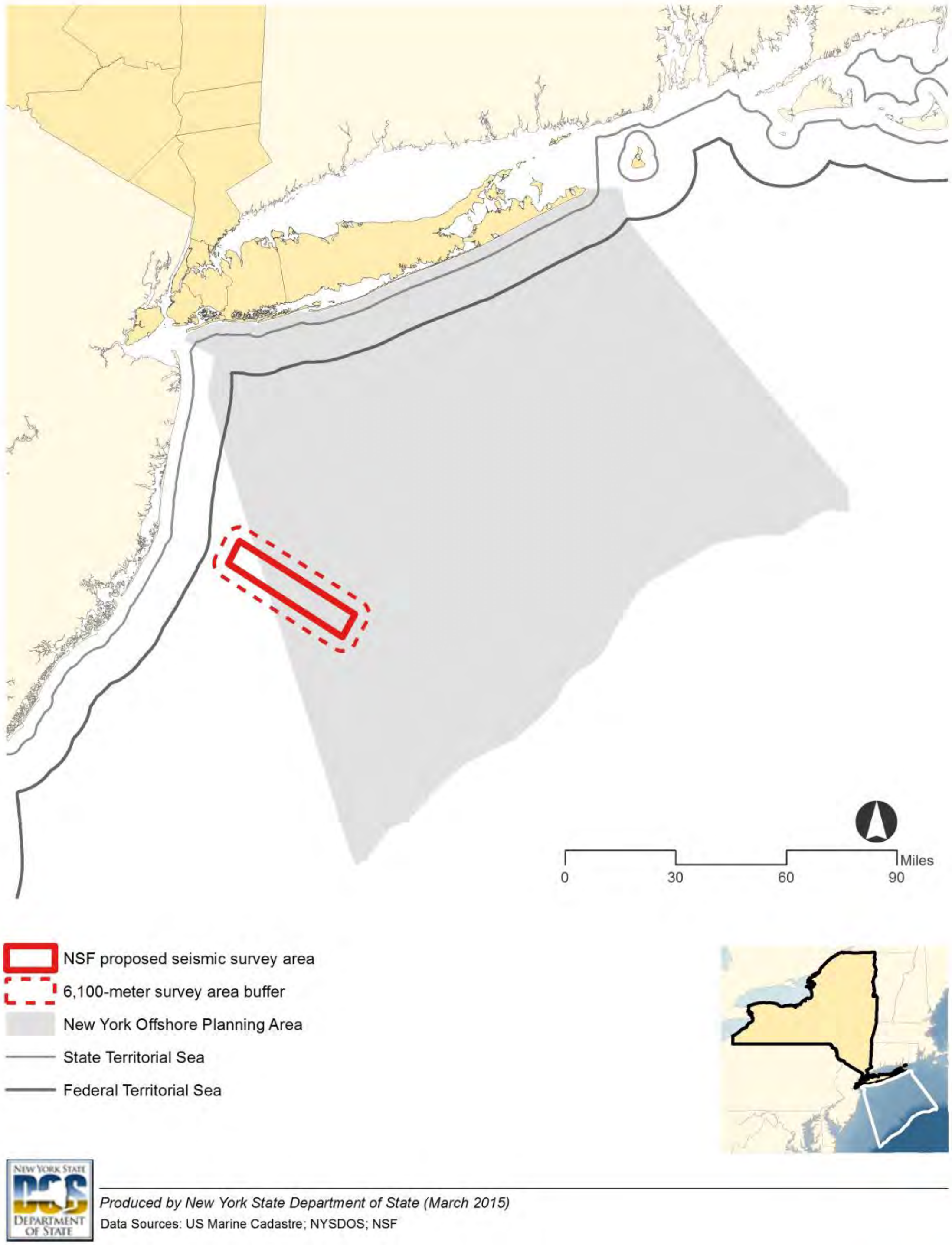

Figure 2: Overlap of proposed activity and known locations of traditional commercial fishing areas.

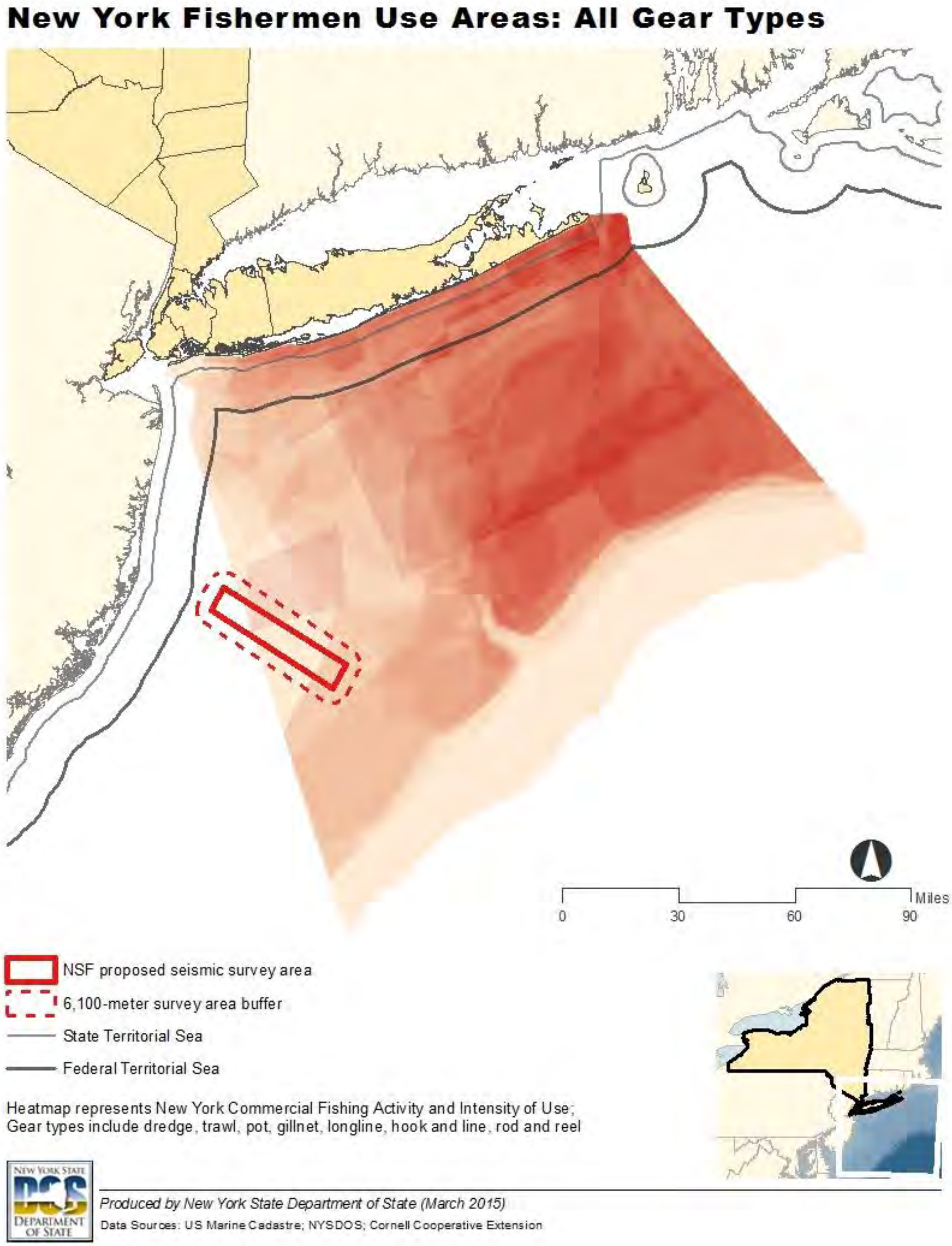

Figure 3: Longfin squid abundance

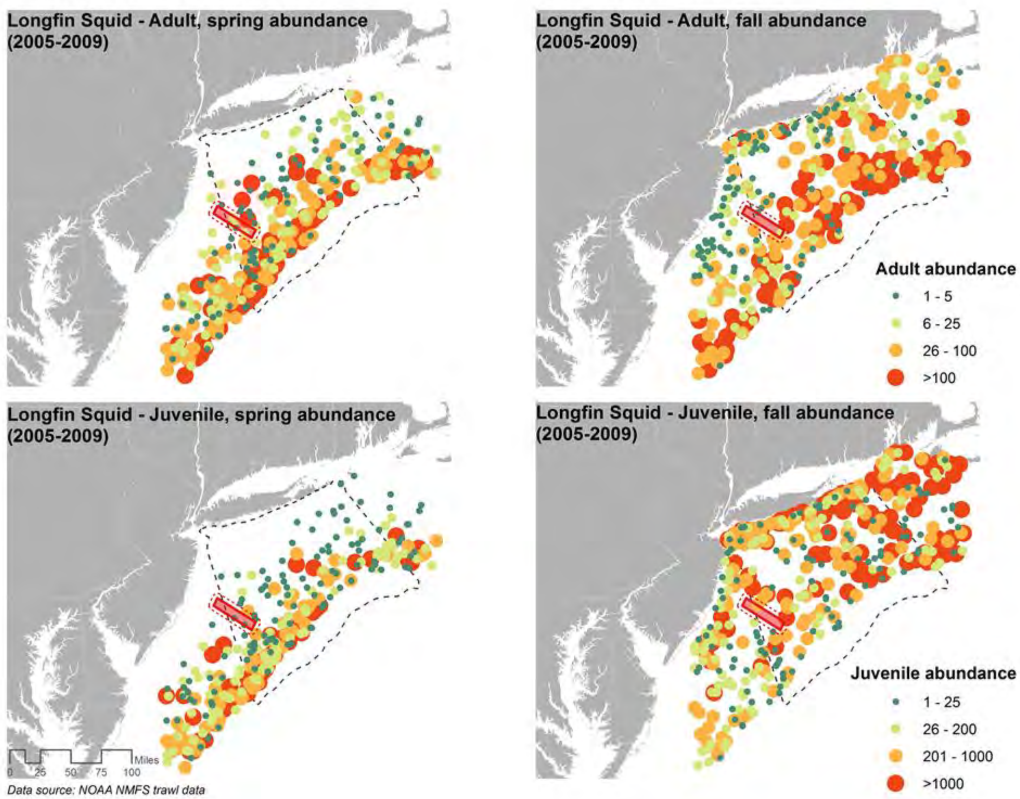

Figure 4: Scup abundance.