Final Environmental Assessment for Seismic Reflection Scientific Research Surveys During 2014 and 2015 in Support of Mapping the US Atlantic Seaboard Extended Continental Margin and Investigating Tsunami Hazards

Prepared for

United States Geological Survey

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ACRONYMS AND ABBREVIATIONS

μPa	microPascal
BOEM	Bureau of Ocean Energy Management
2D	Two Dimensional
CR	Critically Endangered
dB	decibel re: 1 μPascal m
DOC	Department of Commerce
EA	Environmental Assessment
ECS	Extended Continental Shelf
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EN	Endangered
ENAM	Eastern North American Margins
ESA	Endangered Species Act
EZ	Exclusion Zone
FLS	Fisheries Log Book System
FMZ	Full Mitigation Zone
HMS	Highly Migratory Species
Hz	Hertz
IHA	Incidental Harassment Authorization
in^3	cubic inches
ICCAT	International Commission for the Conservation of Atlantic Tuna
IVQ	individual vessel quota
kHz	kiloHertz
km	kilometer
kW	kilowatt
LC	Least Concern
LME	Large Marine Ecosystem
L-DEO	Lamont-Doherty Earth Observatory
LNG	Liquefied Natural Gas
m	meter
MAB	mid-Atlantic Bight
MAR	mid-Atlantic Region
MARAD	Maritime Administration
MARPOL	Marine Pollution
MBES	MultiBeam EchoSounder
MCS	Marine Conservation Society
MMS	Mineral Management Service
MPA	Marine Protected Area
MMPA	Marine Mammal Protection Act
ms	millisecond
mt	metric ton
MSDS	Material Safety Data Sheets
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
NL	Not Listed
nm	nautical mile
NMFS	National Marine Fisheries Service
NMO	Normal-Moveout

NOAA	National Oceanographic and Atmospheric Administration
NSF	National Science Foundation
OBIS	Ocean Biogeographic Information System
OCS	Outer Continental Shelf
OEIS	Overseas Environmental Impact Statement
OPR	Office of Protected Resources
PAM	Passive Acoustic Monitoring
PEIS	Programmatic Environmental Impact Statement
PLL	Pelagic Long Lines
PSO	Protected Species Observer
PSVO	Protected Species Visual Observer
PTS	Permanent Threshold Shift
rms	Root Mean Square
s	second
SAB	South Atlantic Bight
SAFE	Stock Assessment and Fishery Evaluation
SBP	Sub-Bottom Profiler
SCRS	Standing Committee for Research and Science
SEFSC	Southeast Fishery Science Center
SEL	Sound Exposure Level
SEL_{cum}	cumulative Sound Exposure Level
SOPEP	Shipboard Oil Pollution Emergency Plan
SPL	Sound Pressure Level
TAC	Total Allowable Catch
TR	Threatened
TTS	Temporary Threshold Shift
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
UO	Unexploded Ordnance

EXECUTIVE SUMMARY

The United States Geological Survey (USGS) proposes to conduct regional marine two-dimensional (2D) seismic reflection scientific research surveys in the Atlantic over the next two years (2014-2015). The purposes of the project are two-fold: 1) To establish the outer limits of the U.S. continental shelf, also referred to as the Extended Continental Shelf (ECS), as defined by Article 76 of the Convention of the Law of the Sea, and 2) To study the sudden mass transport of sediments down the continental shelf as submarine landslides that pose potential tsunamigenic hazards to Atlantic and Caribbean coastal communities. The activities are proposed to be conducted on the National Science Foundation (NSF) owned research vessel, *R/V* Marcus G. *Langseth*, which is operated through a cooperative agreement with Columbia University's Lamont-Doherty Earth Observatory (L-DEO).

The 2D seismic surveys are proposed to occur in two phases over a one year period between August, 2014 and August, 2015. The 2014 survey is proposed to commence in mid-August and proceed for approximately 18 days (including transits and equipment mobilization and demobilization). The 2015 survey is proposed to occur for approximately 21 days between April and August, 2015. This Final Environmental Assessment (EA) was prepared to fulfill USGS and NSF responsibilities under the National Environmental Policy Act and Executive Order 12114. NSF is participating as a cooperating agency with USGS on this Final EA.

Scoping for the Final EA was derived from the Final 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 (June 2011), NSF Record of Decision (June 2012), and the USGS Record of Decision (Feb 2013) (referred to herein as NSF/USGS PEIS).

Impact definitions used in the Final EA were based on magnitude, geographic extent, and duration. Impact zones, particularly for marine mammals, are defined as the areas within which specific sound level thresholds established by National Oceanic and Atmospheric Administration (NOAA)'s National Marine Fisheries Service (NMFS) / National Oceanic and Atmospheric Administration (NOAA) are exceeded. For cetaceans, NMFS guidelines used to assess potential hearing impairment effects are:

- received sound pressure level (SPL) ≥ 180 dB re 1 μPa^2 for Permanent Threshold Shift (PTS) in hearing (MMPA Level A harassment); and
- received sound pressure level (RMS) >160 dB re 1 µPa for behavior disturbance (MMPA Level B harassment)

Acoustic modeling results provided by the vessel operator Lamont-Doherty Earth Observatory (Appendix A) were used to determine 160 dB and 180 dB isopleth radii.

USGS and NSF are committed to the mitigation measures and monitoring as outlined in the NSF/USGS PEIS, which included both pre-cruise planning and operational activities.

The application of mitigation measures would minimize the possibility of potential adverse effects on the environment including marine species, populations, and habitat.

Other potential activities external to the proposed activity that could occur within or near the survey area include fishing, scientific research surveys, military, submarine cables, marine transportation, and potentially other seismic surveys. Cumulative environmental effects resulting from the proposed action or the proposed action in combination with these other activities would be negligible and not additive because the proposed action would be transitory, moving about 200 km a day. With the implementation of mitigation measures and the limited spatial overlap with other activities, any potential for cumulative effects would be minimized.

USGS and Lamont-Doherty Earth Observatory submitted an Incidental Harassment Authorization (IHA) request to NMFS pursuant to the Marine Mammal Protection Act (MMPA). USGS and National Science Foundation (NSF) requested formal consultation under Section 7 of the Endangered Species Act (ESA) with NOAA and the US Fish and Wildlife Service (USFWS). The IHA application is included in this Final EA as an Appendix B. Consultation for Essential Fish Habitat was also conducted.

1 INTRODUCTION

The US Geological Survey (USGS) proposes to conduct a regional marine two-dimensional (2D) seismic reflection survey program in two separate field seasons in 2014 and 2015. The surveys would be conducted with the *R/V Marcus G. Langseth* (hereafter referred to as the *Langseth*), a research vessel owned by the National Science Foundation (NSF) and operated under Cooperative Agreement by the Lamont-Doherty Earth Observatory (LDEO) of Columbia University. The survey region (hereafter "Study Area") would be in the northwest Atlantic Ocean within the U.S. Exclusive Economic Zone (EEZ) and extending into international waters as far as 350 nautical miles (nm) from the coast (Figure 1). Water depth in the Study Area would range from 1,450 m to 5,400 m. The survey program is proposed to occur in two phases, the first proposed for August to September 2014 and the second in 2015, between April and August (dates are yet to be determined). As the funding agency, the USGS has taken the lead in the environmental compliance requirements and science planning.

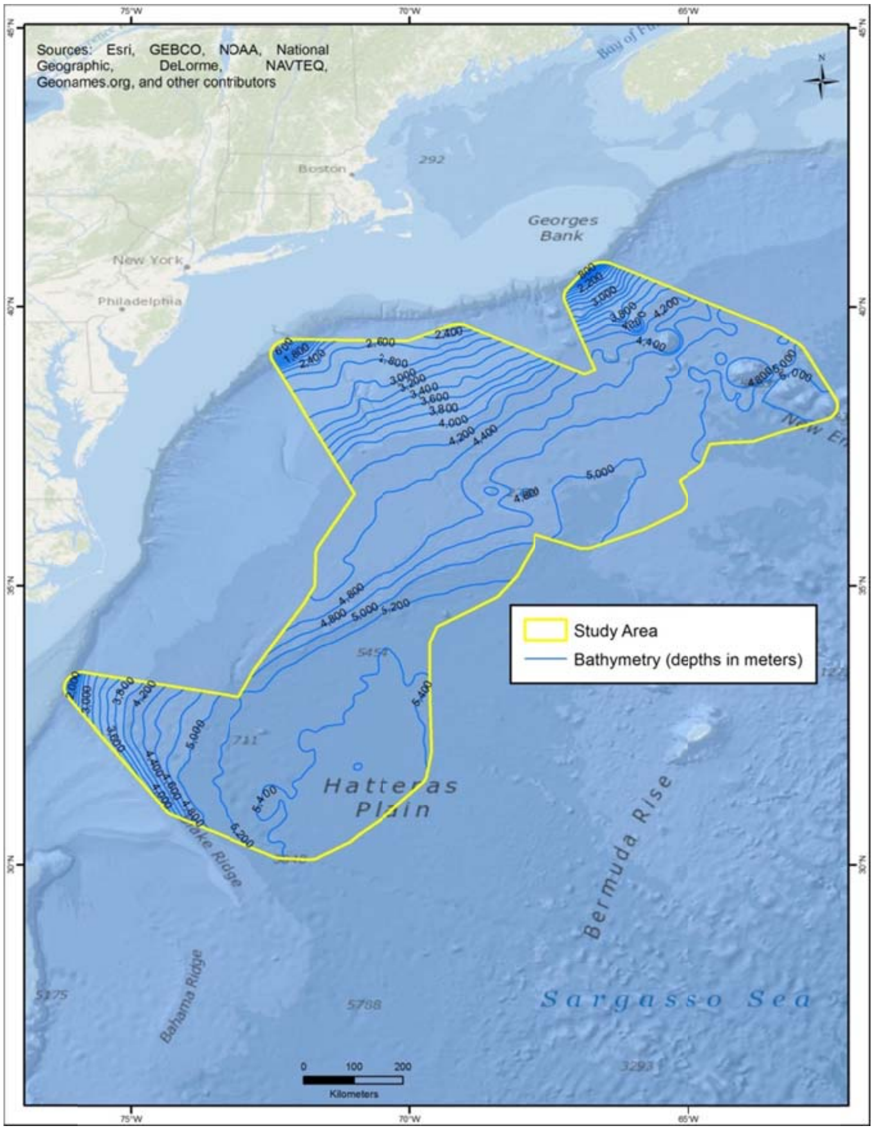

Figure 1: Study Area with Bathymetry

The purpose of this Final Environmental Assessment (EA) is to provide the information needed to assess the potential environmental impacts associated with the proposed seismic surveys.

The Final EA addresses the requirements of the U.S. National Environmental Policy Act (NEPA) and Executive Order 12114, Environmental Effects Abroad of Major Federal Actions. Alternatives addressed in this Draft EA consist of a corresponding program at a different time, along with issuance of an associated Incidental Harassment Authorization (IHA); and the no action alternative, with no IHA and no seismic survey. This Final EA tiers to the Final 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 (June 2011), the USGS Record of Decision (February 2013) and the NSF Record of Decision (June 2012)[1], referred to herein as NSF/USGS PEIS. Additionally, information from the Draft Environmental Assessment of a Marine Geophysical Survey by the *R/V Marcus G. Langseth* in the Atlantic Ocean off Cape Hatteras, September-October, 2014 (NSF, 2014, referred to herein as NSF ENAM Draft EA) prepared for the NSF proposed U.S. GeoPRISMS Eastern North American Margin (ENAM) seismic survey discusses scientific publications subsequent to the issuance of the NSF/USGS PEIS that are relevant to the proposed actions and therefore are incorporated by reference into this Final EA where appropriate.

The USGS and LDEO requested an IHA from the U.S. National Marine Fisheries Service (NMFS). USGS and NSF also requested Section 7 consultations with NMFS and U.S. Fish and Wildlife Service (USFWS) under the Endangered Species Act (ESA) to authorize the incidental, i.e., not intentional, harassment of small numbers of marine mammals that could occur during the seismic survey. The information in this Final EA supported the IHA application process and provided additional information on marine species that were not addressed by the IHA application, including marine and migratory birds, sea turtles, invertebrates, fish; and socio-economic components. The IHA request is included in this document as Appendix B.

The *Langseth* has conducted research seismic surveys world-wide since 2008. Information from previous EAs and IHAs may be found at:

http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications
http://www.nsf.gov/geo/oce/envcomp/index.jsp

Many of these reports and applications were prepared by LGL Limited, Environmental Research Associates, under contract to L-DEO or the USGS. Because material from earlier documents is owned by the U.S. Government and in the public domain, some material common to these documents may have been used verbatim herein without attribution. The USGS and NSF acknowledge the role of LGL in preparing material that has been used.

[1] http://woodshole.er.usgs.gov/project-pages/environmental_compliance/ and http://www.nsf.gov/geo/oce/envcomp/index.jsp

1.1 PURPOSE AND NEED FOR THE PROJECT

The purposes of the project are two-fold:

1) To establish the outer limits of the U.S. continental shelf, also referred to as the Extended Continental Shelf (ECS), as defined by Article 76 of the Convention of the Law of the Sea[2].

The purpose of the proposed study is to define the seafloor and sub-seafloor that is part of the United States of America's Continental Shelf. Only after the ECS is delineated can it be designated for conservation, for management, for resource exploitation, or for other purpose. The proposed seismic survey is independent of oil and gas exploration, which is regulated by BOEM. The proposed project is part of an interagency task force that has been in existence since 2007 to identify all the parts of the U.S. margins beyond 200 nm where the U.S. can potentially exert its sovereign rights, including, but not limited to conservation, management, or exploitation. Unless the ECS is delineated as part of the United States, it could potentially be developed and utilized outside of the U.S. regulatory framework.

The Atlantic margin is a priority for the US ECS project. The Atlantic is potentially the second largest region of ECS for the US (second to the Arctic). The USGS participated in four field seasons of joint seismic-bathymetric work in the Arctic collaborative with the Geological Survey of Canada as the first priority between 2008 and 2011. An opportunity to collect data for the ECS in the Pacific Ocean was possible in 2011, and at that time, data were collected in the Gulf of Alaska and the Bering Sea, two areas of potential U.S. ECS. Since 2011, the Atlantic has been the highest priority for gathering ECS-relevant seismic data, both for the ECS Interagency Task Force and the Coastal and Marine Geology Program of USGS.

The ECS project has teams that have been working in each region since 2010. A preliminary assessment of existing data for the Atlantic margin was completed in 2012. Since that time, the final track line program has been proposed and modified per presentations to the ECS working group and the ECS seismic methodology team. This fiscal year (2014) is the first opportunity that both a ship and sufficient funding resources have been available for a field program in the Atlantic. Finishing data collection in 2015 provides sufficient time to complete interpretations of the data for ECS by 2017, which allows the Department of State sufficient time to complete the documentation of the outer limits of the ECS by the 2018-2019 deadline established in their 5-year program.

One of the criteria for defining the outer limits of the ECS under Article 76 involves measuring the thickness of the sediments beneath the seafloor but above the oceanic crust. The sediment thickness must be measured continuously from the foot of the continental slope seaward to a point where the outer limit point is identified. The established method for measuring sediment thickness is seismic reflection profiling (Kasuga et al., 2000). Other scientific methods (such as measurements of marine gravity and magnetic anomalies) may be used to augment the geologic interpretation, but the internationally accepted method for measuring sediment thickness is seismic reflection profiling. An extensive review of the existing database

[2] Refer to: http://www.state.gov/e/oes/lawofthesea/ and http://continentalshelf.gov/

(Hutchinson and others, 2004) demonstrated that existing seismic-reflection data are entirely insufficient to meet the line-spacing or velocity control requirements specified in Article 76.

The proposed survey is designed using established methods of measuring sediment thickness according to guidelines established by the Commission on the Limits of the Continental Shelf[3].

2) To study the sudden mass transport of sediments down the continental shelf as submarine landslides that may pose tsunamigenic hazards to the Atlantic and Caribbean coastal areas.

Since the 2004 Banda Aceh tsunami and the more recent 2010 Tohoku tsunami, the U.S. Nuclear Regulatory Agency has contracted with the USGS to evaluate tsunami hazards along the U.S. margins, because of the potential threat to, for example, nuclear power plants, coastal cities, industrial centers, and port facilities, including along the Atlantic. Other agencies such as the Federal Emergency Management Agency (FEMA) offices in several coastal states and the City of Boston Office of Emergency Management requested input and assessment from the USGS for their tsunami preparedness. Tsunamis on passive margins such as the Atlantic pose a challenge to regulators because these events are rare (i.e., low probability) but potentially devastating (i.e., high risk). The 1929 Grand Banks tsunami (Fine et al., 2005), measured and modeled overpressures on the NJ margin that can cause slope failure (Dugan et al., 2000), and evidence of enormous submarine landslides (such as the Cape Fear slide [Hornbach et al., 2007]) demonstrate that the Atlantic margin is not immune to the potential tsunamigenic hazard. As part of its research into submarine landslides, the USGS utilizes a multi-pronged approach, for example, analytic and numerical models (Geist and Parsons, 2006; Geist et al., 2009), geomorphologic analysis (Chaytor et al., 2007; Twichell et al., 2009; Locat et al., 2010), regional assessments using existing data (ten Brink et al., 2009; ten Brink et al., 2014), geotechnical analysis (on-going), and laboratory studies (on-going). No single landslide, however, has been mapped from its origin (headwall on the continental slope) to its runout on the lower rise/abyssal plain, with supporting evidence to show the aggradational and structural relationships in the subsurface among the different parts of the composite landslide system. This lack of information prevents further modeling of the processes of these landslides and evaluating the potential tsunamigenic risks they have posed or could pose along the Atlantic margin. The proposed cruise offers the opportunity to study the vertical (depth) aspects of two major landslides on the U.S. margin, and therefore leverage federal resources across two scientific programs and projects (ECS and Natural Hazards). The overlap in the area of interest for the ECS and natural hazards is an effort to eliminate redundant surveys if the field work for the two projects is not combined.

The study of submarine landslide deposits and the geologic conditions that may trigger them similarly require seismic reflection profiles that transect the sediments perpendicular to the continental shelf. Both subjects (sediment thickness [ECS] and geologic structure [hazards]) require seismic-reflection profiles that resolve features on the scale of meters to tens of meters, and penetration of sediments up to several kilometers. The conversion of seismic reflection travel-times (in seconds) to true depth (in meters) is accomplished through the analysis of the

[3] http://www.un.org/depts/los/clcs_new/documents/Guidelines/ CLCS_11.htm

normal-moveout (NMO) correction used to stack the multichannel data. The accuracy of NMO corrections is proportional to the length of the receiving streamer. The 8-km offset of the *Langseth* streamer and the proposed energy level of the airgun array are sufficient to ensure reflection signal strength at the farthest offsets would provide the highly accurate acoustic velocity information required.

1.2 REGULATORY CONTEXT

Section 1.8 of the NSF/USGS PEIS provides details of the regulatory regime for seismic programs. The federal acts and agencies with regulatory responsibility for the proposed seismic program are provided in Table 1.

Table 1: Responsible Regulatory Agencies and Legislation

Administering Organizations	Act
Council on Environmental Quality	National Environmental Policy Act (NEPA)
Office of the President of the United States	Executive Order 12114
NOAA/National Marine Fisheries Service	Endangered Species Act
	Marine Mammal Protection Act
	Magnuson-Stevens Fisheries Conservation Management Act
NOAA/Office of Ocean and Coastal Resource Management	Coastal Zone Management Act
Fish and Wildlife Service	Endangered Species Act (ESA)

1.3 COORDINATION WITH OTHER AGENCIES

These surveys would be conducted by the USGS on behalf of the U.S. Extended Continental Shelf Interagency Task Force, an interagency body, chaired by the Department of State with co-vice chairs from NOAA and the Department of the Interior. Nine additional agencies (Executive Office of the President, Joint Chiefs of Staff, U.S. Navy, U.S. Coast Guard, Department of Energy, NSF, Environmental Protection Agency, Bureau of Ocean Energy Management, and the Arctic Research Commission) participate in Task Force deliberations. USGS, however, is the scientific lead for the proposed program and is funding the activity.

The proposed surveys are also done in coordination with other surveys planned by NSF in the Atlantic. Two surveys planned in 2014 are summarized in Appendix C. In particular, the NSF Eastern North American (ENAM) survey occurs within the U.S. EEZ offshore North Carolina, and is located in the vicinity of the proposed USGS program. Throughout the planning process of both the USGS and ENAM surveys, trackline locations were compared and refined to avoid duplicate data collection and to optimize scientific objectives of both surveys.

This DraftFinal EA and a Draft EA were prepared by YOLO Environmental Inc. with contributions from Ecology and Environment Inc., both firms under contract to EHI (an RPS company) on behalf of USGS and NSF pursuant to NEPA and Executive Order 112114. The Draft EA was used to initiate consultations with regulating agencies and for obtaining public comment on the proposed action. The Draft EA was posted on the NSF and USGS websites for a 30-day public comment period from May 20 to June 20, 2014. No public comments or inquiries were received on the Draft EA during that period. As noted below, public comments were received during the NMFS IHA process (Attachment 1, Appendix G), and although not received as part of the NSF/USGS NEPA process, NSF and USGS considered the responses with respect to the information included in the Draft EA. After consideration of public comments received during the NMFS IHA public comment period and discussions during MMPA and ESA consultations with NMFS, refinements to the information presented in the Draft EA were made in the Final EA, such as more detail on the purpose and need for the proposed action, proposed survey timing, and scientific literature published since the PEIS issued in 2011.

Potential impacts to endangered species and critical habitat have been assessed in the document; therefore, it was used to support the ESA Section 7(a)(2) consultation process with NMFS and USFWS. This document was also used as supporting documentation for an IHA application submitted by USGS to NMFS, under the U.S. MMPA, for "taking by harassment" (disturbance) of small numbers of marine mammals, for this proposed seismic project. Additionally it was used for consultation for Essential Fish Habitat (EFH).USGS and NSF have coordinated and will continue to coordinate, with other applicable Federal agencies and regulations as required.Further details about the various consulatation processes are provided below.

Marine Mammal Protection Act (MMPA)

The Marine Mammal Protection Act (MMPA) procedures for issuance of an IHA involve publication of a proposed IHA notice in the Federal Register, solicitation of comments on that notice, and publication of a notice of issuance in the Federal Register, in addition to compliance with NEPA, and, if applicable, the ESA. USGS and LDEO submitted to NMFS an IHA Application pursuant to the MMPA. NSF and USGS communicated every two weeks by phone with NMFS during the consultation process, and sometimes more frequently. As noted above, public comments (Appendix G) were received by NMFS on the Notice of Intent to Issue an IHA (Appendix F). NMFS will respond to the public comments in a Notice in the Federal Register. Based on consultation discussions, the requirements for issuing an IHA for the proposed action have been met (small take and negligible impacts) and, therefore, it is anticipated that NMFS will issue an IHA. The IHA terms will serve as conditions for conducting the proposed seismic surveys.

Endangered Species Act (ESA)

USGS, together with NSF, engaged in formal consultation with NMFS and informal consultation with U.S. Fish and Wildlife Service (USFWS), pursuant to Section 7 of the Endangered Species Act (ESA). USGS and NSF met every two weeks by phone with NMFS, and sometimes more frequently, during the consultation process. NMFS does not anticipate a jeopardy finding for the proposed action. Based on consultation discussions, it is anticipated that NMFS will issue a Biological Opinion and an Incidental Take Statement for the proposed action. On August 11, 2014, USFWS provided a letter of concurrence that the proposed action would not adversely affect the avian species under their jurisdiction (Appendix E).

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 as a result of the proposed activities, USGS contacted the Habitat Conservation Specialists from the Northeast and Southeast offices of the Greater Atlantic Region regarding the proposed action. After reviewing the analysis and proposed mitigation in the Draft EA, it was determined that minor adverse impacts to water column habitats might occur as a result of the proposed activity; however, the EFH Regional Coordinator concluded "…we have no EFH conservation recommendations to provide pursuant to Section 305(b)(2) of the Magnuson-Stevens Act at this time." (Appendix D).

Coastal Zone Management Act (CZMA)

USGS was the lead federal agency on the proposed action, and as such, NSF had no obligations under CZMA. As the lead federal agency for the proposed activity, the USGS considered whether the proposed activities would have effects on coastal resources of any state along the Atlantic Seaboard. As concluded in the Final EA, any potential impacts from the proposed activities would mainly be to marine species in close proximity to the vessel and would be of short duration and temporary in nature. The proposed survey would occur in ~2000-5000 m water depth, and would occur mostly beyond 200 nm. The closest point of approach to land would be ~170 km/~106 statute miles/~92 nautical miles. Additionally, the Level B zone for the project, the area considered by NMFS that has the potential to harass marine mammals would be ~159 km/~99 statute miles/~86 nautical miles to the closest approach to state waters. Because of the proposed surveys' location in deep water and long distances from the U.S. coast, USGS concluded the survey would have no effect on coastal zone resources. USGS reviewed the Federal Consistency Listings for the states along the Atlantic Seaboard and determined that the proposed activity is not listed. USGS did not a receive request from any state for a consistency review of the unlisted activity. Therefore, it was concluded that the USGS had met all of the responsibilities under CZMA. NSF and USGS also discussed the proposed project with the NOAA Office of Ocean and Coastal Resource Management (OCRM) to confirm the agencies responsibilities under CZMA for the proposed unlisted activity.

1.4 ENVIRONMENTAL ASSESSMENT SCOPE AND METHODOLOGY

The Final EA scope and methodology for the project have been developed to meet the regulatory requirements under NEPA and Executive Order 112114. The Final EA includes consideration of the following factors:

- the environmental effects of the project, including any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or would be carried out; and
- measures that are technically and economically feasible and that would mitigate any adverse environmental effects of the project.

1.5 APPROACH

The approach used in this report stresses the importance of focusing the assessment on environmental and socio-economic components of greatest concern to society or as indicators of environmental health. In general, the methodology is designed to produce an EA analysis that:

- focuses on issues of greatest concern;
- addresses issues raised by the public and other stakeholders;
- addresses regulatory requirements;
- integrates mitigation and monitoring; and
- considers cumulative effects

The methodology for this Final EA included an evaluation of the potential effects from routine activities. The evaluation of potential cumulative effects with regard to other projects and activities includes past, present, and future activities that would be carried out and would interact temporally or spatially with the proposed project.

Preparation of this Final EA consisted of several steps including:

- assembling project baseline information, including a clear description of the proposed project (Section 2) and developing an understanding of existing conditions (Section 3);
- establishing the scope of the assessment (this section);
- assessing the potential environmental effects of the project (Section 4) and cumulative effects (Section 5).
- consulting with the relevant regulatory agencies; and
- making final determinations that are reflected appropriately throughout this document.

1.6 SCOPE OF THE ASSESSMENT

A scoping process focuses the environmental assessment on the project components and activities to be assessed, the key environmental issues, and the appropriate spatial and temporal boundaries. The scope of an EA must be established early in the process to ensure the analysis remains focused and manageable. The scoping process for this assessment included the following:

- project description prepared by USGS;
- previous site-specific NSF EA: Environmental Analysis of a Marine Geophysical Survey by the *R/V Marcus G. Langseth* in the Northeast Atlantic Ocean, June–July 2013;
- previous site-specific NMFS EA: Environmental Assessment for Issuance of an Incidental Harassment Authorization to Lamont-Doherty Earth Observatory to Take Marine Mammals by Harassment Incidental to a Maine Geophysical Survey in the Northwest Atlantic Ocean, June-August 2014 (NMFS 2014);
- review of the Final Programmatic Environmental Impact Statement (PEIS) Atlantic Outer Continental Shelf (OCS) Proposed Geological and Geophysical Activities Mid-Atlantic and South Atlantic Planning Areas (BOEM 2012);

- 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);
- preliminary research, which included a review of existing literature, relevant scientific research publications, and regulatory guidelines; and
- professional judgment of the EA preparation team.

This Final EA tiers to the NSF/USGS PEIS document. The Final BOEM PEIS for Mid-Atlantic and South Atlantic planning areas overlaps with the proposed project area for this survey thus provided useful scientific regional information in deep water. The NSF/USGS PEIS assessed global areas and one detailed analysis area of the northwest Atlantic: a nearshore shallow water location off the coast of New Jersey. Figure 2 shows the area coverage of the BOEM PEIS and the location of the NSF/USGS PEIS NW Atlantic detailed analysis area in relation to the Study Area for this Final EA.

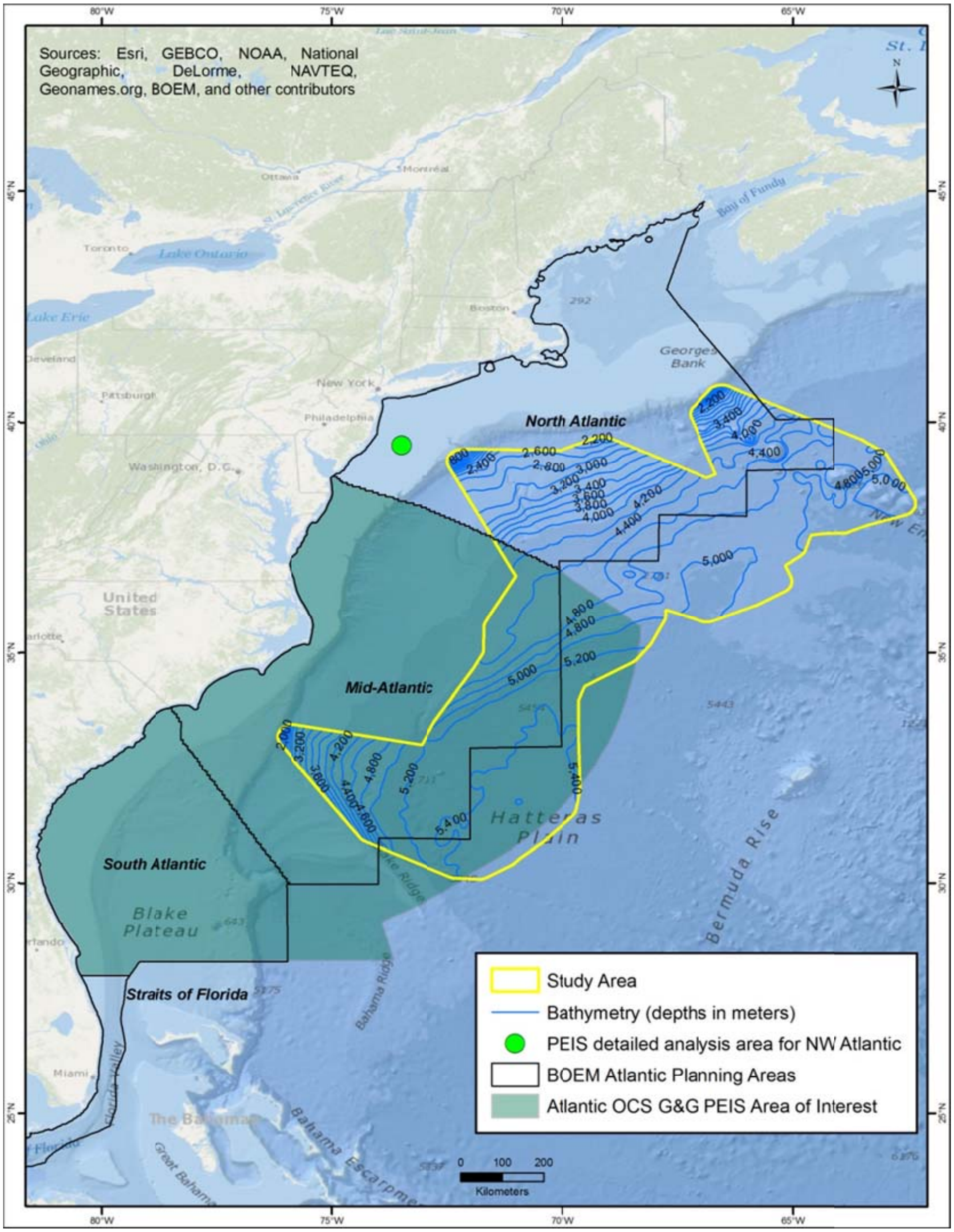

Figure 2: Study Area with NSF/USGS PEIS NW Atlantic detailed analysis area and BOEM Atlantic OCS G&G PEIS Area of Interest

A focused EA requires a process of scoping to define the components and activities that are to be considered in the assessment, to identify the key environmental issues, and to set the spatial and temporal boundaries of the assessment. While the project activities are generally focused within the footprint of the project activities (i.e., area of influence), the effects of these activities may extend beyond these footprints.

1.6.1 Scoping Requirements

As described in the NSF/USGS 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 project area. Initial review and analysis of the proposed project activities determined that the following resource components identified in Table 2 did not require further analysis.

Table 2: Resource Components Determined to Require No Further Analysis

Component	Assessment Considerations
Transportation	Only the R/V *Langseth* would be used during the marine seismic surveys. Therefore, 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.
Land Use	All activities are proposed to occur in the marine environment. Therefore, no changes to land uses would result from the proposed program.
Benthos and Geological Resources (Topography, Geology and Soil	The proposed project would not interact with the soil or seafloor sediments; therefore benthic habitat would also not physically be affected.
Terrestrial Biological Resources	All proposed program activities would occur in the marine environment and would not impact terrestrial biological resources.
Socioeconomic and Environmental Justice	Implementation of the proposed program 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; human activities in the area around the survey vessel would be limited to commercial fishing activities and at most minor interaction with recreational fishing; however, because of the distance from local ports, short duration of the proposed activities (<1 month), and survey design, interaction with fishing activity is expected to be very limited in the Study Area. Further description about potential impacts to fishing are described in this document. No other socio-economic impacts would be anticipated as 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.
Cultural Resources	There are no known cultural resources in the proposed study area. Therefore, no impacts to cultural resources would be anticipated.

1.7 ASSESSMENT METHODOLOGY

1.7.1 Identification of Valued Environmental Components

The scoping process identified a focused list of environmental components. Scoping considerations for these components are presented in Table 3 along with the rationale for inclusion or exclusion of an environmental factor for further evaluation.

Table 3: Selection of Environmental and Socio-economic Components

Environmental Component	Scoping Considerations
Air Quality	Compliance with US Coast Guard regulations, American Bureau of Shipping Certification, and best vessel-operational practices
Marine Water Quality	Compliance with US Coast Guard regulations, American Bureau of Shipping Certification, and best vessel-operational practices
Marine Benthos	The BOEM PEIS (2012) showed lack of groundfish or shellfish commercial fisheries in the Study Area. Coral and sponge protected areas occur in the Study Area.
Marine Fish	Spawning activity may be affected by seismic operations. Vessel and airgun noise may affect fish behavior by causing fish to avoid areas of vessel travel and/or by causing a 'startle response'. Fish spawning has been included as an environmental factor.
Marine Mammals	Several species of marine mammals are likely to be present in the Study Area year-round and could potentially be affected by Project noise and vessel traffic. Marine mammals of particular concern (ESA-listed) would be assessed.

Environmental Component	Scoping Considerations
Sea Turtles	An assessment of the potential adverse environmental effects on ESA-listed sea turtle species would be undertaken.
Marine Birds	An assessment of the potential adverse environmental effects on ESA-listed seabird species would be undertaken.
Special Areas	The project is situated adjacent to several marine protected areas, but does not encroach into any of them.
Commercial Fisheries	The commercial fishery is an important element in the US Atlantic seaboard socio-economic environments. Although unlikely, seismic operations could interact with commercial fisheries directly and indirectly (*i.e.*, potential effects on fish). The assessment would address commercial fisheries occurring within the Study Area.
Military Operations or Research Surveys	Other resources users (*e.g.,* Department of Defense, seismic research, *etc*.) conduct activities on the OCS and Slope within the Study Area, thereby potentially interacting with the project. Other research surveys may be conducted within the Study Area and may interact with project activities and are included in the assessment of other ocean users.

1.7.2 Description of Existing Conditions

Section 3 of this report provides a description of the existing conditions (i.e., pre-project) for each environmental or socio-economic factor. The description is focused on the status and characteristics of the environmental or socio-economic factors within the boundaries established for the assessment and focuses on aspects that are relevant to potential project interactions. In some cases, baseline data are only available on a larger regional basis extending beyond the boundaries of the assessment, but are still considered relevant and appropriate for the purposes of the assessment.

1.7.3 Study Area

The Study Area encompasses the region over which the 2D seismic survey extends (Figure 3, yellow outline). The study area extends beyond the start and ends of the survey tracks by 30 km to account for the estimated turning radius and distances (<6 km) at which the acoustic level

(160 dB re 1 µPa SPL) from the 2D seismic airgun survey may affect the behavior of marine species. Although unlikely, this area also includes potential interactions with other vessels.

1.7.4 Temporal, Spatial and Ecological Boundaries and Study Area

Temporal and spatial boundaries encompass those periods during, and areas within which, the environmental or socio-economic factors are likely to interact with or be influenced by the project.

The temporal boundaries considered for this assessment include seismic activities from the time the vessel arrives within the Study Area, until it departs the Study Area, and estimated time frames for recovery of pelagic and nektonic communities. Effects of the routine activities associated with the proposed project have been assessed from August to September in 2014 and April to August 2015.

Spatial boundaries encompass those periods during, and areas within which, the environmental or socio-economic factors are likely to interact with, or be influenced by, the project.

Ecological boundaries are determined by the spatial and temporal distributions of the biophysical environmental factors under consideration. Factors such as population characteristics and migration patterns are important considerations in determining ecological boundaries, and may influence the extent and distribution of an environmental effect. Spatial socio-economic boundaries are determined by the nature of the environmental factors under consideration (e.g., the spatial distribution of fishing activity). Such boundaries are particularly important for assessing cumulative environmental effects.

Temporal ecological boundaries consider the relevant characteristics of environmental components or populations, including the natural variation of a population or ecological component, response and recovery times to effects, and any sensitive or critical periods of an environmental factor's life cycle (e.g., spawning, migration), where applicable.

The scope of the proposed program includes all of the components and activities detailed in this section of this report, including any potential accidental events that may occur in relation to the project. To further focus the assessment, the interactions between survey activities and the environmental factors need to be identified (Table 4:). A potential interaction, signified by an "X", does not necessarily indicate a predicted effect, but warrants further analysis in the EA. A full assessment of these interactions is contained in Section 4 (planned routine events and accidental events). Where appropriate, the assessment includes a summary of main concerns regarding the effect of each survey activity on the environmental factors being considered. Knowledge may exist in the scientific literature and is referred to where possible. Negligible interactions are blank and are not discussed further. An interaction may be negligible due to the limited nature of the activity and interaction, strict regulations, or lack of sensitive receptors.

Table 4: Potential Project - Environment Interaction Matrix

Environmental Factors	Marine Mammals	Sea Turtles	Marine Fish	Marine and Migratory Birds	Special Areas	Commercial Fisheries	Marine Traffic	Military Operations or Research
2D Seismic Survey - Noise Emissions (Acoustic Array)	X	X	X	X	X	X		X
Vessel Presence	X	X		X		X	X	X
Presence of Streamers and Cables	X	X				X	X	X
Routine Vessel Discharges	X	X	X	X	X	X		

1.7.5 Analysis, Mitigation and Environmental Effects

For each environmental factor, the potential interactions are investigated and described based on current scientific knowledge with regard to each interaction. .

Where applicable, operational mitigation measures are identified that would minimize potential impacts.

Additionally, pre-cruise planning mitigation measures included 1) evaluating the minimum source level needed for the proposed research and 2) considering environmental conditions such as the seasonal presence of marine mammals, sea turtles, and seabirds when scheduling the survey.

1.8 FOLLOW-UP AND MONITORING

Monitoring by the proponent may be undertaken for a number of reasons including compliance, permit approval/renewal, evaluation of mitigating measures, strengthening predictive capacity in future EAs, and commitments to regulatory agencies.

Monitoring and follow-up requirements are evaluated for each environmental or socio-economic factor and are linked to the sensitivity of an environmental or socio-economic factor to both project related and cumulative environmental effects.

1.9 CUMULATIVE ENVIRONMENTAL EFFECTS ASSESSMENT

Individual environmental effects could accumulate and interact to result in cumulative environmental effects. Past and ongoing human activities have affected the region's natural and human environments. An environmental assessment must include consideration of the cumulative environmental effects that are likely to result from the program in combination with other projects or activities that have been or would be carried out. A critical step in the environmental assessment, therefore, is determining what other projects or activities have reached a level of certainty (e.g., “would be carried out”) such that they must be considered in an environmental assessment.

Certain requirements must be met to consider cumulative environmental effects:

- there must be a measurable environmental effect of the project being proposed;
- the environmental effect must be demonstrated to interact cumulatively with the environmental effects from other projects or activities; and
- it must be known that the other projects or activities have been, or would be, carried out and are not hypothetical.

These criteria were used to guide the assessment of cumulative environmental effects. The other projects and activities considered in this assessment include those that are likely to proceed (such as those listed in the Federal Register), and those which have been issued permits, licenses, leases or other forms of approval.

Past and present activities that may impact cumulatively with the project have been assessed as part of the assessment of routine project activities in Section 5. Future activities that have the potential to interact cumulatively with the project include marine traffic (domestic and international), military activity, submarine cable installations, commercial fishing activities, research surveys, and energy and/or mineral exploration.

2 PROPOSED ACTION AND ALTERNATIVES

2.1 PROJECT OVERVIEW

USGS proposes to conduct an offshore regional 2D seismic reflection survey program, totaling 3,400 nm (6,300 km) on the Outer Continental Shelf (OCS), slope and abyssal plain over the next two years (2014 and 2015). Figure 3 depicts all the proposed survey lines. No survey lines are within 12 nm territorial waters of the United States nor in water depths shallower than 1,000 m.

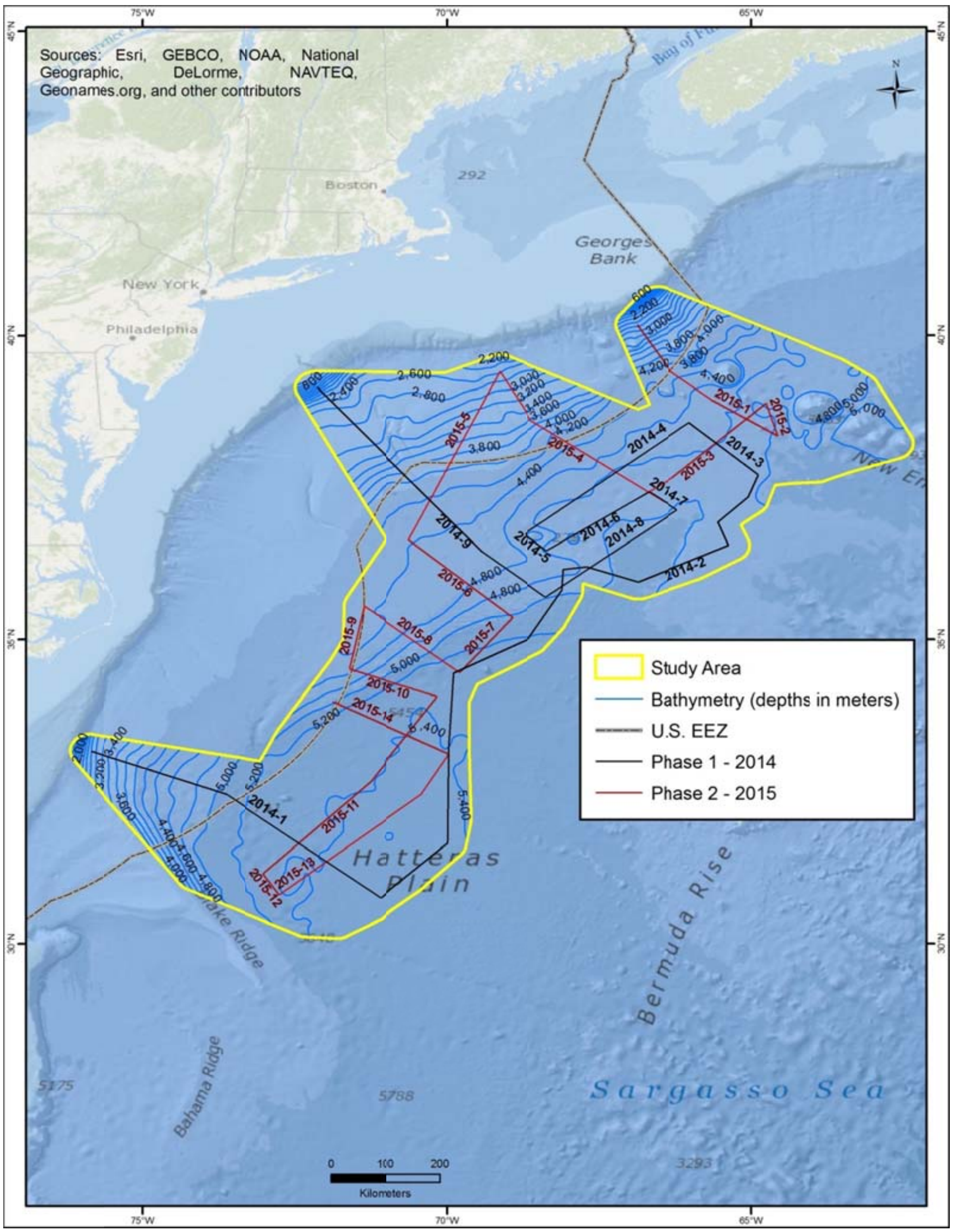

Figure 3: 2D Seismic Lines (2014 and 2015)

The survey in 2014 is proposed for August 16 to September 6. The exact dates of the second survey would depend on the weather conditions, budget and vessel availability; the time period to conduct the survey would be proposed sometime between April and August, 2015. Each program would be about 18-21 days in duration, including transit, equipment mobilization and retrieval.

The vessel would be at sea and operate continuously (i.e., 24-hour operations) during survey operations. There would no crew changes planned and no additional support vessel or helicopter service anticipated.

To address environmental mitigations for the planned scientific research surveys, Protected Species Observers (PSO's) would form a component of the operational crew. Standard mitigation procedures would be implemented to minimize effects on the local marine ecosystem.

2.2 PROJECT LOCATION

The proposed survey area would be bounded by the following geographic coordinates:

Table 5: Geographic Location of Survey

40.5694° N / -66.5324° W
38.5808° N / -61.7105° W
29.2456° N / -72.6766° W
33.1752° N / -75.8697° W
39.1583° N / -72.8697° W

These coordinates define an area where the most easterly survey lines are outside the US EEZ, and extend into international waters. No survey lines extend into the U.S. 12 nautical mile (nm) limit for territorial seas and State waters.

The nearest-to-land extent is in the northwest (39N, 73W) approximately 130 nm (241 km) from shore. Similarly, in the southwestern end of the Study Area (33N, -76W), the nearest-to-land extent is about 155 nm (290 km) from shore.

2.3 PROJECT COMPONENTS

The USGS plans to conduct seismic reflection scientific research surveys off the US Atlantic Seaboard in 2014 and 2015. Each survey would consist of an approximate 21-day leg comprising 1,700 nautical trackline miles (3,165 km) of 2D seismic reflection coverage (total 3,400 nm total over two years). The 2014 survey is currently scheduled to commence in mid-August 2014; the second survey would be conducted in April to August, 2015 time window.

The proposed survey design consists of approximately nine (9) sub-parallel, NW-SE lines (perpendicular to the margin) across the Study Area, with end-line transits and several NE to SW tie or strike lines. The airgun array would operate continuously during the survey, except for power/shut downs, equipment repair or weather issues. Data would continue to be acquired between line changes. The locations of the 2015 tracks for ECS purposes may require minor adjustments depending on analysis of the 2014 data.

Marine seismic surveys for scientific research use arrays of airguns as the source of seismic signals. All conventional seismic surveys share the same basic concept. Seismic airgun sources send sound waves through the water, and formations beneath the seafloor reflect the sound waves back to receivers, such as hydrophone streamers trailing behind the vessel. The components of the proposed 2D surveys would include a seismic vessel, the towed source array (consisting of 36 airguns) and the receiver (hydrophone streamer). These components are shown in Figure 4.

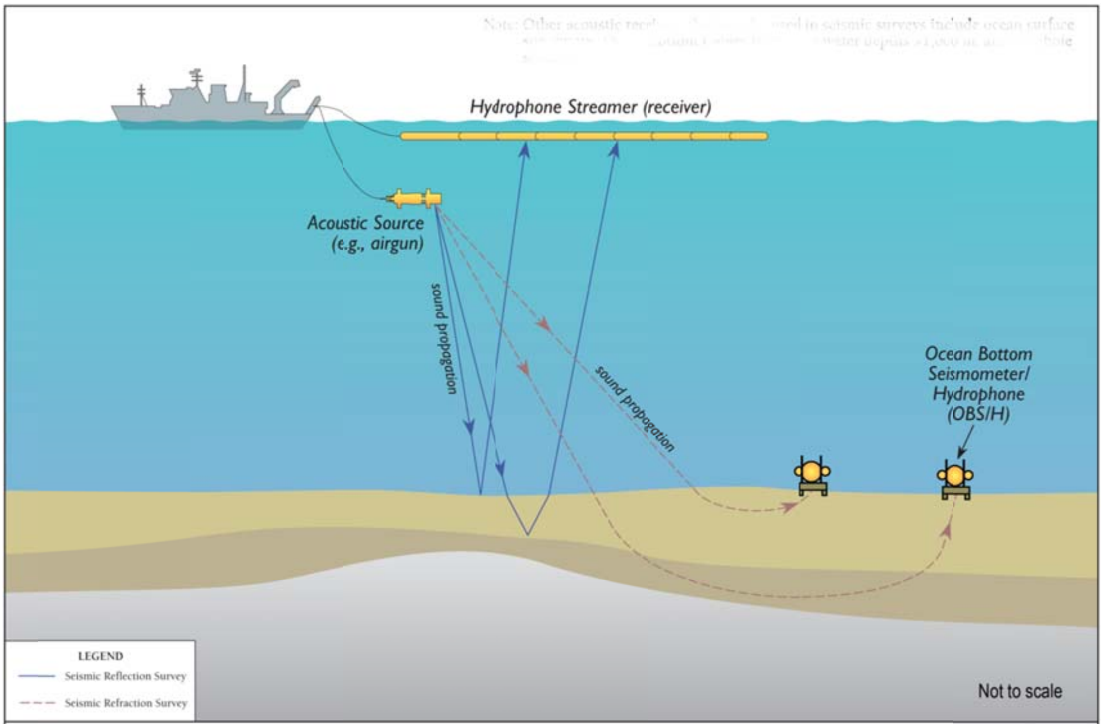

Figure 4: Seismic vessel and towed system (Source NSF/USGS PEIS)

The requirement to establish sediment thickness along the continental margin, where in the Atlantic the sediment thicknesses can be in excess of 8-10 km, requires large sources and low frequencies. For the proposed ECS cruise, the multichannel streamer (8 km), augmented by widely spaced free-floating sonobuoys (acquiring data up to 30 km from the ship) provides the ability to acquire oblique angles to better resolve sedimentary velocities and determine accurate sediment thicknesses. In considering survey design, the guidelines regarding Article 76 of the Law of the Sea Convention state, “The low frequencies allow good penetration. The oblique angles allow the detection and measurement of velocity gradient zones as well as the more abrupt changes, which show up well on reflection profiles.” (CLCS, 2009, §8.2.7). The acquisition of refraction information from widely spaced sonobuoys provides an independent check on sediment thickness and the identification of basement, which reduces uncertainty in determining the outer limit points of the ECS. The guidelines also state “the survey must be designed to prove the continuity of the sediments from each selected fixed point to the foot of the slope (see sect. 8.5).” (CLCS, 2009, §8.2.21). The proposed Langseth source (6600 in^3)

size is appropriate for imaging sediment thickness where the sediments are thickest (near the foot of the slope) and also to have the resolution to determine the base of the sediments with between 5 and 10 % error. Additionally, the survey tracklines are designed to avoid areas of reduced sediment thickness (such as around seamounts).

Most of the track locations are designed to fulfill the requirements of Article 76 of the Law of the Sea Convention. Trackline spacing and coverage is specified in the treaty to be no more than 60 nm apart. However, the 60 nm maximum is impractical unless the points on the tracks are exactly orthogonal between tracks at 60 nm spacing. Any deviation of points from orthogonal between adjacent tracks will result in a distance greater than 60 nm between points, which will not satisfy Article 76. Hence the tracks are generally planned to be 30-50 nm apart. The proposed program is for two field seasons, the first (2014) as a reconnaissance in the area of interest and the second to finalize outer limit points after interpretation of the data from the first field program is completed. The guidelines also note that "…it is evident that …minimum data coverage could miss some important details of the morphology of the outer limit of the continental margin, and the resulting 1 percent line could only be a rough approximation of the true geological limit. Coastal States that suspect that such an approximation will be to their disadvantage will benefit from executing more comprehensive and detailed surveys. In general, the data coverage should reflect the complexity of the outer margin." (8.2.22). The Atlantic margin is inferred to have geologic complexity in the form of fracture zones, where the sediments could be thicker than in the intra-fracture zone regions. These fracture zones are the result of juxtaposing oceanic crust of different ages across ridge offsets during the spreading process. The 2014 part of the program (with lines parallel to the margin) is intended to identify the possible existence of fracture zones that are sub-perpendicular to the margin. If these fracture zones can be identified, the 2015 component of the seismic program is to then collect seismic data along tracks that follow where the sediment is thickest and therefore the size of the US ECS can be established.

Four tracks (2014-1, 2014-9, 2015-1, 2015-4, Figure 3) are located to address tsunami hazards associated with down-slope mass movement and submarine landslides. These lines are intended to image, from south to north, the Cape Fear landslide, the Southern New England Landslide complex, a control line outside of landslide occurrence, and the Munson-Nygren-Retriever Landslide complex. These tracks optimize scientific benefits of the proposed survey by collecting data on transects to and from the area of ECS study. By combining objectives of the USGS Hazards Program (to understand and assess tsunami hazard on the East Coast) with the USGS ECS project (to identify the outer limits of the ECS), ship and personnel resources are leveraged together, saving personnel and ship costs.

2.3.1 Seismic Vessel

The *Langseth* (Figure 5), owned by the National Science Foundation and operated by Lamont-Doherty Earth Observatory of Columbia University would be used as the seismic survey vessel.

Figure 5: Survey Vessel *R/V Marcus G. Langseth*

The *Langseth* was designed as a seismic research vessel, with a propulsion system designed to be as quiet as possible to avoid interference with the seismic signals. The operation speed during seismic acquisition is typically 7.8 to 8.3 km/h (4.2 to 4.5 knots). When not towing seismic survey gear, the *Langseth* can cruise at approximately 20 to 24 km/h (10 to 12 knots). The *Langseth* would tow the 36-airgun array along predetermined lines (see Figure 3). When the *Langseth* is towing the airgun array and the hydrophone streamer, the turning rate of the vessel is limited to five degrees per minute. Thus, the maneuverability of the vessel is limited during operations with the streamer.

The vessel would have equipment, systems, and protocols in place for prevention of pollution by oil, sewage, and garbage in accordance with international standards and certification authorities. The survey vessel would comply with all applicable regulations concerning management of waste and discharges of materials into the marine environment. The vessel has a ballast water management plan. The International Maritime Organization (IMO; http://www.imo.org/) is the United Nations specialized agency with responsibility for the safety of shipping and the prevention of marine pollution by ships. The Shipboard Oil Pollution Emergency Plan (SOPEP) is written in accordance with the requirements of regulation 37 in compliance with latest revision of Marine Pollution (MARPOL) Annex I of the International Convention for the Prevention of Pollution from Ships, 1973. The SOPEP is a guide to the vessel Masters, bridge officers and crew onboard the ship with respect to the steps to be taken when an oil pollution incident has occurred, or is likely to occur.

The *Langseth* would also serve as the platform from which vessel-based Protected Species Visual Observers (PSVO's) would be responsible for visually monitoring, data collection and reporting on marine mammals and sea turtles before and during airgun operations. Resources onboard include two sets of big eyes and handheld binoculars to scan the surrounding area for all protected species plus Passive Acoustic Monitoring (PAM) system would also be monitored 24 hours a day during seismic operations by experienced PAM Operators. The PAM system would consist of a data processing unit, deck cable, hydrophone cable, computers, headphones, and special translation software to listen and read vocalizations of marine mammals under the water.

The *Langseth* has been used to conduct successful seismic surveys world-wide since 2008, rigorously obeying mitigation and monitoring requirements to avoid and minimize Level B harassment of marine mammals. Environmental assessments, IHA's and post-cruise environmental impact reports can be found for more than a dozen *Langseth* cruises at:

http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications or
http://www.nsf.gov/geo/oce/envcomp/index.jsp.

2.3.2 2D Seismic Towed Array and Hydrophone Streamer

Survey equipment for the program is described below in Table 6.

Table 6: Seismic Equipment and Survey Parameters

Total Linear Length of Lines (km)	3,400 nm (6,300 km) two year program, 1,700 nm per year
Number and Length of Streamers	1 X 8 km multi-channel, Thompson-Marconi SENTRY solid streamer
Group Interval	12 groups per section; 12.5 m
Airgun Array	36 guns of Bolt 1500LL and Bolt 1900LLX 6,600 in^3 total volume
Maximum number of sub-arrays	4, 9 guns per sub-array (plus 1 spare)
Source Array Tow Depth	9 m
Airgun Operating Pressure	2000 pounds per square inch
Frequency	2 to188 Hz
Source output	zero to peak (0-p) 84 bar-m (259 dB re 1 μPa m); peak to peak is 177 bar m (265 dB)
Hydrophone	Dual sensor
Type of firing sensors	Pressure activated

Firing duration	0.01 s
Shot Time Interval	50 m or ~22 to 23 s
Recording Time	14 to 16 s
Vessel Speed	4.2 to 4.5 knots while surveying, 10-12 knots in transit
Turning Radius	10 to 12 km

2.3.3 Multibeam Echosounder and Sub-bottom Profiler

Along with the airgun operations, two additional acoustical data acquisition systems would be operated during the survey. The ocean floor would be mapped with the Kongsberg EM 122 multi-beam sounder (MBES) and a Knudsen Chirp 3260 sub-bottom profiler (SBP). These sound sources would be operated from the *Langseth* continuously throughout the cruise (exclusive of transits).

The Kongsberg model EM122 MBES operates at 10.5 to 13 (usually 12) kHz and is hull-mounted on the *Langseth*. The transmitting beam width is 1° or 2° fore–aft and 150° athwartship. The maximum source level is 242 dB re 1 µPa m. Each ping consists of eight (in water >1000 m deep) or four (<1000 m) successive fan-shaped transmissions, each ensonifying a sector that extends 1° fore–aft. Continuous wave (CW) pulses increase from 2 to 15 ms long in water depths up to 2,600 m, and Frequency Modulation (FM) chirp pulses up to 100 ms long are used in water >2,600 m. The successive transmissions span an overall cross-track angular extent of about 150°, with 2-ms gaps between the pulses for successive sectors.

The Knudsen Chirp 3260 SBP is normally operated to provide information about the sedimentary features and the bottom topography that is being mapped simultaneously by the MBES. The SBP is capable of reaching water depths of 10,000 m and penetrating tens of meters into the sediments. The beam is transmitted as a 27º cone, which is directed downward by a 3.5 kHz transducer in the hull of the *Langseth*. The nominal power output is 10 kW, but the actual maximum radiated power is 3 kW or 222 dB re 1 µPa m. The ping duration is up to 64 ms, and the ping interval is dependent on water depth, between 3 and 6 seconds.

MONITORING AND MITIGATION MEASURES

Table 7 summarizes the key monitoring and mitigation measures that would be followed during the proposed activity.

Table 7: Summary of Key Monitoring and Mitigation Measures

Pre-Cruise Planning Measures:

- Survey Timing: Consider environmental conditions (i.e., seasonal presence of marine species, weather, equipment and personnel availability), weather conditions, equipment availability, and other proposed seismic surveys utilizing *Langseth*. - Energy Source: Evaluate research objectives and optimize source selection - Mitigation Zones: Calculate mitigation zones based on LDEO modeling and current NMFS acoustic threshold guidance
Marine Mammal Species
- PSVO's would be based aboard the seismic source vessel, and would watch for marine species during daylight (civil dawn to civil twilight) airgun operations - Five PSVO's would be deployed aboard *Langseth*. Two PSVO's would remain on watch during daytime seismic operations; at least one PSVO would be on watch during meal and restroom breaks. PSVO watch shifts would not exceed 4 hours. - PSVO's would watch for marine mammals and turtles near the seismic vessel for at least 30 minutes (min) prior to the start of airgun operations after any total airgun shutdown longer than 10 minutes. - Based on PSVO observations, airguns would be powered down (see below) or, if necessary, shut down completely when marine mammals are observed within or about to enter a designated Exclusion Zone (EZ). Establishment of the EZ is based on consideration of criterion of ≥180 dB re 1 μPa rms - PSVO's monitor for species to the Full Mitigation Zone (FMZ) which includes the area identified for potential behavioral harassment (Level B harassment). FMZ represents the distance at which the SPL is >160 dB re 1μPa_{rms} - PSVO's would make observations during daytime periods when the seismic systems are not operating for comparison of animal abundance and behavior during seismic and non-seismic periods for similar geographic regions, as feasible. - Passive Acoustic Monitoring (PAM) would be used during seismic operations in conjunction with visual monitoring. PAM would be monitored continuously during seismic operations by a specialized PAM operator or PSVO, in shifts of no greater than 6 hours duration. - Shutdown of airguns for marine mammals and sea turtles detected inside of Exclusion Zone. Unless the marine mammal or sea turtle is observed to leave EZ, ramp up (procedure described below) would commence 15 minutes for small cetaceans or 30 minutes for large cetaceans after the last sighting.
General Ship Operations
Speed or course alteration. If a marine mammal or sea turtle is detected outside the EZ but is likely to enter it based on relative movement of the vessel and the animal, if safety of

operations allow, the vessel speed and/or course would be adjusted to minimize the likelihood of the animal entering the EZ. It should be noted that major course and speed adjustments may be impractical when towing long seismic streamers.
Power down procedures. A power down involves reducing the number of airguns operating to a single 40 in^3 ("mitigation") airgun in order to minimize the size of the EZ. The continued operation of one airgun is intended to alert marine mammals and turtles to the presence of the seismic vessel nearby. If a marine mammal or sea turtle is detected within, or is likely to enter the EZ of the array in use, and if vessel course/speed changes are impractical or would not be effective to prevent the animal from entering the EZ, then the array would be powered down to ensure the animal remains outside the smaller EZ of the single airgun. If the animal appears on course to enter the EZ of the single mitigation airgun, then a total shutdown would be required, as described below. Following a power down, airgun activity would not resume until the marine mammal or sea turtle is outside the EZ for the full array. The animal would be considered to have cleared the EZ if it: - is visually observed to have left the EZ; - has not been observed within the EZ for 15 min in the case of small odontocetes; - has not been observed within the EZ for 30 min in the case of mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, and beaked whales; or - the vessel has moved outside the applicable EZ in which the animal in question was last seen. Following a power down and subsequent animal departure as noted above, the airgun array would resume operations.
Shutdown procedures. If a marine mammal or sea turtle is within or about to enter the EZ for a single airgun, or for a single airgun following a power down, all operational airguns would be shut down immediately. Airgun activity would not resume until the animal had cleared the EZ for the full array of airguns to be used, as described above.
Ramp-up procedures. A ramp-up procedure would be followed when an airgun array begins operating after a specified period without operations.. Ramp-up would begin with the smallest airgun in the array. Airguns would be added in a sequence such that the source level of the array would increase in steps not exceeding 6 dB per 5-min period. A 36-airgun array would take approximately 30 min to achieve full operation via ramp-up. During ramp-up, the PSVO's would monitor the EZ, and if marine mammals or sea turtles are sighted, decisions about course/speed changes, power down, and shutdown would be implemented as though the full array were operational. An exception occurs when the shut-down period is less than 10 minutes. In this situation, the length of time of the shut down is defined as the time taken for the source vessel to travel the radius of the EZ specified for the array to be used; for this survey the period would be

approximately 10 minutes for the vessel traveling at 3.0 knots. Initiation of ramp-up procedures from shutdown requires that the full EZ must be visible by the PSVO's for 30 min, whether conducted in daytime or nighttime. This requirement would often preclude startups under nighttime or poor-visibility conditions except for small sources with small EZs. Ramp-up is allowed from a power down under reduced visibility conditions if the single mitigation airgun has been operating continuously during the power-down period. It is assumed that the single airgun would alert marine mammals and turtles to the approaching seismic vessel, allowing them to avoid the seismic source. Ramp-up procedures would not be initiated if a marine mammal or sea turtle is observed within the EZ of the airgun array to be operated.
Special mitigation measures: airgun arrays would be shut down (not just powered down) if North Atlantic Right whale is sighted from the vessel, even if outside the EZ, due to their rarity and conservation status. In case of confirmed sightings, airgun operations would not resume until 30 min after the last documented visual sighting and the PSVO is confident that the whale is no longer in the vicinity of the vessel.
US Coast Guard Notice to Mariners.. LDEO would issue Notices to Mariners to alert and inform vessels in the vicinity of *Langseth* about the project activity and to avoid entanglement with towed equipment.

Section 2.4.1.1 of the NSF/UGSG PEIS details standard monitoring and mitigation for NSF and USGS marine seismic surveys. With the proposed monitoring and mitigation provisions, potential effects on most if not all individual marine species are expected to be limited to minor behavioral disturbance. Those potential effects are expected to have negligible impacts both on individual marine mammals and on the associated species population or stocks. To minimize the likelihood that impacts would occur to the speciespopulations or stocks, sound source operations would be conducted in accordance with all applicable U.S. federal regulations and IHA requirements. The proposed mitigation procedures to be followed are based on NSF/USGS PEIS protocols used during previous L-DEO seismic research surveys based on best practices recommended in Richardson et al. (1995), Pierson et al. (1998), Weir and Dolman (2007), and Wright (2014) and/or required under NMFS-issued IHA's.

The standard operational monitoring and mitigation strategies would include:

- Visual monitoring by PSVO's
- Passive acoustic monitoring
- PSVO Report submitted to NMFS within 90 days after the end of the cruise
- Proposed safety Exclusion Zones based on acoustic modeling
- Operational Mitigation
    - Ramp-up procedures
    - Power-down procedures

- Shut-down procedures
- Vessel course/speed alteration

In addition to operational mitigation measures, measures to mitigate potential impacts were also considered during survey planning. The USGS worked with L-DEO and NSF to identify potential time periods 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*. Most marine mammal species are expected to occur in the area year-round, however, so altering the timing of the proposed project likely would result in no net benefits for those species.

The USGS proposes to use the standard *Langseth* 36-airgun array with a total volume of approximately 6,600 in3. This tuned array features spectral content and power appropriate for the objectives of the survey. The 6,600 in^3 array would be required to image full sediment thickness back to the upper continental rise. Given the research goals, location of the survey and associated deep water, this energy source level was deemed appropriate.

2.4 ALTERNATIVES TO THE PROJECT

Two alternatives were evaluated:

1) "No Action" alternative.

2) A corresponding seismic survey at an alternative time, along with issuance of an associated IHA.

Additionally, alternative technologies to conduct seismic surveys were considered in the PEIS and are described further below, including why they were eliminated from further consideration.

2.4.1 No Action

An alternative to the proposed seismic surveys is the No Action Alternative, i.e., do not issue an IHA and do not conduct the research operations. If the survey was not conducted, the "No Action" alternative would result in no disturbance to the environment, including marine species, due to the proposed activities.

A No Action Alternative would preclude the establishment of outer limit points using the sediment thickness criteria, and would jeopardize the ability of the U.S. to define the seafloor and subseafloor where it is entitled to certain sovereign rights, such as managing, exploring or conserving the region. The USGS has examined the existing seismic reflection data in the area of interest, and determined that the current coverage is entirely insufficient in both extent and quality to meet the criteria required by Article 76.

The No Action Alternative could also, in some circumstances, result in delay of other studies that would be planned on the *Langseth* for 2014 and beyond, depending on the timing of the decision. An evaluation of the effects of this alternative is given in section 4.5.

2.4.2 Alternative Time

An alternative to issuing the IHA for the period requested for conducting the project is to issue the IHA for another time and to conduct the project with the same monitoring and mitigation measures at that alternative time. The U.S. Interagency Task Force on the Extended Continental Shelf (ECS), under leadership of the Department of State, has established a Project Office to complete work on delineating the outer limits of the U.S. ECS in 5 years from 2014-2019. Delineating the Atlantic margin ECS takes two field surveys (as proposed in this action), at least two years of analysis and interpretation following data acquisition, as well as one year to develop the appropriate technical documentation for Article 76 of the Law of the Sea Convention. Delaying the proposed 2014 field program by a year jeopardizes completing the necessary steps to meet the 5-year Project Office deadline.

The ECS task force has been in existence since 2007 to identify and support collecting data in all the parts of the U.S. margins beyond 200 nm where the U.S. can potentially exert its sovereign rights. The current proposed time for the first of the two field programs (August – September, 2014) has been planned for more than two years, is the most suitable time for the participating USGS scientists and technical support staff; and accomdates the task force schedule for finishing delineating the outer limits of the ECS. The proposed time also takes into consideration the limited maneuverability of the vessel when towing and 8-km streamer, which makes late fall, winter and early spring, with its associated stormy weather, impractical and unsafe in this part of the Atlantic Ocean. Because of ship scheduling, delaying the 2014 field program to a later time effectively delays the survey until 2015 because no more suitable weather window exists nor are technical staff available until 2015. The planned 2015 survey would then be delayed until 2016, which would delay analysis and interpretation of the complete dataset that in turn would delay finishing delineation of the outer limits of the ECS according to funding and priorities of the ECS Interagency Task Force. Because the multichannel seismic methodology is a requirement for delineating the outer limits of the ECS when using sediment thickness (CLCS, 1999), delaying to an alternate time would not change the need for an IHA or Section 7 Consultation or establishing incidental takes.

2.4.3 Alternative Technologies

While alternative technology was considered, none is appropriate for the survey requirements. As discussed in the PEIS (Section 2.6), alternative technologies to airguns were considered but eliminated from further analysis as those technologies were not commercially viable. USGS, NSF, and L-DEO continue to closely monitor the development and progress of these types of systems. However, at this point in time, these systems are still not commercially available. Geo-Kinetics has a potentially viable option for marine vibroseis but does not have a viable towable array and its current testing is limited to transition zone (shallow water) settings. The hull-mounted transducer is intended for use in shallow water, sensitive environments and the vicinity of pipelines or other infrastructure and is not designed nor suited to deep-water, long-offset reflection profiling. Other possible vibroseis developments lack even prototypes to test. As noted by Pramik (2013) as recently as last November, the leading development effort by the Joint Industry Program "has the goal of developing three competing designs within the next few years". Similarly, engineering enhancements to airguns to reduce high frequencies are currently under development by industry; however at present, these airguns are not commercially available. The BP North America staggered burst technique would have to be developed well beyond the patent stage to be remotely practicable and would require extensive modification and testing of the Langseth source and recording systems. None of the other technologies mentioneded (gravity, EM, DTAGS, etc.) produce the resolution or sub-seafloor penetration required to resolve sediment thickness and geologic structure at the requisite scales. Improving the streamer signal to noise through improved telemetry (e.g. fibre optic cable) would involve replacing the Langseth streamers and acquisition units, requiring a major capital expenditure.

L-DEO and USGS maintain contact with a number of developers and companies and have expressed a willingness to serve as a testbed for any such new technologies. As noted in the PEIS (Section 2.6), should new technologies to conduct marine geophysical surveys become available, USGS and NSF would certainly consider whether they would be effective tools to meet research goals.

Lower-power sources (such as sparker or Chirp) do not have sufficient capacity to penetrate the entire sediment column, which in the Atlantic Ocean may be as great as several kilometers. The compressed air array proposed for the current survey uses a proven technology and program design that is standard throughout the world. More than 30 countries have proposed ECS limits using sediment thickness, and all have based those limits on seismic reflection data acquired with compressed air sources and multichannel hydrophone technology.

3 AFFECTED ENVIRONMENTS

This section covers the primary environments that would be effected by the proposed action. A number of environments were identified in section 1.6.1 as not requiring further analysis and therefore are not covered here.

3.1 METOCEAN DATA

The proposed Study Area is solely in offshore mid-Atlantic waters. Bathymetry ranges between 1,450 m and abyssal depths of 5,400 m. The majority of the proposed project occurs at depths below 3,500 m (Figure 6).

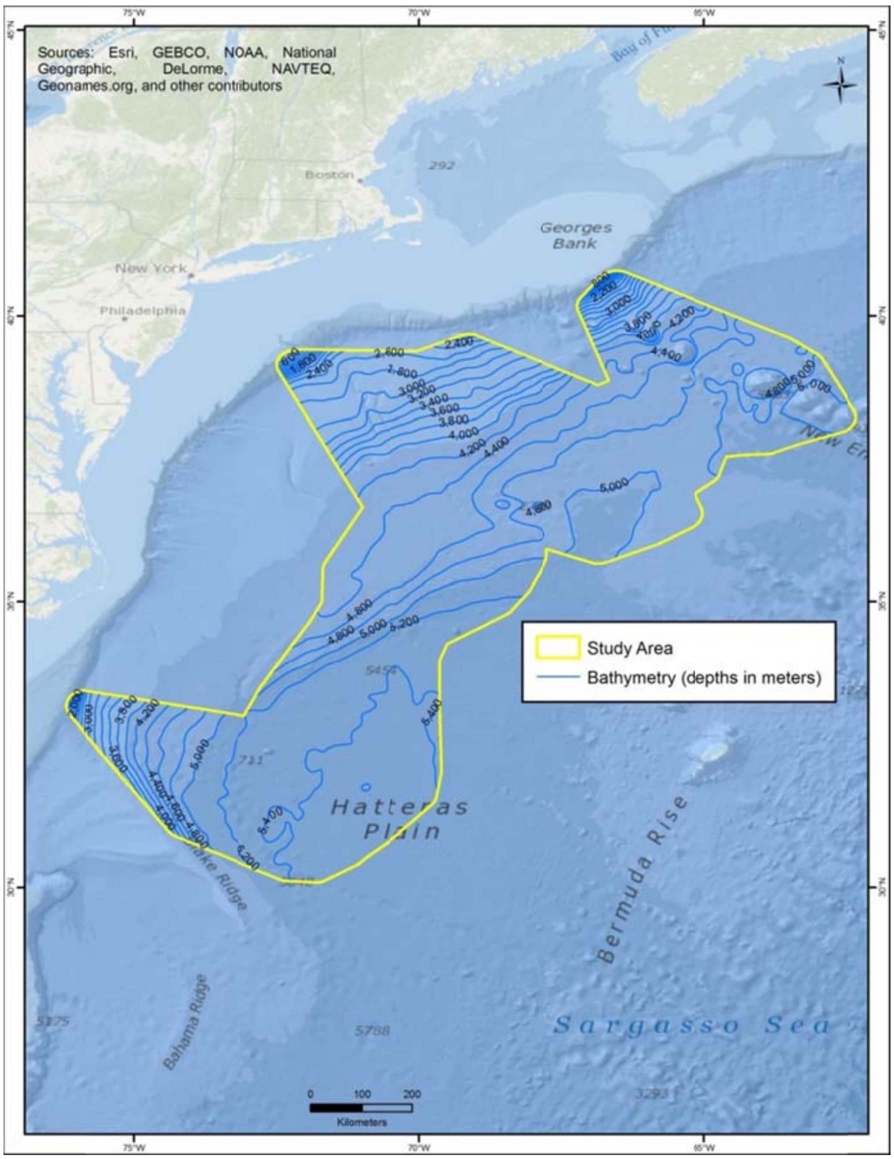

Figure 6: Study Area with Bathymetry

The Study Area is situated well east of the Mid-Atlantic Bight (MAB), a 621 mi (1,000 km) coastal region running from Massachusetts to North Carolina. The western edge of the Study Area lies at the base of the continental shelf-slope and is east of physiographical features such as the Baltimore Canyon, Washington Canyon, and Norfolk Canyon, and northeast of features such as the Blake Ridge.

The region is greatly influenced by a prominent ocean current system, the Gulf Stream. This is a powerful, warm, and swiftly flowing current that flows northward, generally along the shelf edge, carrying warm equatorial waters into the North Atlantic (Pickard and Emery, 1990; Verity et al., 1993) (Figure 7). Upwelling along the Atlantic coast is both wind-driven and a result of dynamic uplift (Shen et al., 2000; Lentz et al., 2003).

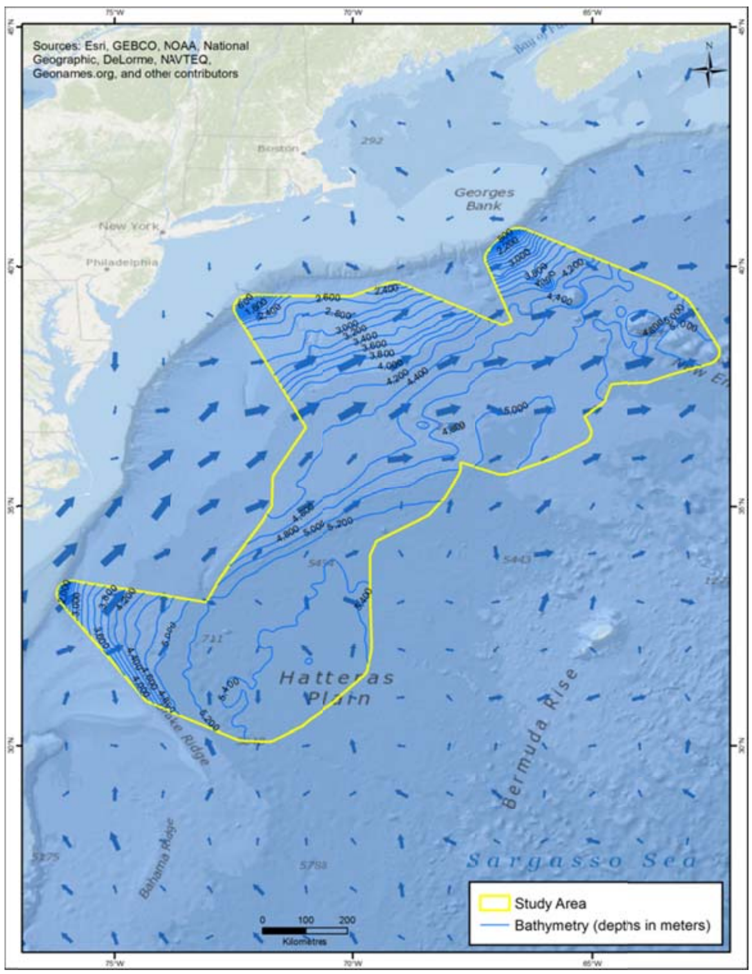

Figure 7: Gulf Stream

In addition to the Gulf Stream, currents originating from the outflow of both the Chesapeake and Delaware Bays influence the surface circulation in the MAB. The Chesapeake Bay plume flows seaward from the mouth of the Bay and then turns south to form a coastal jet that can extend as far as Cape Hatteras. Similarly, the Delaware Coastal Current begins in Delaware Bay and flows southward along the Delmarva Peninsula before entrained into the Chesapeake Bay plume.

The climate for the Study Area is of a typical marine environment. It is influenced to varying degrees year–round by passing systems, prevailing winds, and warm Gulf Stream waters. Of considerable influence, are three atmospheric pressure systems that control the wind patterns and climate for this region: The Bermuda-Azores High, the Icelandic Low, and the Ohio Valley High (Blanton et al., 1985). The Bermuda-Azores High dominates the climate in the region from approximately May through August, and produces south-easterly winds of <6m/s (<20ft/s) (BOEM, 2012a). Persistent high levels of humidity and moisture during this time reduces visibility, increases precipitation levels, and increases levels of fog.

The proposed Study Area is susceptible to tropical and sub-tropical cyclones, which can greatly influence the weather and sea state. During the summer and fall, tropical cyclones are severe, but infrequent (BOEM 2012a). In contrast, during the winter and spring, extra-tropical cyclones frequent the area. Most storms, including hurricanes occur during the North Atlantic hurricane season, which occurs from June through November.

3.2 GEOLOGY AND SEDIMENTOLOGY AND SEDIMENTARY BASINS

Appendix F, Section 1.2 of BOEM (2012a) provides information on geological history and sedimentary basins for the general area. As such, the information is pertinent for this proposed action. Small portions of this Study Area lie within the Carolina Trough, the Baltimore Canyon Trough, and the Georges Bank Basin. Parts of the study area are on the Hatteras Abyssal Plain.

Appendix F, Section 1.3 of BOEM (2012a) provides a summary of the seafloor sediments found in this project Study Area, along with adjacent sediment structures. The western edge of the Study Area is situated at the base of the Continental Slope and extends eastwards. Slope sediments are highly variable, consisting mainly of sandy silts on the upper slope and silts and clays on the lower slope (McGregor, 1983). Much of the seafloor is fine sand or mud associated with the distal ends of turbidity systems (Pilkey and Cleary, 1986) or fine-grained hemipelagic and biogenic deposition (Amato, 1994; McCave and Tucholke, 1986).

3.3 UNDERWATER SOUND ENVIRONMENT

Section 3.1 and 3.1.2 of the NSF/USGS PEIS (2011) provides a full description of ambient underwater sound and factors affecting sound propagation. Underwater sound is generated by many sources, and in the uppermost part of the ocean, weather can contribute to increased sound in the oceans at certain frequencies. Ambient sound is made up of contributions from many sources, both natural and anthropogenic. These sounds combine to give the continuum of noise against which all acoustic receivers have to detect required signals. Ambient sound is generally made up of three constituent types – wideband continuous sound, tonals and impulsive sound and covers the whole acoustic spectrum from below 1 Hz to well over 100 kHz. Above this frequency the ambient sound level drops below thermal sound levels.

3.4 PROTECTED AREAS

No marine protected areas (MPAs) (existing or proposed) are located within the proposed Study Area (Figure 8). Within US Atlantic waters, six MPAs exist and one is proposed. The closest proximity of the Study Area to the Bermuda Whale Sanctuary is 43 km at the most eastern boundary of the Study Area.

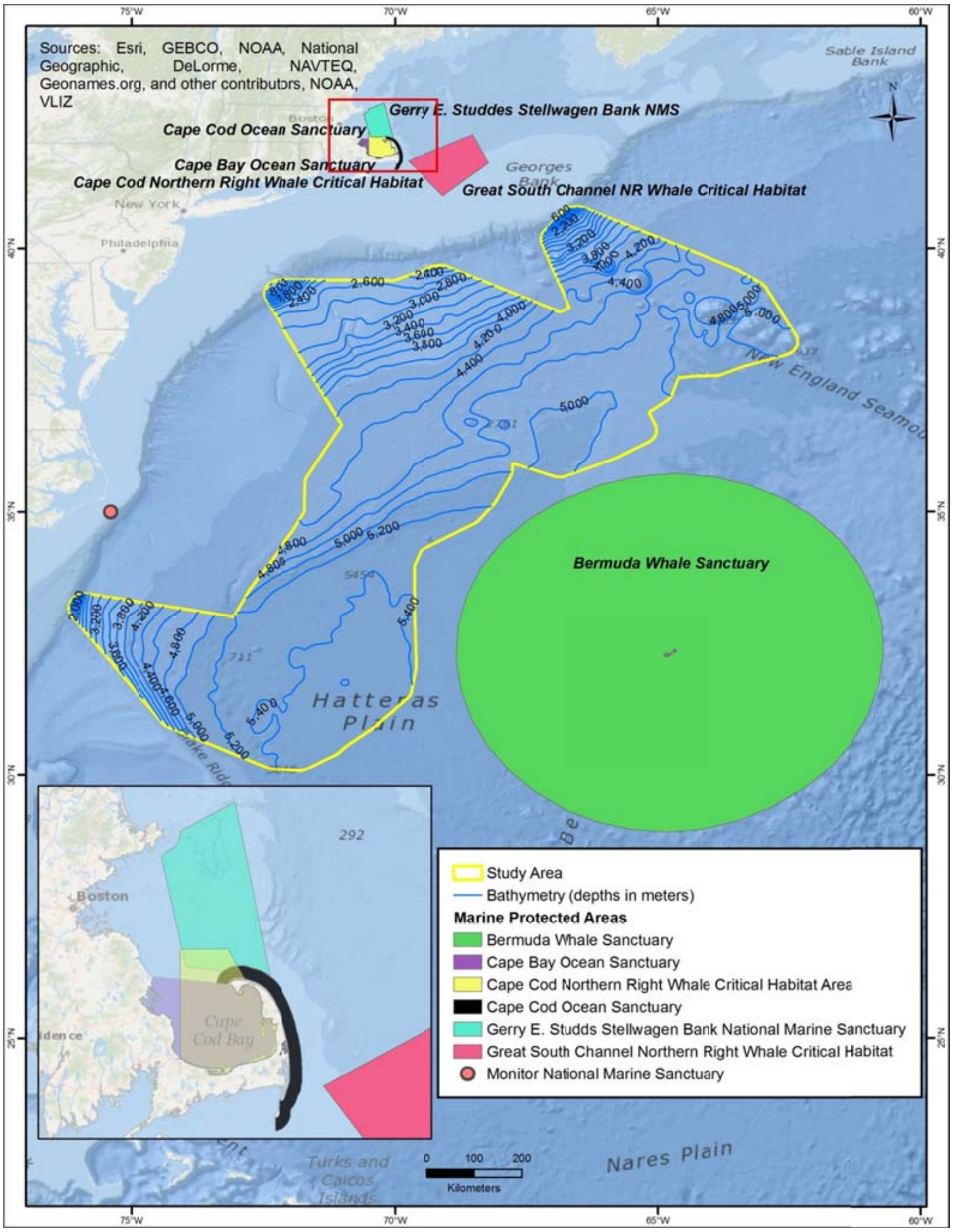

Figure 8: Marine Protected Areas and the Proposed Study Area

3.5 MARINE MAMMALS

Forty-one (41) species of marine mammals, including 27 odontocetes and 7 mysticetes, and 7 pinnipeds, are known to occur in the North Atlantic Ocean. Of those, 34 cetacean species (7 mysticetes and 27 odontocetes) could occur near the proposed Study Area. Pinnipeds are not recorded to occur in the proposed Study Area. Six of the 34 cetacean species that are listed under the U.S. Endangered Species Act (ESA) as endangered are the sei, blue, fin, North Atlantic right, humpback, and sperm whales.

Table 8 summarizes the habitat, regional abundance, distribution, and conservation status of these marine mammals. General information on the taxonomy, ecology, distribution and movements, and acoustic capabilities of mysticetes and odontocetes are given in Section 3.6.1 and Section 3.7.1, respectively, of the NSF/USGS PEIS (2011). The general distribution of mysticetes and odontocetes in the North Atlantic and on the mid-Atlantic Region (MAR) is discussed in Sections 3.6.3.4 and 3.7.3.4 of the NSF/USGS PEIS (2011), respectively. Figure 9 and Figure 10 illustrate the observations of baleen whales relative to the Study Area. Figure 11 shows the observations of North Atlantic right whale habitats adjacent to the Study Area. Figure 12 and Figure 13 show observations of odontocete whales, and Figure 14 and Figure 15 show location of dolphins and porpoise.

The rest of this section deals specifically with species distribution near the proposed Study Area. The main source of information used here is the Ocean Biogeographic Information System (OBIS) database hosted by Rutgers and Duke University (Read et al., 2009).

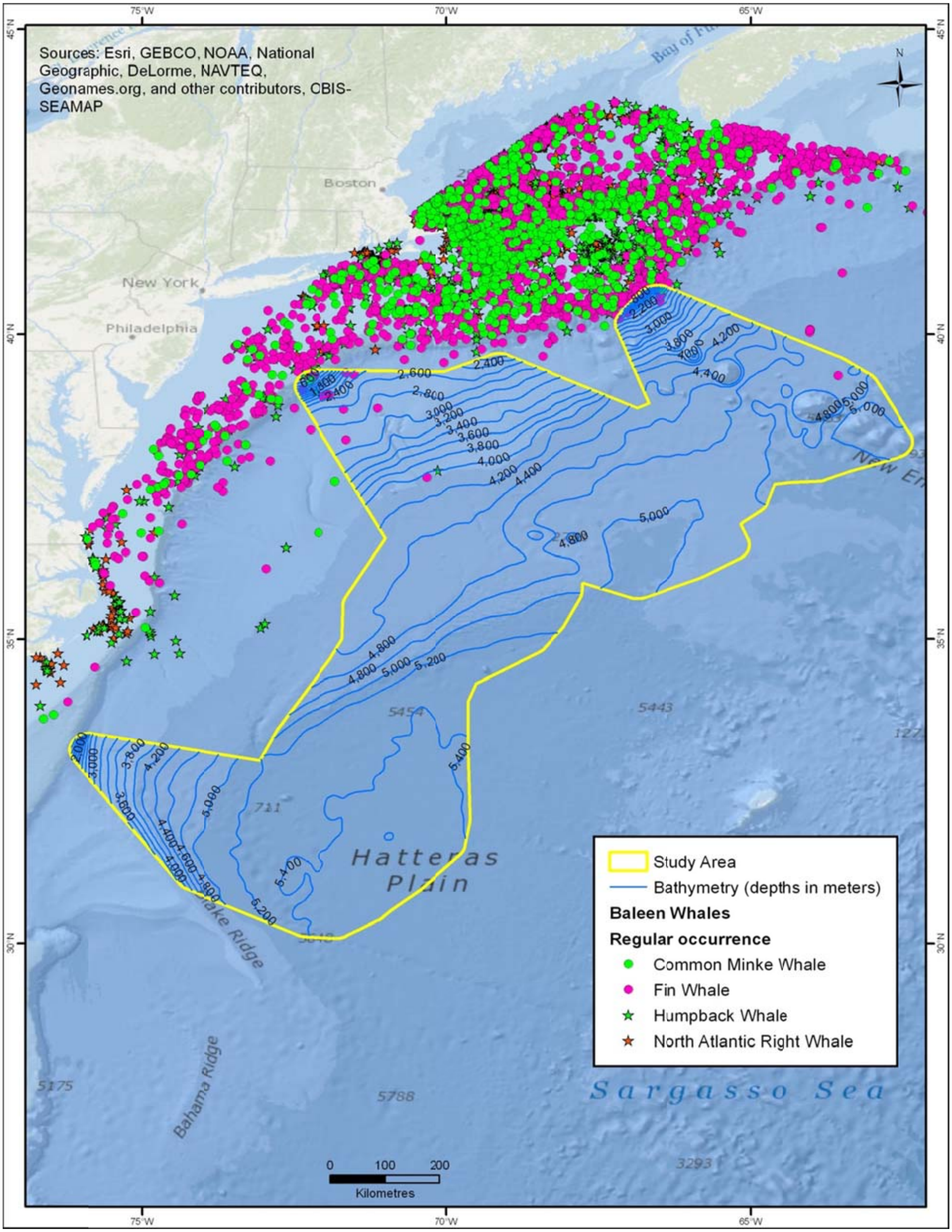

Figure 9: Baleen Whales (regular occurrence, multiyear observations)

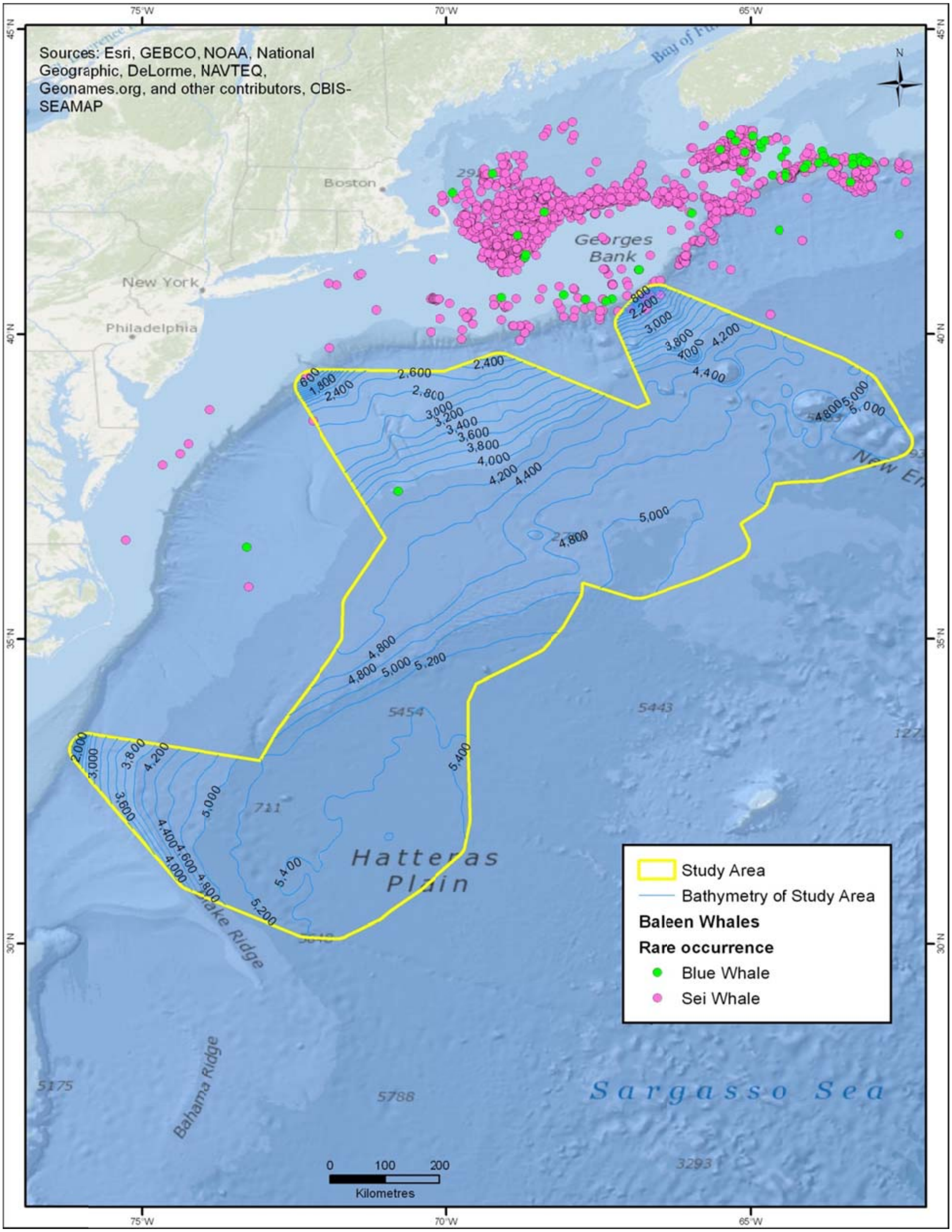

Figure 10: Baleen Whales (rare occurrence, multiyear observations)

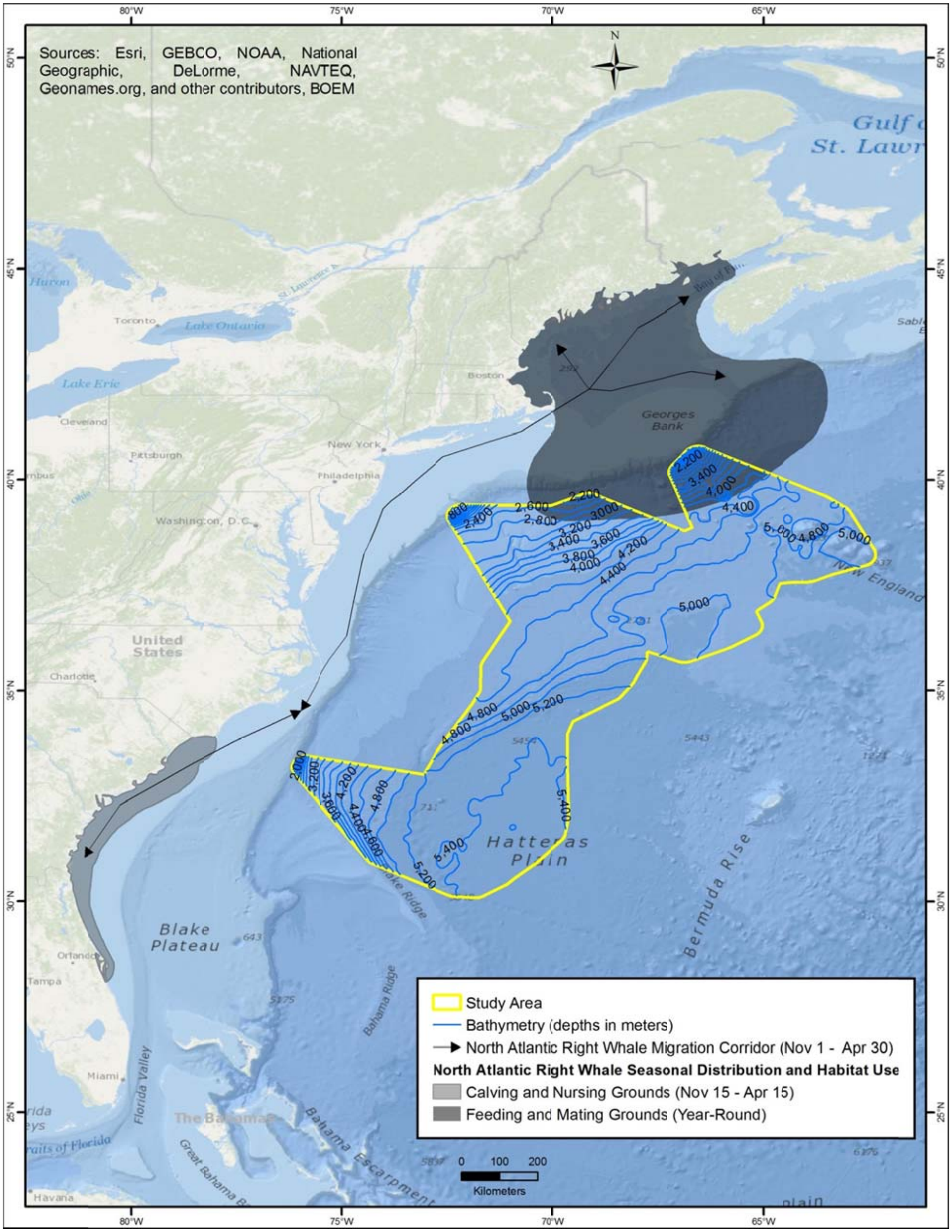

Figure 11: North Atlantic Right Whale Seasonal Distribution and Habitat Use

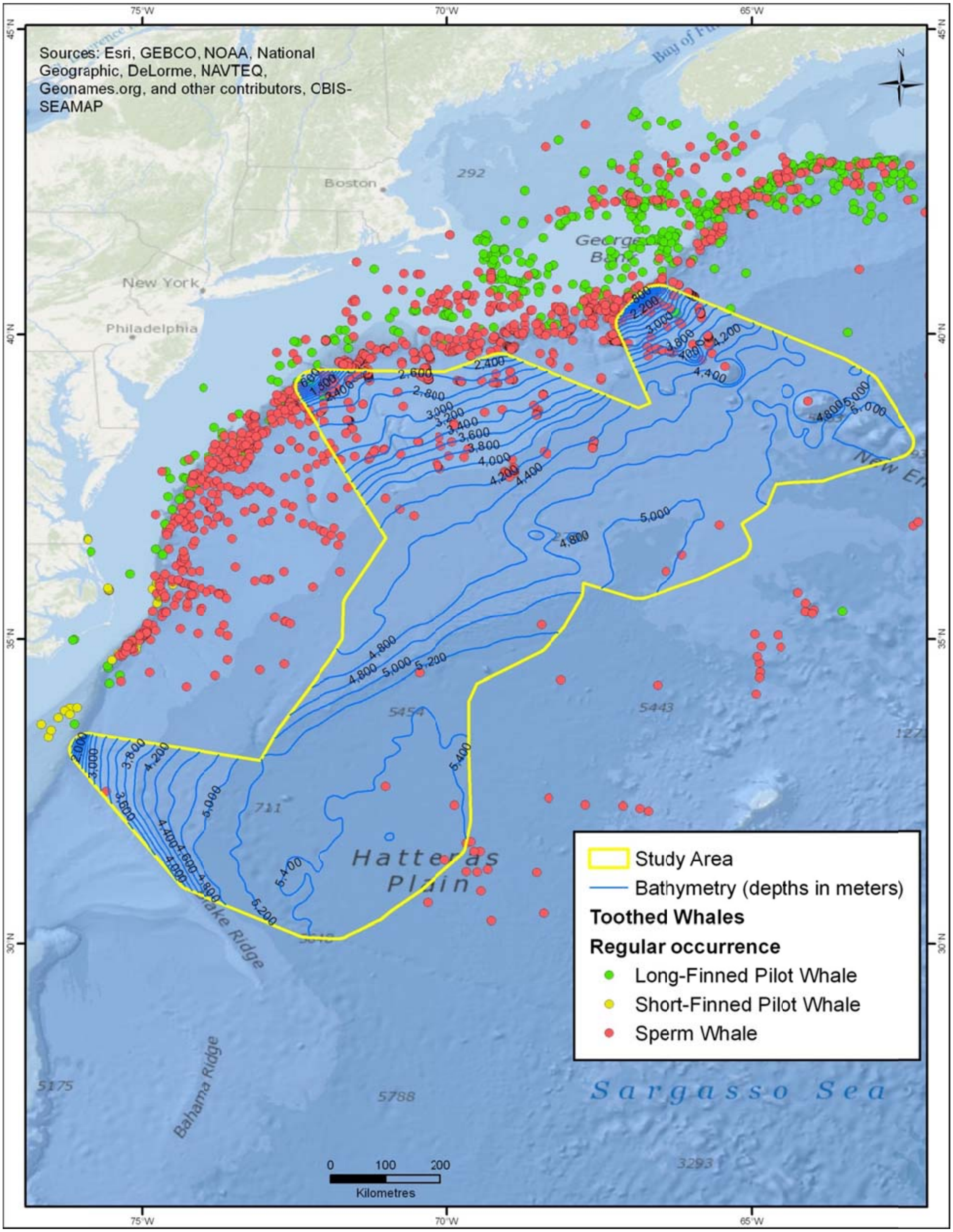

Figure 12: Toothed Whales (regular occurrence, multiyear observations)

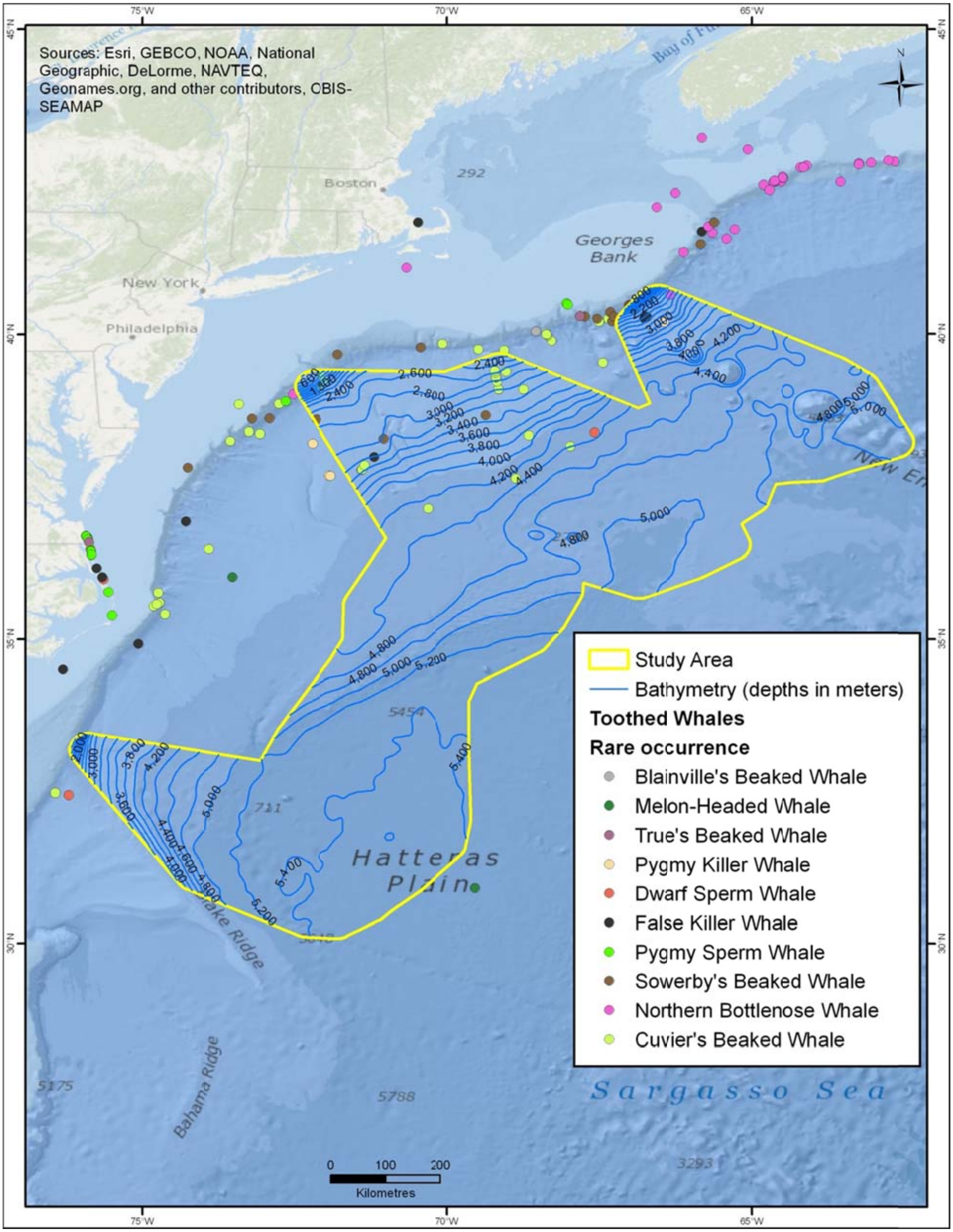

Figure 13: Toothed Whales (rare occurrence, multiyear observations)

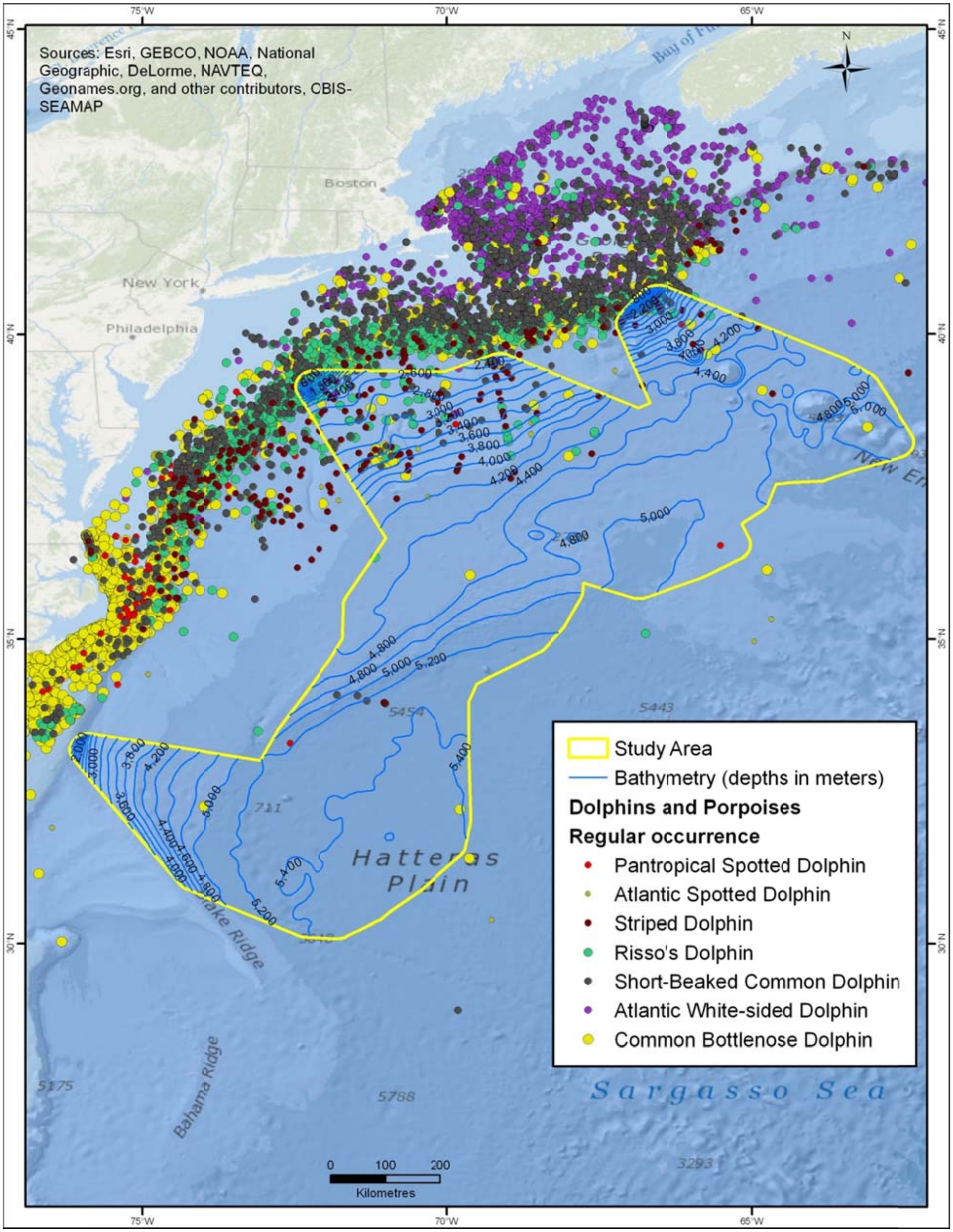

Figure 14: Dolphins and Porpoises (regular occurrence, multiyear observations)

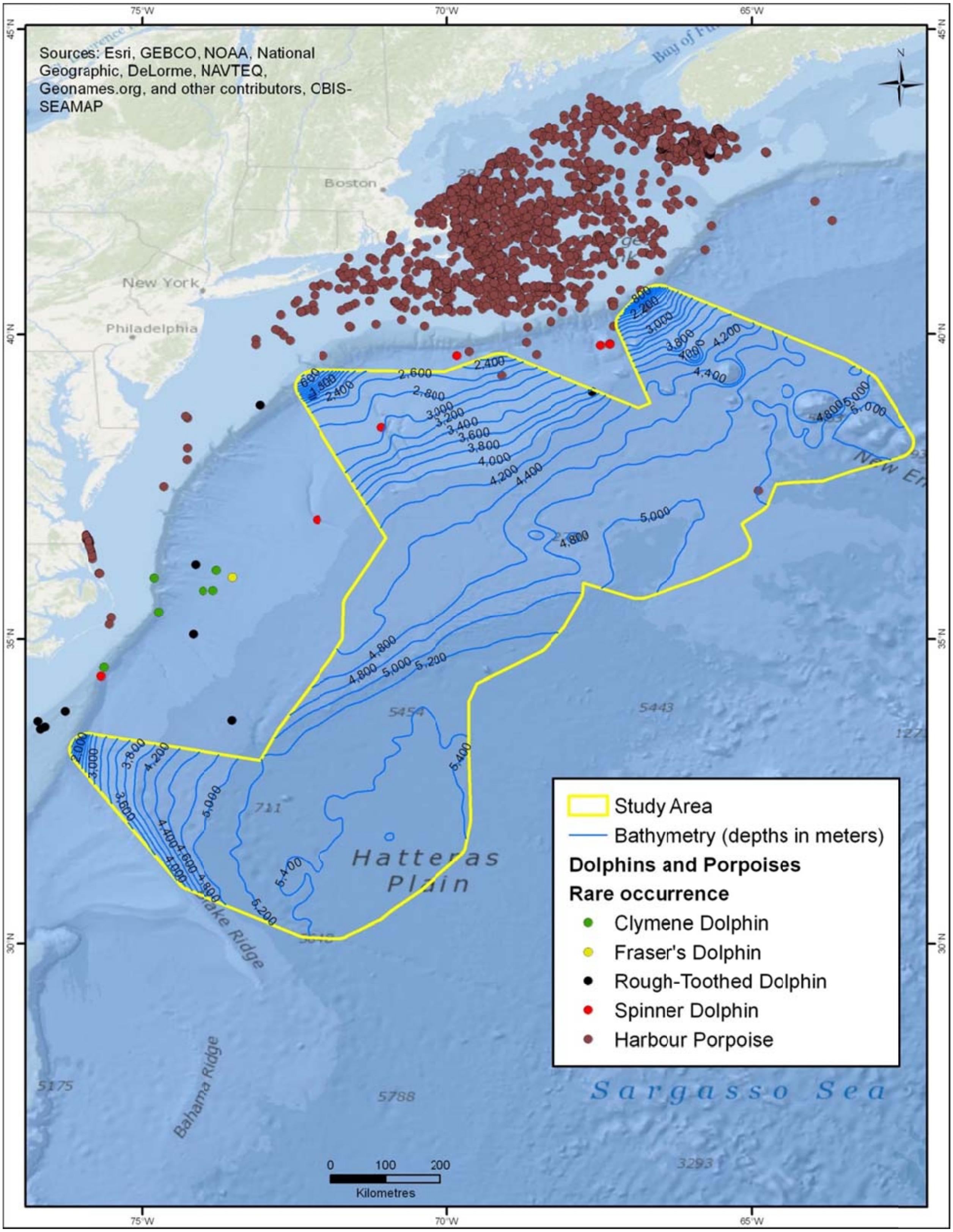

Figure 15: Dolphins and Porpoises (rare occurrence, multiyear observations)

Table 8: Marine Mammals Occurring in the Study and Regional Areas

Species (Common Name)	Frequency of Occurrence Near Study Area	Habitat	Population Estimates	Status			Comments
				ESA[1]	IUCN[2]	CITES[3]	
***Suborder Mysticeiti* (Baleen Whales)**							
Common Minke Whale (*Balaenoptera acutorostrata*)	Regular	Coastal, banks, shelf	8,987[4]; 125,000[5]	NL	LC	I	The common minke whale are among the most widely distributed and most abundant of the baleen whales (Carwardine 1998). The OBIS database reports several sightings of the common minke whale along the western edge of the proposed Study Area. The sightings increase toward the northwest, in the area identified as the year-round feeding and mating grounds for the NA right whale. In 1980, OBIS reported three sightings of the common minke whale within the proposed Study Area.
Sei Whale (*Balaenoptera borealis*)	Rare	Mostly pelagic, some offshore	386[4]; 12-13,000[6]	EN	EN	I	Sei whales are typically associated with steep bathymetric relief, such as the continental shelf break, canyons, or basins situated between banks and ledges where prey is concentrated (Kenney and Winn 1987; Schilling et *al.* 1992; Best and Lockyer 2002). This highly migratory species' (Jefferson et *al.* 2008) range includes the continental shelf waters of the northeastern U.S. and extends to south of Newfoundland. Sei whales are not common in U.S. Atlantic waters (NMFS 2012), however, OBIS reports six sightings of the sei whale within the proposed Study Area. The most recent being in October, 2006, and June 2001, both during the Northeast Fisheries Science Center (NEFSC) Right Whale Survey.
Bryde's Whale (*Balaenoptera brydei*)	Rare	Coastal, offshore	N/A	NL	DD	I	Bryde's whales are considered rare within the waters of the proposed Study Area, and there are no OBIS sightings reported in its vicinity. The season distribution of this whale is not well known (Reilly et al. 2008).
Blue Whale (*Balaenoptera musculus*)	Rare	Coastal, shelf, and pelagic	937[7]	EN	EN	I	Blue whales are considered rare within the proposed Study Area. OBIS sightings identified one blue whale within the Study Area boundary back in 1969.

Species (Common Name)	Frequency of Occurrence Near Study Area	Habitat	Population Estimates	Status			Comments
				ESA[1]	IUCN[2]	CITES[3]	
Fin Whale (*Balaenoptera physalus*)	Regular	Coastal, banks	3,985[4]; 24,887[8]	EN	EN	I	Fin whales are one of the more common mysticeiti species found within the proposed Study Area, and in the waters surrounding it. According to Palka (2006), they are the most commonly sighted ESA-listed large whale in the western North Atlantic. There are hundreds of OBIS sightings logged of this species near the Study Area boundaries, and 14 logged within it. The three most recent sightings are in 2003 and 2004 observed during the NEFSC Right Whale Survey. All other sightings are from the 1970s and 1980s. The USDOC, NMFS (2010) reports summer feeding grounds mostly between 41°20' and 51°00'N latitude (shore to 1,829m [6,000ft]). The proposed Study Area and project dates coincide with this cycle of the fin whale. Fin whale mating and births occur in the winter (November-March), with reproductive activity peaking in December and January. Hain et al. (1992) suggested that calving takes place during October to January in latitudes of the U.S. Mid-Atlantic region. The proposed survey period of April to September would not interfere with these important times.
North Atlantic Right Whale *(Eubalaena glacialis)*	Regular	Coastal and shelf waters	361[44]; 396[9]	EN	EN	I	Research results suggest the existence of six major congregation areas for the NA right whales: the coastal waters of the southeastern U.S., the Great South Channel, Georges Bank/Gulf of Main, Cape Cod and Massachusetts Bays, the Bay of Fundy, and the Scotian Shelf (Waring et al., 2010). Movements of individuals within and between these congregation area are extensive, and data show distant excursions, including into deep water off the continental shelf (Mate et al., 1997; Baumgartner and Mate, 2005). The congregations in U.S. eastern seaboard waters are recorded west of the Study Area; however, movements of the NA right whale could result in their presence in the proposed Study Area. In addition, year-round feeding and mating grounds exist for the NA right whale, which overlaps the north section of the proposed Study Area (Figure 11). While the OBIS database makes reference to hundreds of sightings in the vicinity of the proposed Study Area, mainly along the continental shelf, along the western boundary edge of the proposed Study Area, and in the year-round feeding and mating grounds, OBIS does not report any sightings within the confines of the Study Area.

Species (Common Name)	Frequency of Occurrence Near Study Area	Habitat	Population Estimates	Status			Comments
				ESA[1]	IUCN[2]	CITES[3]	
Humpback Whale (*Megaptera novaeangliae*)	Regular	Coastal, banks	847[4]; 11,570[10]	EN	LC	I	Sightings data show that humpback whales traverse coastal waters of the southeastern U.S., including the proposed Study Area (Waring et al. 2010). Reports of humpback whale sightings off Delaware Bay and Chesapeake Bay during the winter, suggest that the Mid-Atlantic region, including the proposed Study Area, may serve as wintering grounds for this species (Swingle et al. 1993; Barco et al. 2002). OBIS logged four sightings of humpback whales within the Study Area. The most recent sighting is from 2006, logged by the NEFSC Right Whale Survey spotted near the latter coordinates.
Suborder Odontoceti (Toothed Whales, Dolphins, and Porpoises)							
Sperm Whale (*Physeter macrocephalus*)	Regular	Pelagic, slope, canyons	4,804[4]; 13,190[15]	EN	VU	I	The sperm whale is the most commonly occurring odontoceti species within the proposed Study Area, and in the adjacent waters. The sperm summers in the Mid-Atlantic Bight off the Eastern U.S. coast from Virginia to Massachusetts (Reeves et al, 2002; Palka 2006). Hundreds of OBIS sightings of the sperm place them primarily in shelf and slope waters of the northeast U.S. and Nova Scotia which is customary given that groups commonly consist of 20 to 40 animals, including adult females, their calves, and juveniles (Waring et al. 2006). OBIS also recorded several sightings at abyssal depths ~ 16,400-ft (5000m). Within the proposed Study Area, there is in excess of 300 OBIS sightings of sperm whale, with the majority occurring in the slope waters in the northern and western extent.
Short-Finned Pilot Whale (*Globicephala macrorhynchus*)	Regular	Mostly pelagic, high relief	24,674[4,9]; 780,000[11]	NL	DD	II	The short-finned pilot whale is considered uncommon in mid-Atlantic waters, including the proposed Study Area. While there are no OBIS sightings of this species recorded within the Study Area, OBIS has records of 18 sightings of this species, all of which occurred since 2004.
Long-Finned Pilot Whale (*Globicephala melas*)	Regular	Mostly pelagic	12,619[4,9]; 780,000[8]	NL	DD	II	Similar to the short-finned pilot whale, the long-finned is also considered uncommon in the mid-Atlantic waters, including the proposed Study Area. There are five OBIS sightings of this species within the Study Area boundary. Three sightings from the 1980s. OBIS has hundreds of sightings of this species along the shelf and coastal waters of the U.S. and Canada.

Species (Common Name)	Frequency of Occurrence Near Study Area	Habitat	Population Estimates	Status			Comments
				ESA[1]	IUCN[2]	CITES[3]	
Killer Whale *(Orcinus orca)*	Rare	Coastal	unknown	NL	DD	II	There are five reported sightings in the OBIS Database (no dates, or further information for sightings available).Four sightings occurred near the north north-east extent of the Study Area, of which two were in the slope waters.1 sighting occurred in the south-central extent of the Study Area (34°41' and 71°87'N).
Pygmy Killer Whale (*Feresa attenuata*)	Rare	Pelagic	N/A	NL	DD	II	There is only one OBIS sighting of the pygmy killer whale in the proposed Study Area. It was observed in 1981 during the Bureau of Land Management Cetacean and Turtle Assessment Program (BLM CETAP) Air Sightings survey. Two other OBIS sightings were recorded along the shelf-waters, near the proposed Study Area.
Northern Bottlenose Whale (*Hyperoodon ampullatus*)	Rare	Pelagic	~40,000[12]	NL	DD	II	The northern bottlenose whale is considered rare within the proposed Study Area and adjacent waters. There is only one OBIS sighting of this species from 2006, recorded by the NEFSC Right Whale Survey.
Pygmy Sperm Whale (*Kogia breviceps*)	Rare	Deep waters off shelf	395[4,6,13]	NL	DD	II	Considered rare in the mid-Atlantic region, the pygmy sperm whale has no OBIS recorded sightings within the proposed Study Area. However, three sightings have been recorded in the slope waters near the Study Area. The single sighting was in 2004, during the NEFSC Mid-Atlantic Marine Mammal Abundance Survey 2004, while the other was in 1998 during the NERSC Survey.
Dwarf Sperm Whale (*Kogia sima*)							Similar to the pygmy sperm whale, the dwarf sperm whale is also considered rare in the mid-Atlantic region, including in the proposed Study Area. Nonetheless, OBIS has logged two sightings of this species. One in 2004 during the NEFSC mid-Atlantic Marine Mammal Abundance Survey 2004. The other sighting occurred in 1998 during the NEFSC Survey.
Sowerby's Beaked Whale (*Mesoplodon bindens*)	Rare	Pelagic, deep slope, canyons	3,513[4,9,14]	NL	DD	II	OBIS reports eight sightings of the Sowerby's beaked whale within the proposed Study Area. Six have occurred along the shelf with the other two being in the slope waters.
Blainville's Beaked Whale (*Mesoplodon densirostris*)							OBIS reports only one sighting of the Blainville's beaked whale recorded in 2004 during the NEFSC Mid-Atlantic Marine Mammal Abundance Survey 2004. A second sighting near the northeast extent of the Study Area was logged in 1995 by NEFSC.

Species (Common Name)	Frequency of Occurrence Near Study Area	Habitat	Population Estimates	Status			Comments
				ESA[1]	IUCN[2]	CITES[3]	
Gervais' Beaked Whale (*Mesoplodon europaeus*)							There are no OBIS sightings of the Gervais' beaked whale within the proposed Study Area on in any adjacent waters.
True's Beaked Whale (*Mesoplodon mirus*)							OBIS does not have any records for sightings of the True's beaked whale within the proposed Study Area. However, of the 20 OBIS sightings for this species, two exist in the waters adjacent to the northwest boundary line of the Study Area. In 1995, during the NERSC 1995 per 9502 survey one True's was spotted along the shelf edge. In 2003, during the Virginia Aquarium Marine Mammal Strandings 1998-2008 the second was reported stranded near ~ 76°N, 37°W. Survey details do not report on the type of stranding.
Cuvier's Beaked Whale (*Ziphius cavirostris*)				NL	LC	II	Of all the beaked whales, the Cuvier's was the most common recorded in OBIS sightings in the shelf and slope waters adjacent to and within to the proposed Study Area. The 15 sightings within the Study Area occurred mostly in the slope waters in the northwest.
Melon-Headed Whale (*Peponocephala electra*)	Rare	Deep waters off shelf	N/A	NL	LC	II	The melon-headed whale is considered rare within the proposed Study Area and in all adjacent waters. While there are no OBIS sightings within the Study Area, one sighting was recorded near the southeastern extent of its boundary. This sighting occurred in 2005 during the Sargasso 2005 cetacean sightings survey.
Harbour Porpoise (*Phocoena phocoena*)	Rare	Shelf, coastal, pelagic	89,054[4]	NL	LC	II	OBIS has records for thousands of sightings of the harbor porpoise in the coastal and shelf water around the Gulf of Maine. Within the proposed Study Area, three sightings have been reported. Two in the slope waters near the northern extent of the Study Area, and one at abyssal depth ~ 16,400-ft (5000m). The latter was spotted in 1978 during the Programme Integre de recherches sur les oiseaux pelagiques (PIROP) Northwest Atlantic survey
False Killer Whale (*Pseudorca crassidens*)	Rare	Pelagic	N/A	NL	DD	II	The false killer whale is considered rare within the proposed Study Area and adjacent waters. There are only 11 OBIS sightings of this species off the U.S. coast with two occurring within the Study Area. One record in 1971, the other two occurred in 1997.

Species (Common Name)	Frequency of Occurrence Near Study Area	Habitat	Population Estimates	Status			Comments
				ESA[1]	IUCN[2]	CITES[3]	
Shorted-beaked Common Dolphin (*Delphinus delphis*)	Regular	Shelf, pelagic, high relief	120,743[4,9]	NL	LC	II	The short-beaked common dolphin is considered common within the proposed Study Area and surrounding waters. Within the Study Area, OBIS reports 83 sightings. Four studies have reported sightings since the year 2000. In 2001 and 2002, the NEFSC Right Whale Survey recorded 14 and four sightings respectfully. Also in 2001, the Canada Maritime Regional Cetacean Sightings identified one short-beaked common dolphin. Lastly, in 2004 the NEFSC Mid-Atlantic Marine Mammal Abundance Survey 2004 reported spotting eight of these species.
Risso's Dolphin (*Grampus griseus*)	Regular	Shelf, slope, seamounts	20,479[4,9]	NL	LC	II	The Risso's dolphin is considered common within the proposed Study Area. OBIS has over 100 sightings of this species within the boundaries, and thousands along adjacent coastal, shelf and slope waters. Many of the sightings occur in the shelf and slope waters, nine sightings occurred in the deeper waters, in isobaths of ~ 14,438-ft (4,400m).
Atlantic White-sided Dolphin (*Lagenorhynchus acutus*)	Regular	Shelf and slope	63,368[4]	NL	LC	II	The Atlantic white-sided dolphin has thousands of OBIS sightings in coastal, shelf and slope waters, with the majority occurring on the shelf north of the proposed Study Area. Within the Study Area boundaries OBIS has recorded ten sightings of this species. While nine of the sightings were from the late 1970s and early 1980s, one sighting was reported in 2002 from the NEFSC Right Whale Survey.
Striped Dolphin (*Stenella coeruleoalba*)	Regular	Offshore convergence zones and upwellings	94,462[4,9]	NL	LC	II	OBIS records indicate ~ 75 sightings of the striped dolphin within the proposed Study Area, nearly all occurring along the shelf and slope waters in the north and west extent.
Atlantic Spotted Dolphin (*Stenella frontalis*)	Regular	Shelf, offshore	50,987[4,9]	NL	DD	II	Within the proposed Study Area, OBIS records indicate that eight Atlantic spotted dolphins have been sighted. The sightings were divided between mid and base slope waters. Four were observed in 1998 during the NEFSC Survey 1998 1. The other four in 2004 during the NEFSC Mid-Atlantic Marine Mammal Abundance Survey.

Species (Common Name)	Frequency of Occurrence Near Study Area	Habitat	Population Estimates	Status			Comments
				ESA[1]	IUCN[2]	CITES[3]	
Common Bottlenose Dolphin (*Tursiops truncates*)	Regular	Coastal, shelf, pelagic	81,588[4,16]	NL	LC	II	Of the NW Atlantic stock, there are at least five genetically distinct stocks of the common bottlenose dolphin distributed from southern Long Island, New York to central Florida (NMFS 2001; McLellan et al. 2003). These are further divided into two morphotypes: coastal and offshore (Waring et al. 2006). OBIS sightings are in the thousands for the common bottlenose dolphin in coastal and shelf, slope and abyssal waters. There are ~ 100 sightings of this species in the proposed Study Area and likely consist of the offshore morphotype. NOAA has declared an Unusual Mortality Event (UME) along the east coast for bottlenose dolphin (NOAA, 2013). The UME appears to be a result of morbillivirus and seems to be affecting the dolphin populations in nearshore waters <50m. There remains some uncertainty on cause and populations affected.
Fraser's Dolphin (*Lagenodelphis hosei*)	Rare	Shelf and slope	N/A	NL	LC	II	There are no OBIS sightings of the Fraser's dolphin within the proposed Study Area, and only one OBIS sighting in the waters adjacent to its boundaries. This dolphin was observed near the western boundary of the Study Area.
Pantropical Spotted Dolphin (*Stenella attenuata*)	Regular	Coastal, shelf and slope	4,439[4,9]	NL	LC	II	There are six OBIS sightings of the pantropical spotted dolphin within the proposed Study Area. Three occurred in shelf and slope waters one in slopes waters, one at the base of the slope, and one in abyssal depths of ~ 16,400-ft (5000m). The latter was observed in 2005 during the Sargasso 2005 cetacean sightings survey.
Clymene Dolphin (*Stenella clymene*)	Rare	Coastal, shelf and slope	N/A	NL	DD	II	There are no OBIS sightings for the clymene dolphin within the proposed Study Area and only seven sightings in shelf and slope waters in southern U.S. waters.
Spinner Dolphin (*Stenella longirostris*)	Rare	Mainly nearshore	N/A	NL	DD	II	OBIS only has one sightings record of the spinner dolphin within the proposed Study Area. It occurred in 1997, during a BLM CETAP Ship sighting. Other sightings in adjacent waters occurred in the slopes west of the Study Area.
Rough-Toothed Dolphin (*Steno bredanensis*)	Rare	Mostly pelagic	N/A	NL	LC	II	Within the proposed Study Area, there are two OBIS sightings of the rough-toothed dolphin. One occurred in 1998 during the NEFSC Survey 1998 1, near the shelf edge in slope waters. The other occurred near the base of the slope in 1979 during an ELM CETAP Ship sighting.

Species (Common Name)	Frequency of Occurrence Near Study Area	Habitat	Population Estimates	Status			Comments
				ESA[1]	IUCN[2]	CITES[3]	

N/A – Not available or not assessed

U.S. Endangered Species Act: EN = Endangered; NL = Not listed (ECOS 2013)

[2] Codes for IUCN classification: EN = Endangered; VU = Vulnerable; LC = Least Concern; DD = Data Deficient. Classifications are from the IUCN Red List Threatened Species (IUCN 2013).

[3] 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.

[4] Best population estimate "NBest" from Table 1 of Waring et *al*. (2010) stock assessment report.

[5] Central and Northeast Atlantic (IWC 2012)

[6] North Atlantic (Cattanach et at. 2003)

[7] Central and Northeast Atlantic (Pike et *al.* 2009)

[8] Central and Northeast Atlantic (Vikingsson et al. 2009)

[9] Western North Atlantic, in U.S. and southern Canadian waters (Waring et *al.* 2012)

[10] Likely negatively biased (Stevick et *al.* 2003)

[11] *Globicephala sp.* combined, Central and Eastern North Atlantic (IWC 2012)

[12] Eastern North Atlantic (NAMMC 1995)

[13] Both *Kogia* species

[14] *Ziphius* and *Mesoplodon* spp. Combined

[15] For the northeast Atlantic, Faroes-Iceland, and the U.S. east coast (Whitehead 2002)

[16] Offshore, Western North Atlantic (Waring et *al.* 2012)

[17] Western Atlantic Population (NOAA 2012)

[18] All stocks of NW Atlantic (Thomas et *al.* 2011)

[19] Northwest Atlantic (Hammill, M.O. and Stenson, G.B. 2011)

[20] Northwest Atlantic (Andersen, J.M. et *al.* 2009)

3.5.1 ESA-listed Cetacean Species

Several large cetacean species are listed as threatened or endangered by NMFS (Table 9Table 9:). Many cetacean species, which have very low reproductive potentials, are particularly vulnerable to anthropogenic impacts such as accidental entanglement in fishing gear, collisions with ships, and noise and chemical pollution, which threaten many populations and may prevent depleted populations from recovery. The sei, blue, fin, humpback, sperm, and North Atlantic right whales are listed by NMFS as endangered species under the ESA.

Table 9: ESA-listed Marine Mammal Species that May Occur in the Study Area

Species	Status			Comments
	ESA1	IUCN2	CITES3	
Sei Whale	EN	EN	I	During the 19th and 20th centuries, sei whales were targeted and greatly depleted by: commercial hunting and whaling, with an estimated 300,000 animals killed for their meat and oil. Other threats that may affect sei whale populations are ship strikes and interactions with fishing gear, such as traps/pots.
Blue Whale	EN	EN	I	Whaling reduced the original blue whale population. There are fewer than 250 mature individuals and strong indications of a low calving rate and a low rate of recruitment to the studied population. Today, the biggest threats for this species come from ship strikes, disturbance from increasing whale watch activity, entanglement in fishing gear, and pollution. They may also be vulnerable to long-term changes in climate, which could affect the abundance of their prey (zooplankton).
Fin Whale	EN	EN	I	The fin whale population has been decimated by exploitation. Populations have also been impacted by commercial whaling, collisions with vessels, entanglement in fishing gear, reduced prey abundance due to overfishing, and habitat.
North Atlantic Right Whale	EN	EN	I	North Atlantic right whales, found only in the North Atlantic, were heavily reduced by whaling. The total population currently numbers about 322 animals (about 220-240 mature animals), has been decreasing during the last decade, and is experiencing high mortality from ship strikes and entanglement in fishing gear.

Species	Status			Comments
	ESA1	IUCN2	CITES3	
Humpback Whale	EN	LC	I	Humpback whales face a series of threats including: entanglement in fishing gear (bycatch), ship strikes, whale watch harassment, habitat impacts, and harvest. Humpbacks are increasing in abundance in much of their range.
Sperm Whale	EN	VU	I	Commercial whaling reduced the sperm whale population. Sperm whales face a series of threats such as ship strikes, entanglement by fishing gear, and accumulation of stable pollutants.

[1] U.S. Endangered Species Act: EN = Endangered; TR = Threatened; DE = Delisted; UR = Under Review; NL = Not listed (ECOS 2013)
[2] Codes for IUCN classification: EN = Endangered; CR = Critically Endangered; VU = Vulnerable; LC = Least Concern; DD = Data Deficient. Classifications are from the IUCN Red List Threatened Species (IUCN 2012).
[3] 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.

3.6 MARINE AND MIGRATORY BIRDS

General information on the taxonomy, ecology, distribution and movement, and acoustic capabilities of seabird families is given in Section 3.5.1 of the NSF/USGS PEIS (2011).

There are numerous marine and coastal bird species that may be present in or near the study area, including both resident and migratory species. Resident species are present throughout the year, whereas migratory species may be present only during breeding and wintering seasons, or they may only migrate through the area. There are three distinct taxonomic and ecological groups: seabirds, waterfowl, and shorebirds, which comprise 18 taxonomic families. Species within a given taxonomic family of birds share common physical and behavioral characteristics that allow these birds to be presented in this document by family rather than by individual species. Because of these common characteristics, the potential for exposure to geophysical activities would be similar for species within a given family that share similar behavioral characteristics. Table 10: provides a summary of this information, including OBIS sightings data for seabird species that could occur within the proposed Study Area. The distribution of which is dependent on availability and distribution of preferred prey and the breeding status of the species.

Table 10: Conservation Status and Sightings of Seabirds That May Occur In or Near the Proposed Study Area

Group/Species	Occurrence Near Study Area	ESA[1a] / IUCN[1b] / CITES[1c]	OBIS Sightings Within Study Area
Common Loon (Gavia immer)	Rare	NL / LC / N/A	None

Group/Species	Occurrence Near Study Area	ESA[1a] / IUCN[1b] / CITES[1c]	OBIS Sightings Within Study Area
Grebes (Podiceps grisegena, Podiceps auritus Podiceps conutus, Podilymbus podiceps)	Rare	N/A / LC / N/A	None
Petrel (Pterodroma hasitata[i], Pterodroma arminjoniana[ii])	Regular	UR[i]; N/A[ii] / EN[i]; VU[ii] / N/A	7 (spp. *hasitata*)
Shearwaters (Puffinus gravis, Puffinus lherminieri, Calonectris diomedea, Fulmarus glacialis)	Regular	N/A / LC / N/A	Hundreds along the shelf, slope and oceanic waters
Pelicans (*Pelecanus occidentalis*[iii], Pelecanus erythrorhynchos[iv])	Rare	DE[iii]; NL[iv]/ LC / N/A	None
Gannets/Boobies (Morus bassanus, Sula leucogaster)	Regular	N/A / N/A / N/A	~15 sightings (spp. *bassanus*) in shelf and slope waters in northern extent
Cormorants (Phalacrocorax auritus[v], Phalacrocoracidae carbo[vi])	Rare	NL[v]; N/A[vi] / N/A / N/A	None
Gulls (Larus argentatus[vii], Larus atricillav[viii], Larus marinus[vii], Larus philadelphia[vii], Rissa tridactyla[vii])	Regular	N/A[vii]; NL[viii] / N/A / N/A	~ 100 sightings in shelf, slope and oceanic waters (mostly spp. *argentatus* then spp. *marinus*)

Group/Species	Occurrence Near Study Area	ESA[1a] / IUCN[1b] / CITES[1c]	OBIS Sightings Within Study Area
Tern (Sterna hirundo[ix], Sterna anaethetus[x], Sterna dougallii[xi])	Regular [5]; Rare[6]	NL[ix]; N/A[x]; EN & TR[xi] / N/A / N/A	6 sightings in shelf, slope and oceanic waters (spp. *hirundo* and unk.)

N/A – Not available or not assessed
[a] U.S. Endangered Species Act: EN = Endangered; TR = Threatened; DE = Delisted; UR = Under Review; NL = Not listed (ECOS 2013)
[1b] Codes for IUCN classification: EN = Endangered; CR = Critically Endangered; VU = Vulnerable; LC = Least Concern; DD = Data Deficient. Classifications are from the IUCN Red List Threatened Species (IUCN 2012).
[1c] 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 by may become so unless trade is closely controlled.

Seabirds are defined as those species that live in the marine environment and feed at sea (Schreiber and Burger, 2002). Seabirds may be categorized by the marine zones in which they tend to forage. Pelagic birds forage away from the coastal zone and in open ocean and shorebirds forage in coastal waters, while other seabirds use both nearshore and pelagic zones (Michel, 2011). Certain waterfowl (Order Anseriformes) taxa commonly termed sea ducks feed and rest within coastal (nearshore and inshore) waters outside of their breeding seasons. They typically form large flocks and are often observed in large rafts on the sea surface during this period. Shorebirds utilize coastal environments for nesting, feeding, and resting. They are included within Order Charadriiformes (along with gulls and terns). The shorebird group consists of four families and includes sandpipers, plovers, and stilts.

In offshore waters, prey distribution is generally of prime importance. The upwelling and subsequent mixing of the water at the edge of the shelf is attractive to seabirds as it concentrates prey. Pelagic seabirds spend most of their lives at sea, coming to land only to breed. Most pelagic seabirds subsist on a diet of small fish including sand lance, capelin and herring and plankton.

The temporal distribution of marine seabirds offshore is typically as follows:

- The offshore seabird community consists primarily of shearwaters and storm-petrels during the summer months, and of kittiwakes, fulmars during the winter.
- Nearly all the pelagic birds found on the Shelf and Slope do not breed in the Study Area waters.
- Greater Shearwaters are abundant from April to December.
- Northern Fulmars have been observed in proximity of the Study Area throughout the year.
- Large numbers of Storm-petrels arrive in offshore waters in May. They remain abundant on the Shelf until early autumn when they migrate south at the end of the breeding season.

3.6.1 ESA-listed Bird Species

Section 4.2.4.1.1 of the BOEM Final PEIS (2014) and 3.3 of BOEM 2012 Biological Assessment provides a species overview and critical habitat designation for three ESA listed, species: the Roseate Tern (*Sterna dougallii*), Bermuda Petrel (*Pterodroma cahow*), Piping Plover

(*Charadrius melodus*), and one non-listed seabird, the Red Knot (*Calidris canutus*). Piping Plover and Red Knot are shorebirds that are unlikely to come into contact with geophysical activities.

Table 11 describes the two ESA-listed marine bird species relevant to the Study Area. Roseate Terns are more likely to come into contact with geophysical activities, as they forage offshore and feed by plunge-diving, often submerging completely when diving for fish. The Bermuda Petrel is also known to occur within the area, but feeds by snatching prey from the sea surface. USGS has submitted a request for formal consultation under Section 7 of the ESA with the USFWS concerning these bird species.

Table 11: ESA-listed Bird Species That May Occur in the Study Area

Species	Status	Comment
Roseate Tern (Sterna dougallii)	Endangered, ESA Atlantic Coast south to North Carolina *Threatened* in all other areas of the Western Hemisphere (USFWS 2012b), *Least Concern* - 2012 IUCN Red List of Threatened Species (IUCN 2012)	Human exploitation (trapping for market) of the Roseate Tern on its wintering grounds has been the main threat for the species. Toxic chemicals passed through the food chain and their effects on reproduction (thinning of eggshells, premature breakage of eggs, and reduced reproductive success) are also a concern. Breeding habitat includes sandy or rocky offshore islands and barrier beaches (Gochfeld et al. 1998). European populations winter in West Africa, between Guinea and Gabon (del Hoyo et al. 1996). During the breeding season, roseate terns are strictly coastal, whereas during the non-breeding season, they migrate well offshore and may be primarily pelagic. Roseate terns feed primarily on small marine fish taken over sandbars or shoals, or over schools of pelagic predatory fish (Gochfeld et al. 1998).
Bermuda Petrel (Pterodroma cahow)	*Endangered,* ESA (USFWS 2012a) Endangered- 2012 IUCN Red List of Threatened Species (IUCN 2012).	The Bermuda petrel was exploited for food and was thought to be extinct by the 17th century. It was only rediscovered in 1951, at which time the population consisted of 18 pairs (del Hoyo et al. 1992). The population has been the subject of an ongoing recovery effort and by 2008 was up to 85 breeding pairs (Maderios et al. 2012). This population is now increasing slowly, but remains vulnerable to storm damage, erosion, and predation (BirdLife International 2012a; Maderios et al. 2012).

3.7 MARINE FISH

General information on the taxonomy, ecology, distribution and movements, and acoustic capabilities of marine fish are given in Section 3.3.1, of the NSF/USGS PEIS (2011. The Study Area encompasses demersal and pelagic habitats in the open ocean that support approximately 600 fish species (Ray et al., 1998, Smith-Vaniz et al., 1999). From a geographic perspective, the Study Area is offshore from two broad eco-regions:

(1) the Mid-Atlantic Bight (MAB) from Delaware Bay to Cape Hatteras, North Carolina; and

(2) the South Atlantic Bight (SAB) from Cape Hatteras to Cape Canaveral, Florida.

3.7.1 Demersal Fish

Demersal fish are fish that live near the seafloor for the majority of their adult lives. They are commonly referred to as groundfish and historically supported the largest fisheries in the western Atlantic. A selection of demersal fish known to occur in the Study Area are described here, including the codfishes (Family Gadidae), the flounders (Family Pleuronectidae), the redfishes (Family Scorpaeniudae), the skates (Family Rajidae). moray eels (Muraenidae), squirrelfishes (Holocentridae), groupers and sea basses (Serranidae), scorpionfishes (Scorpaenidae), grunts (Haemulidae), snappers (Lutjanidae), porgies (Sparidae), wrasses (Labridae), damselfishes (Pomacentridae), angelfishes (Pomacanthidae), blennies (Labrisomidae and Blenniidae), and triggerfishes (Balistidae). (Ophichthidae), searobins (Triglidae), drums and croakers (Sciaenidae), lizardfishes (Synodontidae), sand flounders (Paralichthyidae), and tonguefishes (Cynoglossidae).

3.7.2 Pelagic Fish

Pelagic fish are those species that spend the majority of their lives at the surface or in the water column off the seafloor. Within this broad life history classification, there exists three sub-divisions: the epipelagic fishes that live from coastal to oceanic waters, but only within the upper 100 m layer of water; the mesopelagic fishes that live between the euphotic zone and approximately 1,000 m; and the bathypelagic species that live in the water column below 1,000 m. Most epipelagic species are migratory and present on the shelf and slope typically during the summer and fall. The primary coastal pelagic families occurring in the SAB and MAB are sharks (Carcharhinidae, Lamnidae and Sphyrnidae), dogfish sharks (Squalidae), anchovies (Engraulidae), herrings (Clupeidae), mackerels (Scombridae), jacks (Carangidae), mullets (Mugilidae), bluefish (Pomatomidae), and cobia (Rachycentridae), flyingfishes (Exocoetidae), halfbeaks (Hemiramphidae), oarfishes (Regalecidae and Lophotidae), snake mackerels (Gempylidae), jacks (Carangidae), dolphinfish (Coryphaenidae), pomfrets (Bramidae), marlins, sailfish, and spearfish (Istiophoridae), swordfish (Xiphiidae), tunas (Scombridae), medusafishes (Centrolophidae), molas (Molidae), and triggerfishes (Balistidae). A number of these species, e.g., dolphin (*Coryphaena hippurus*), sailfish (*Istiophorus platypterus*), white marlin (*Tetrapterus albidus*), blue marlin (*Makaira nigricans*) and tunas are important to commercial and recreational fisheries. These species tend to school, undergo migrations, and are generally piscivorous.

Smaller coastal pelagic fishes exhibit similar life history characteristics, but the species are usually planktivorous. Smaller coastal pelagic fishes occurring in the Study Area include herrings such as alewife (*Alosa pseudoharengus*), American shad (*Alosa sapidissima*), blueback herring (*Alosa aestivalis*), Atlantic herring (*Clupea harengus*), thread herring (*Opisthonema oglinum*), Spanish sardine (*Sardinella aurita*), round herring (*Etrumeus teres*), and Atlantic menhaden (*Brevoortia tyrannus*).

In the mesopelagic and bathypelagic zones of the Study Area, fish assemblages are numerically dominated by lanternfishes (Myctophidae), bristlemouths (Gonostomatidae), and hatchetfishes (Sternoptychidae).

3.7.3 Fish Species Listed as Threatened or Endangered

Section 3.3 of the NSF/USGS PEIS (2011) provides the species overview, distribution, and critical habitat designation for fish species that could occur within the proposed Study Area. The Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) is a proposed threatened/ endangered species found in shelf waters (including areas offshore of Virginia and North Carolina) during fall and winter months. Two anadromous species, the blueback herring (*Alosa aestivalis*) and the alewife (*Alosa pseudoharengus*), are candidate species currently undergoing a status review to be listed as threatened. Atlantic bluefin tuna (*Thunnus thynnus*) is now designated as a species of special concern.

3.7.4 Fish Eggs and Larvae

Section 4.2.5.1.2 of the BOEM PEIS (2012) describes ichthyoplankton in the Study Area. Pelagic eggs and larvae found in the SAB are products of spawning mainly from warm temperate and tropical. The warm temperate species are spawned within the SAB, whereas the tropical eggs and larvae are carried into the area from more southerly spawning locations. Several of the region's commercially important species, including Atlantic menhaden, Atlantic croaker, spot, summer flounder, and southern flounder (*Paralichthys lethostigma*), migrate from nearshore shelf waters to the shelf edge to spawn. The larvae of these species are transported back across the shelf and eventually into inshore/estuarine nursery areas. Depending on the position of the Gulf Stream front, the ichthyoplankton in the SAB forms a mixture of slope and shelf/slope groups. The slope group is typified by lanternfish throughout the year. During spring, mackerel larvae reach peak abundance. Members of the slope group at other times of the year include inshore species such as gobies, wrasses, and flounders. The shelf/slope group includes fishes such as lefteye flounders, jacks, mullets (Mugil spp.), bluefish, filefish (Monacanthidae), goatfish (Mullidae), and sea basses (Serranidae); several of these are economically important species. The composition and abundance of ichthyoplankton at any particular time depends upon the position of the Gulf Stream front (Govoni 1993).

Fish eggs and larvae found in the MAB come from warm temperate, cold temperate, and boreal regions (Doyle et al., 1993). In general, the most abundant fish eggs and larvae found during winter months are those of cold temperate species originating in more northerly waters. During spring, summer, and fall months, ichthyoplankton is dominated by warm temperate species originating from more southerly waters. Lanternfishes (*Benthosema glaciale* and *Ceratoscopelus maderensis*) define the slope/oceanic group (Doyle et al., 1993) and some flatfish larvae occur with *C. maderensis*. The outer shelf group includes witch flounder, silver hake, Atlantic bonito, cusk-eels (Ophidiidae), and species from more southerly waters such as razorfish (*Xyrichtys* spp.), lefteye flounders (Bothidae), and gobies (Gobiidae) (Hare and Cowen, 1991; Cowen et al., 1993; Doyle et al., 1993).

3.8 BENTHIC INVERTEBRATES

Section 3.2 of the NSF/USGS PEIS (2011) addresses marine benthic invertebrates status, ecological importance, general ecology, and distribution. Of relevance to marine seismic activities are those invertebrates potentially sensitive to low-frequency seismic noise. Limited studies suggest that a few invertebrate groups are capable of detecting seismic noise. Among invertebrates, only decapods (lobsters, crabs and shrimps, including prawns [e.g., Offutt, 1970]), and mollusks (cephalopods such as octopuses, squids, cuttlefishes, and nautiluses [e.g., Budelmann and Williamson, 1994]) are known to sense low-frequency sound. No decapod crustaceans or cephalopod species of invertebrates are listed as vulnerable, threatened, or endangered within the Study Area.

3.8.1 Deep-Sea Corals and Sponges

Deep-sea coral species have been shown to occur in the Northeastern U.S. waters (NOAA NMFS 2011) and in close proximity to the Study Area with a few known locations (Figure 16). Deep-sea corals are important components for benthic habitats and contribute to structure and species diversity (Templeman, 2010). They provide structural complexity to relatively homogeneous seafloor and therefore likely to provide shelter, food, or substrate for epifaunal growth for other organisms (Watanabe et al., 2009) including commercial fish (Gilkinson and Edinger, 2009). Damage to corals caused by humans results in slow recovery, and the potential to alterations in associated benthic and fish communities (Templeman, 2010).

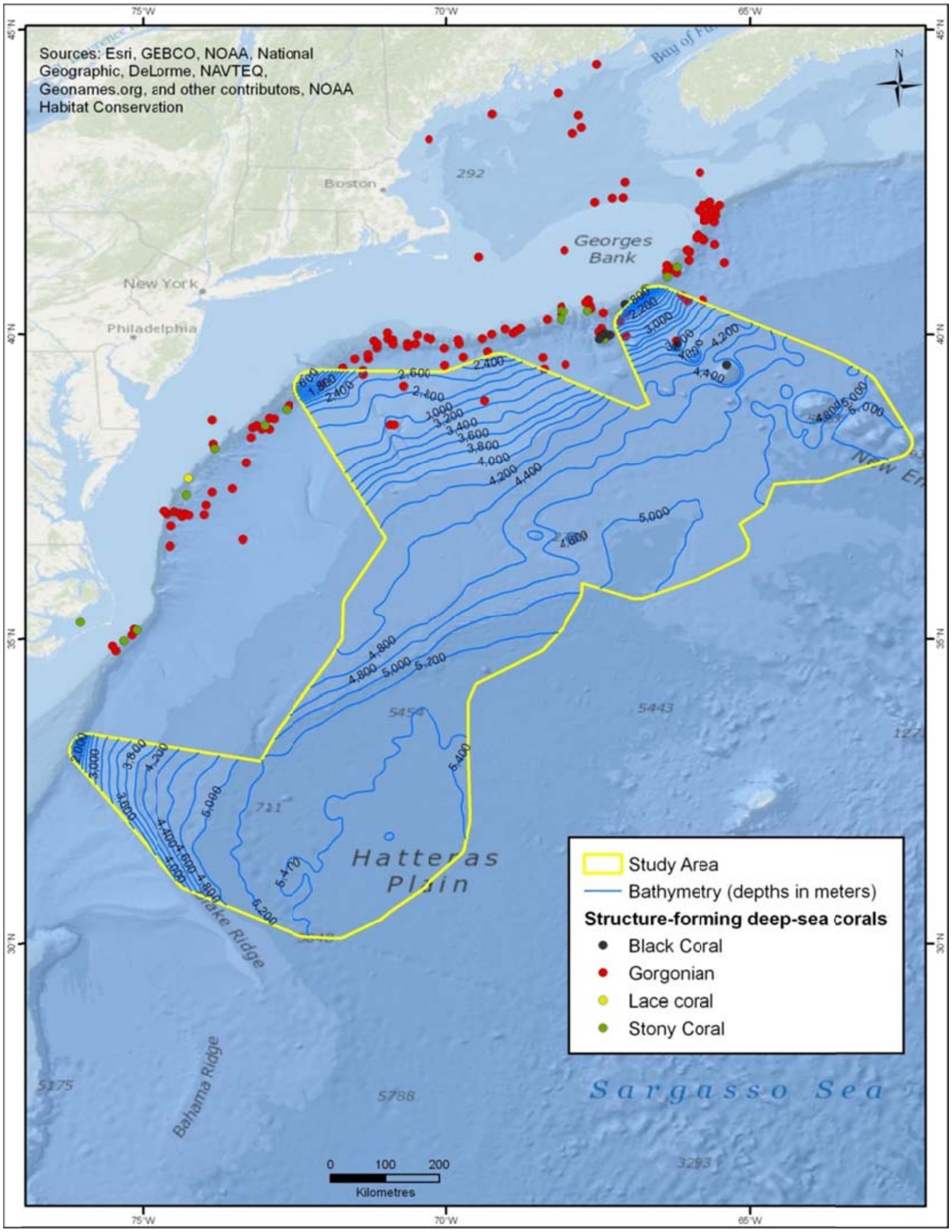

Figure 16: Deep-sea Corals

Deep corals in the northeastern U.S. belong to three major groups. There are the Hexacorals (or Zoantharia), which include the hard or stony corals (Scleractinia); the Ceriantipatharians which includes the black and thorny corals (Antipatharia), and finally there are the Octocorals (or Alcyonaria), with flexible, partly organic skeletons that include the true soft corals (Alcyonacea), gorgonians (Gorgonacea or sea fans and sea whips), and sea pens (Pennatulacea). Among all three groups, there appear to be a suite of species that occurs at depths of less than 500 m (shelf and upper slope), and a separate suite that occurs at depths greater than 500 m (lower slope and rise) (NOAA, n.d.). Population trends for deep-sea corals are not currently available, and therefore population statuses are generally unknown (NOAA NMFS, 2011). Although there are no known coral reefs in the northeast U.S. waters, deep corals can be found from shallow waters to 6,000 m depth, and are most common at depths of 50 to 1,000 m on hard substrate (NOAA NMFS, 2011).

Similar to deep-sea corals, sponges also provide deep-sea habitat, enhance species richness and diversity, and exert clear ecological effects on other local fauna. Sponge grounds and reefs support increased biodiversity compared to structurally-complex abiotic habitats or habitats that do not contain these organisms.

Physical damage or dislodgement of organisms and hard substrate, and/or crushing of corals and sponges can result from: anchoring and/or mooring of floating vessels, and seabed placement of equipment. Given the nature of seismic surveys, survey equipment is not expected to come in contact with the seafloor and deep-water corals and sponges.

3.8.2 Essential Fish Habitat

By definition, Essential Fish Habitat (EFH) is "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The entire East Coast from shoreline to the 200 nm limit is considered EFH. The proposed Study Area borders the Northeast U.S. Continental Shelf Large Marine Ecosystem (LME) and extends south and east into deeper waters. The LME is considered EFH. Section 3.3.2.1 of NSF/USGS PEIS describes the EFH for the Northwest Atlantic DAA. EFH for various life stages of numerous fish species, including Atlantic cod, Atlantic salmon, Atlantic halibut, flounder, hake, herring and other pelagic species, occurs in or proximate to the analysis area extending out to the limit of the U.S. EEZ. Table 4.20 in the BOEM PEIS (2012) lists the soft bottom species and life stages with EFH identified within the area of interest. The Study Area is overlain by sand/silt/clay surficial sediments (Figure 17) – a soft bottom. The demersal species identified with EFH include scallop, golden crab, red crab, royal red shrimp, offshore hake and witch flounder. *Sargassum*,(an abundant brown algae that occurs on the surface in the warm waters of the western North Atlantic) is also considered an EFH because of the mutually beneficial relationship between fishes and algae. Juvenile loggerhead turtles also utilize floating *Sargassum* as habitat.

Habitat Areas of Particular Concern (HAPC) are subsets of EFH that provide important ecological functions and/or are especially vulnerable to degradation. HAPC are described in the NSF ENAM Draft EA and are incorporated by reference into this Final EA.

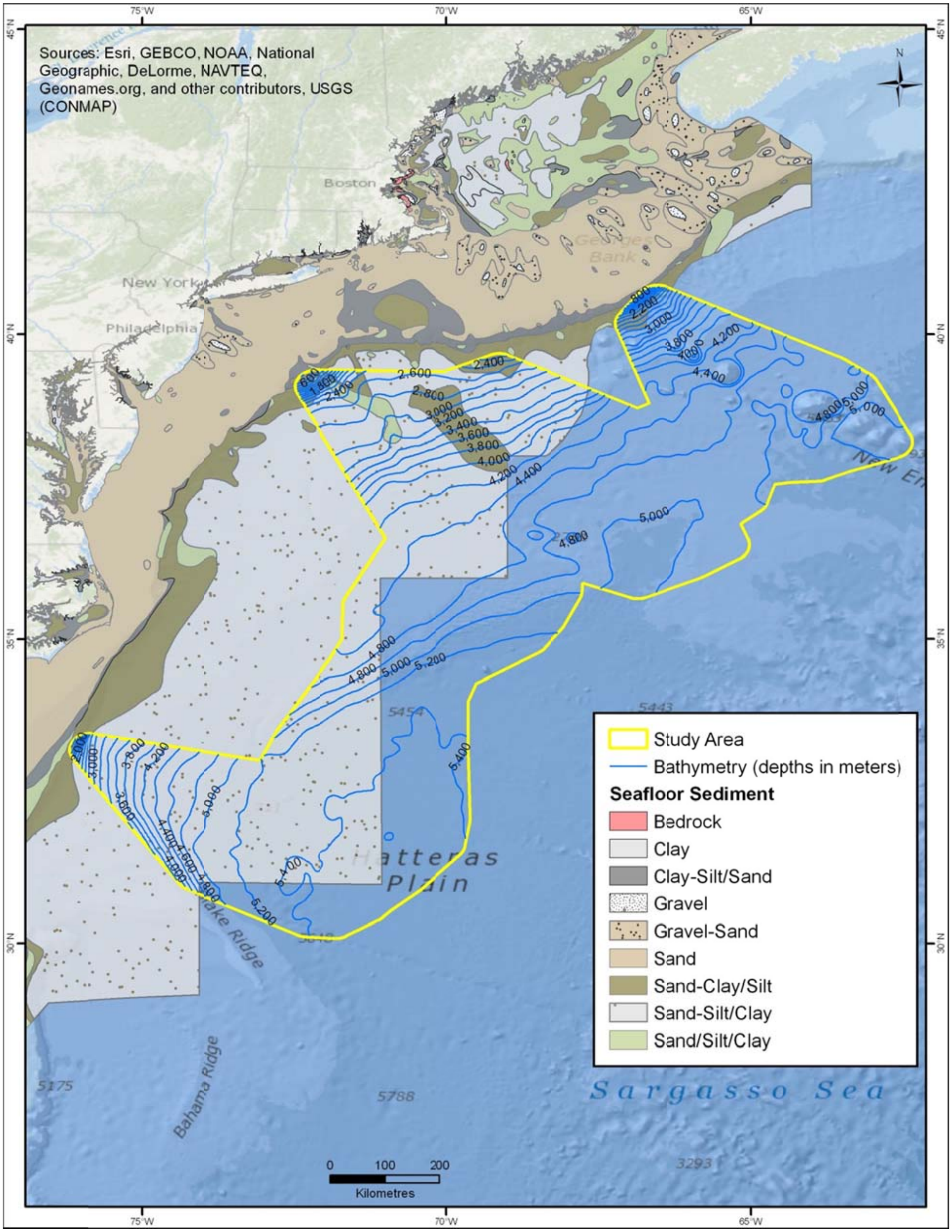

Figure 17: Seafloor Sediment

3.9 SEA TURTLES

General information on the taxonomy, ecology, distribution and movements, and acoustic capabilities of sea turtles are given in Section 3.4 of the NSF/USGS PEIS (2011). In addition, Section 3.2 of BOEM's Final PEIS (2014) Biological Assessment reviews similar information for all species of sea turtles which may occur within the proposed Study Area. Figure 18, Figure 19, Figure 20, Figure 21 and Figure 22 show the location based on OBIS sighting data of each of the five species relative to the Study Area.

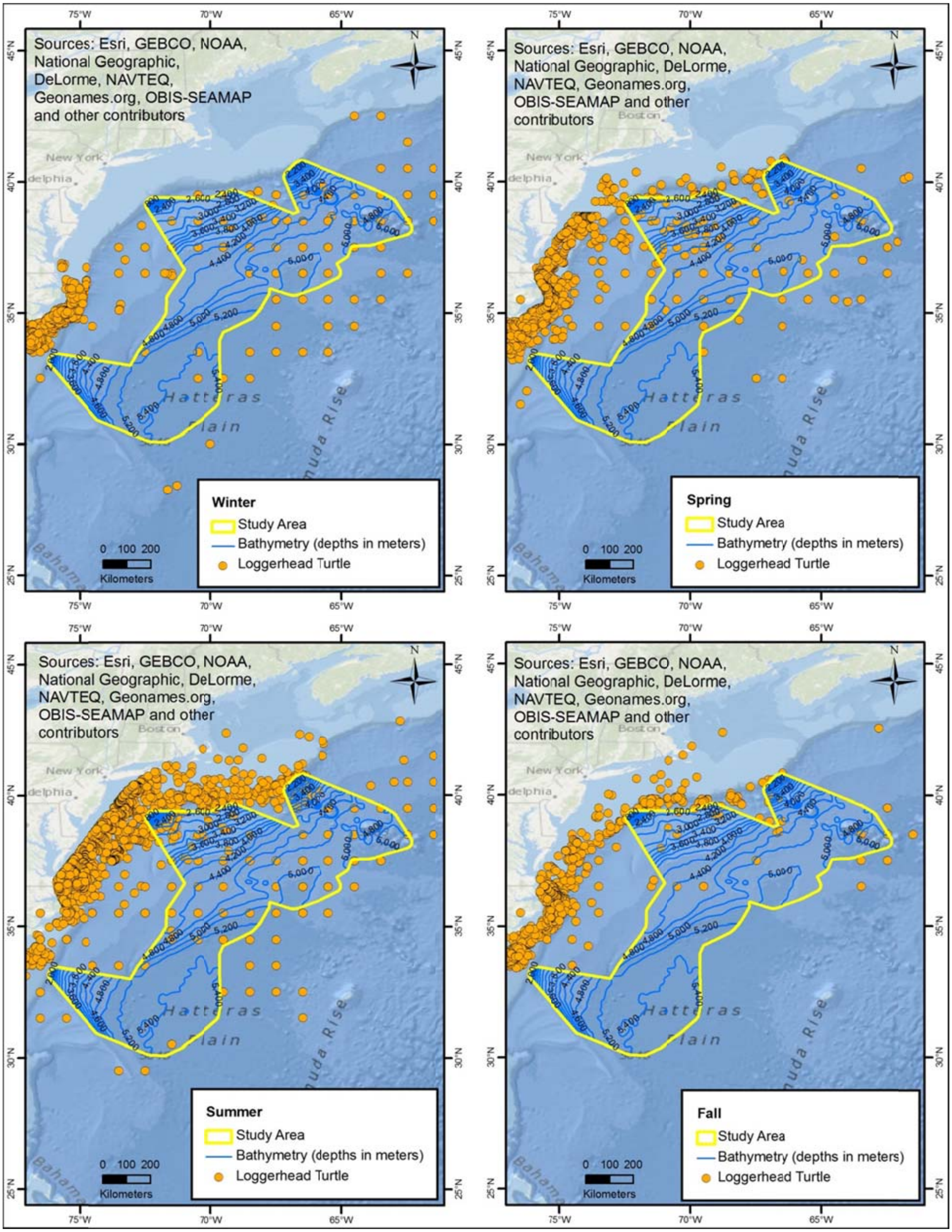

Figure 18: Seasonal Distribution of Loggerhead Turtles (multiyear observations)

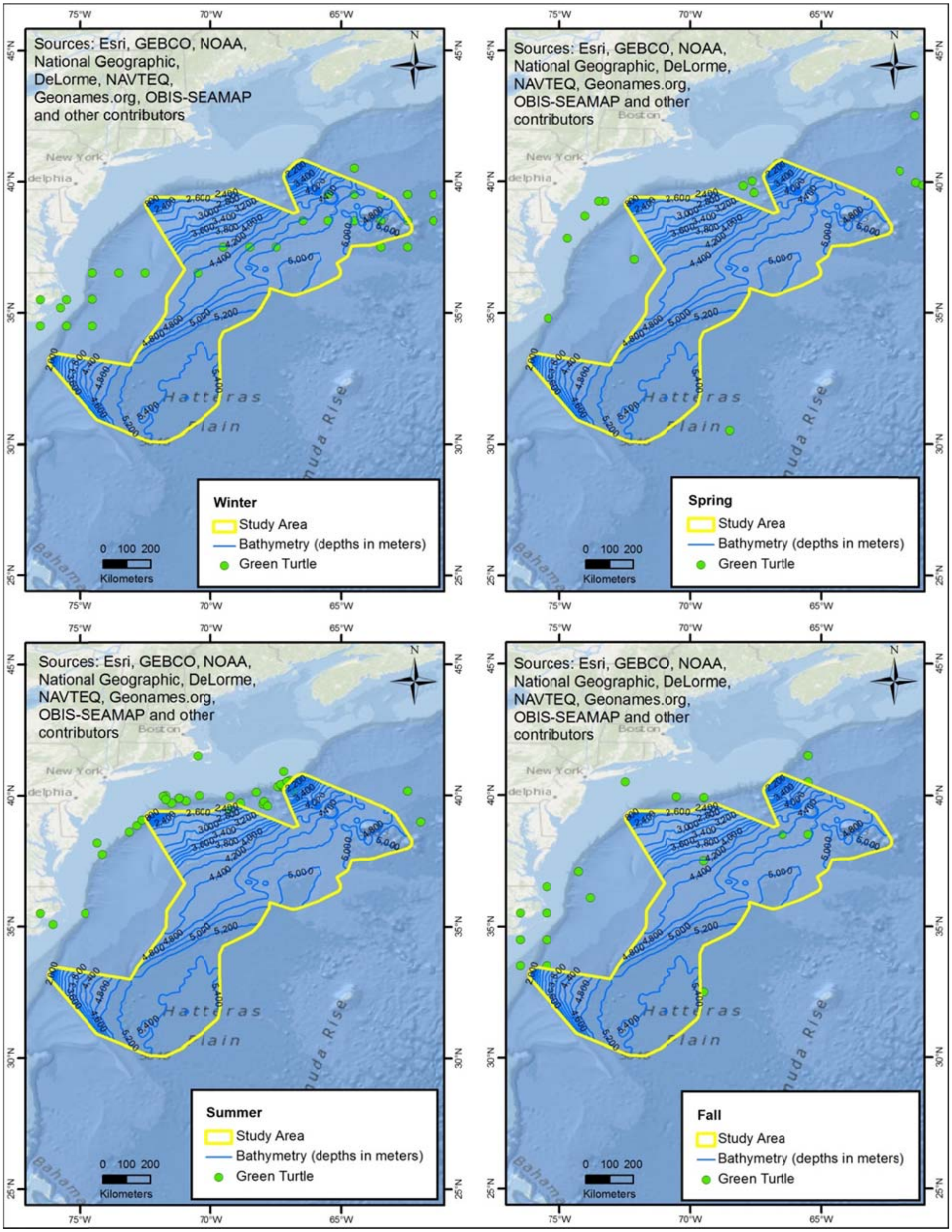

Figure 19: Seasonal Distribution of Green Turtles (multiyear observations)

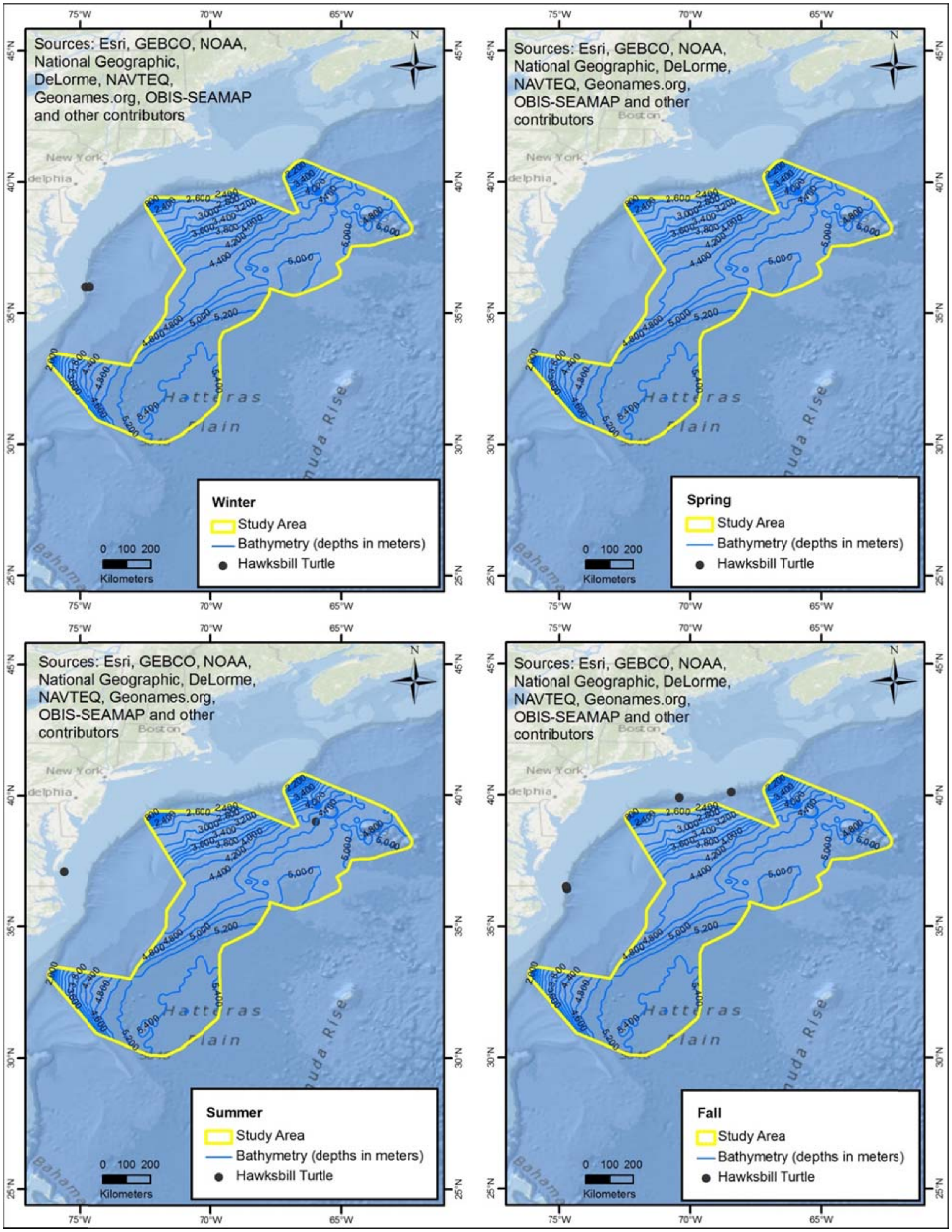

Figure 20: Seasonal Distribution of Hawksbill Turtles (multiyear observations)

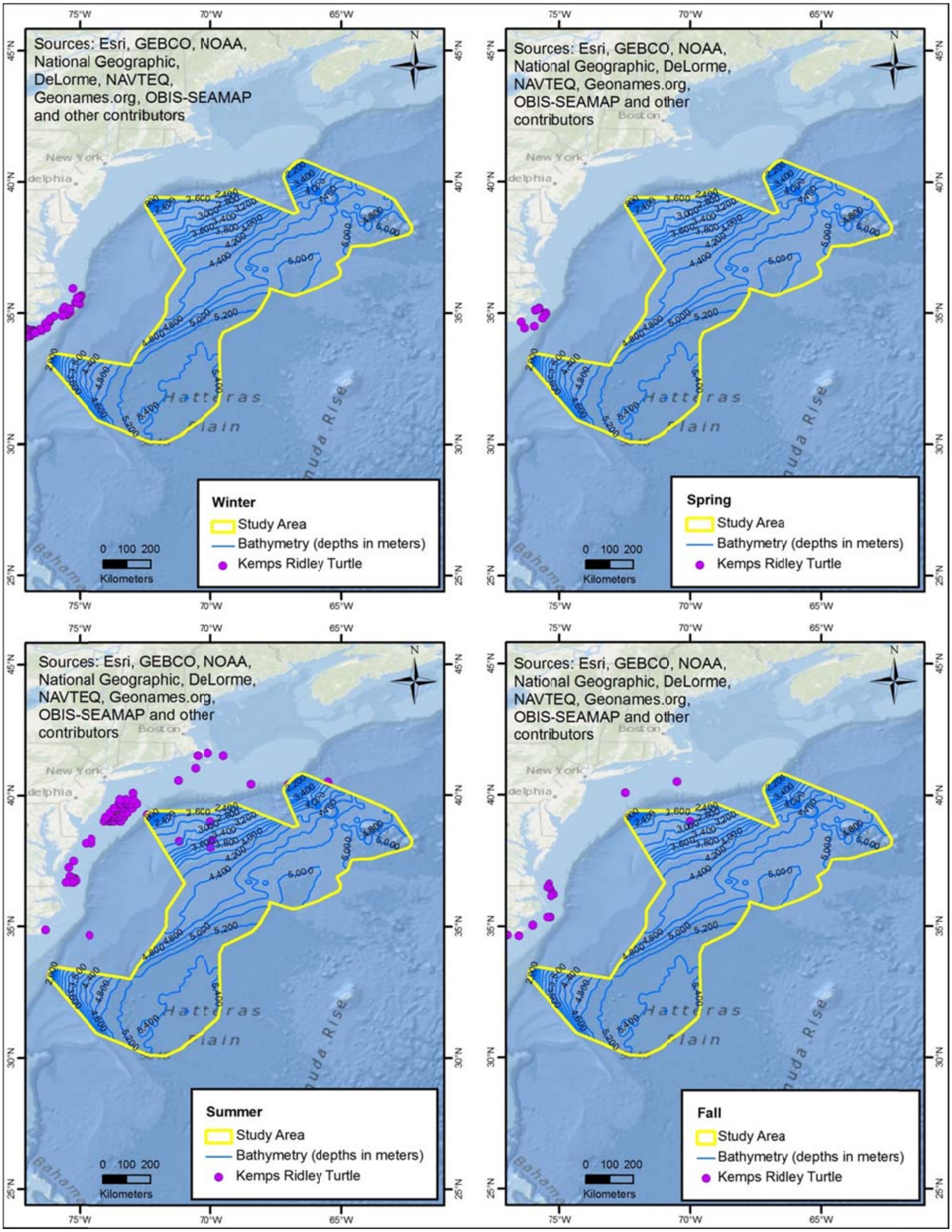

Figure 21: Seasonal Distribution of Kemp's Ridley Turtles (multiyear observations)

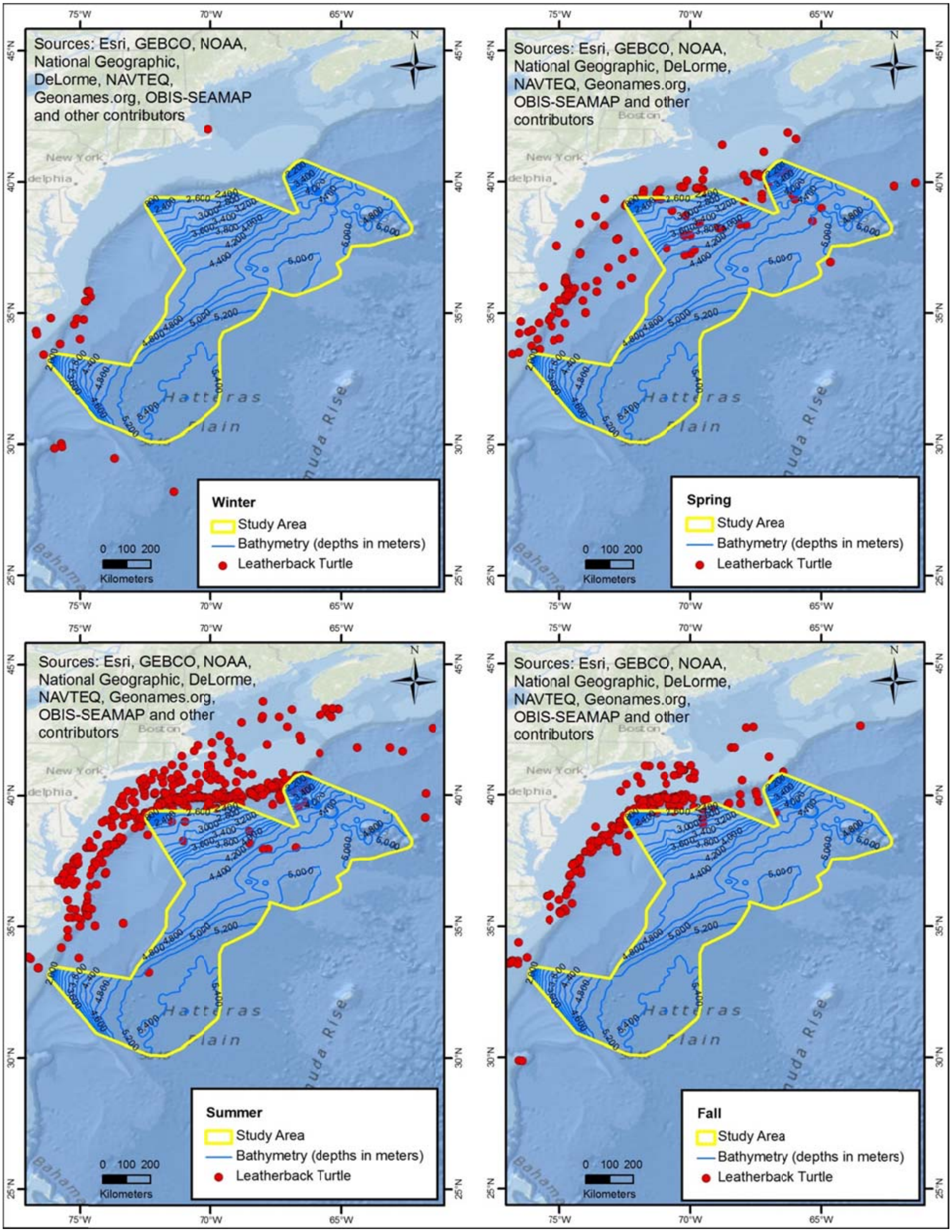

Figure 22: Seasonal Distribution of Leatherback Turtles (multiyear observations)

Table 12 summarizes the habitat, regional abundance, and conservation status of these reptiles. This section describes their distribution near the proposed Study Area. The main source of information is the OBIS database (Read et al,. 2009).

Table 12: ESA-listed Sea Turtles That May Occur the Proposed Study Area

Species (Common Name)	Occurrence near Study Area	Habitat	Estimated Annual Total Nesting Population	Status		
				ESA1	IUCN2	CITES3
Loggerhead	Regular	Oceanic, Coastal, Estuaries	38,334[4]; 68,000-90,000[5;] 9,000-50,000[6]	EN[7], TR[8]	EN	I
Green	Rare	Coastal, seagrass beds	200-1,100[5]	EN[9], TR[10]	EN	I
Hawksbill	Rare	Coral reefs, oceanic, hard bottom habitats	500-1,150[5]	EN	CR	I
Kemps ridley	Rare	Temperate and tropical coastal	5,000[11]	EN	CR	N/A
Leatherback	Regular	Ocean, continental shelf, nearshore	5,215[12]; 906[13]; 26,000-43,000[14]	EN	CR	NA

N/A – Not available or not assessed
U.S. Endangered Species Act: EN = Endangered; TR= Threatened; NL = Not listed (ECOS 2013)
[2] Codes for IUCN classification: EN = Endangered; CR = Critically Endangered; VU = Vulnerable; LC = Least Concern; DD = Data Deficient. Classifications are from the IUCN Red List Threatened Species (IUCN 2012).
[3] 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 by may become so unless trade is closely controlled.
[4] Richards et al. (2011) (Western North Atlantic stock)
[5] NOAA (2013) – In the U.S.
[6] Ernst et al. (1994) – North American Population
[7] Northeast Atlantic Ocean stock
[8] Northwest Atlantic Ocean stock
[9] Breeding population in Florida and on the Pacific coast of Mexico
[10] All other populations
[11] NOAA & FWS (1991)
[12] NMFS and FWS (2008) - Nesting beaches from Florida-Georgia border through southern Virginia
[13] NMFS and FWS (2008) - Nesting beaches from Franklin County on the northwest Gulf coast of Florida through Texas
[14] Dutton et al. (1999) - Worldwide Population

Loggerhead Turtle (*Caretta caretta*)

Loggerhead turtles are likely to be the most present species in the proposed Study Area. OBIS has several thousands of sightings for this species in the waters adjacent to the proposed Study Area. The majority of sightings occurring near the Study Area are off the western extent of its boundaries in the coastal and shelf waters. None the less, there are still hundreds of sightings in the deeper oceanic waters as well. Within the Study Area boundaries, OBIS sightings are ~ 200, with the majority occurring in the northwest. Recent sightings include a 2010 record by the North Carolina Long-Term Sea Turtle Monitoring Project, and a 2010 record by the Casey Key Loggerheads survey. The majority of the sightings within the Study Area were made between the months of June and August. However, several winter and spring sightings from NOAA'sSoutheast Fishery Science Center (SEFSC) Fisheries Log Book System (FLS) Commercial Pelagic Logbook Data suggest that Loggerheads use this area year-round.

Green Turtle (*Chelonia mydas*)

Although not considered common within the proposed Study Area, the green turtle has been observed within its boundaries. According to OBIS there were 24 sightings of this species, with the majority occurring in the northeast. Eighteen of these sightings were made between November and January, and a majority was reported in January 2004, all within a week of each other by Duke North Atlantic Turtle Tracking. This may indicate that the same specimen was seen time and time again during the study. The other sightings occurred between June and August.

Hawksbill Turtle (*Eretmochelys imbricata*)

The hawksbill turtle is considered rare within the proposed Study Area, with only two reported OBIS sightings. In the adjacent water west of the Study Area, only seven sightings exist in the OBIS database. The two sightings within the Study Area occurred in October, 1992 and June, 1993. Both were logged from SEFSC FLS Commercial Pelagic Logbook Data.

Kemp's Ridley Turtle (*Lepidochelys kempii*)

Within adjacent waters to the proposed Study Area, the Kemp's Ridley turtle is primarily observed in coastal and shelf waters. Within the Study Area, this species has been observed in shelf and slope waters at its northern extent twice, and northwestern extent five times. All observations were made between May and August with the most recent being in 1998.

Leatherback Turtle (*Dermochelys coriacea*)

The OBIS database reports that there are several hundreds of sightings of the leatherback in the vicinity of the proposed Study Area. Within its boundaries there are ~ 100 sightings of these species in the shelf and slope waters in the north and northwest. The majority of the sightings occurred between May and August. However, the SEFSC FLS Commercial Pelagic Logbook Data has recorded sightings between September and January.

3.10 OCEAN RESOURCE USERS

3.10.1 Navy Operation Areas

Military range complexes and civilian space program use is covered in Appendix A, Section 4.1.3 of BOEM Final PEIS (2014). The Study Area overlaps spatially with the Narragansett Operation Area (Figure 23). Military activities could include various air-to-air, air-to-surface, and surface-to-surface naval fleet training, submarine and antisubmarine training, and Air Force exercises.

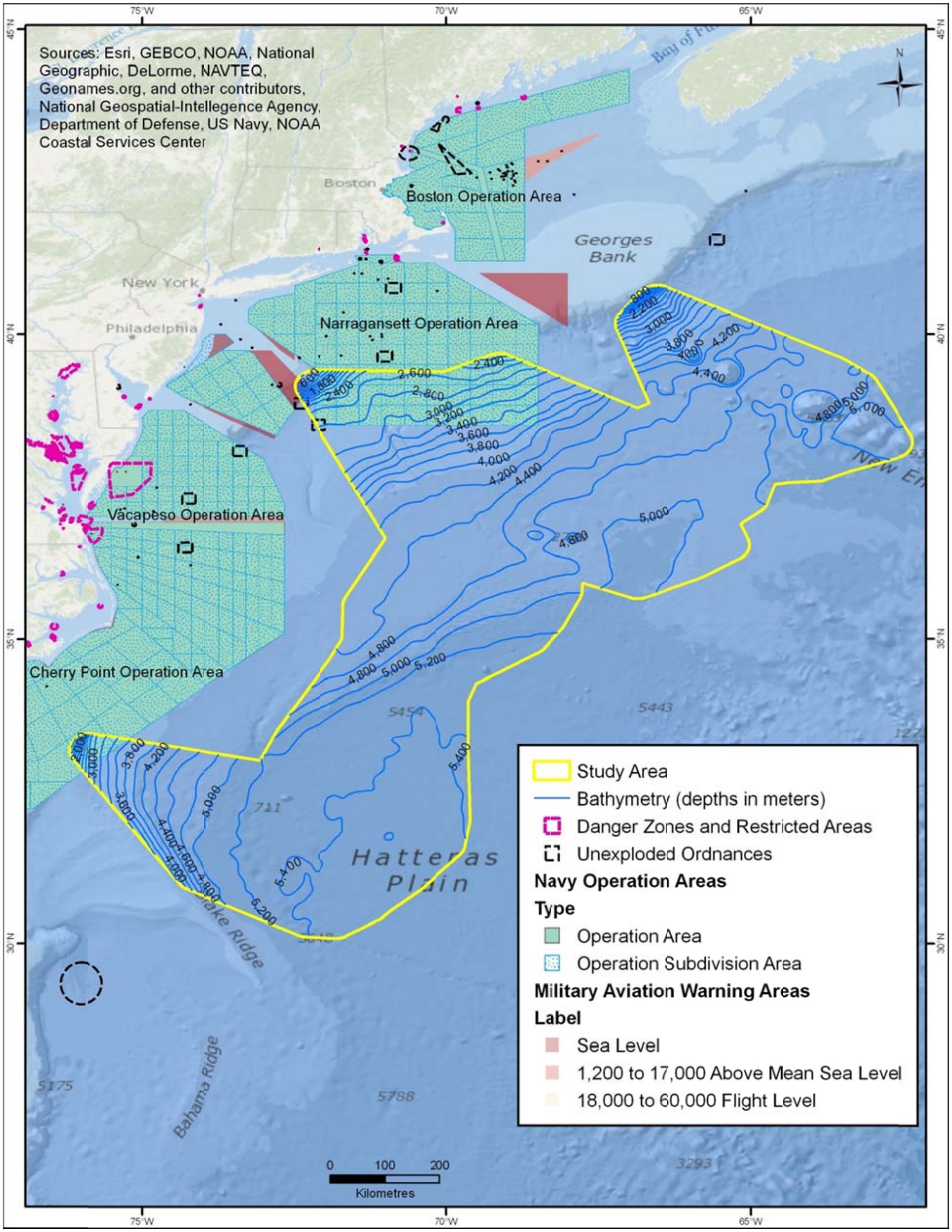

Figure 23: Navy Operation Areas

Unexploded Ordnances

Unexploded ordnance (or UXOs/UXBs, sometimes identified as UO) are explosive weapons (bombs, bullets, shells, grenades, land mines, naval mines, etc.) that did not explode when they were employed and still pose a risk of detonation, potentially many decades after they were used or discarded (DOC, NOAA, NOS, and CSC 2012). As shown in Figure 24 two UOs may exist within the proposed Study Area, and one lies only ~12.4mi (~20-km) of the northern boundary line. This is not a complete collection of unexploded ordnance on the seafloor, nor are the locations to be considered exact (DOC et al., 2012). The presence and locations of the unexploded ordnance have been derived from graphical representations recorded on NOAA Raster Navigation Charts (DOC et al., 2012).

Given that there is no bottom-founded activity associated with the proposed seismic surveying there would be no anticipated interaction with the potential UO sites.

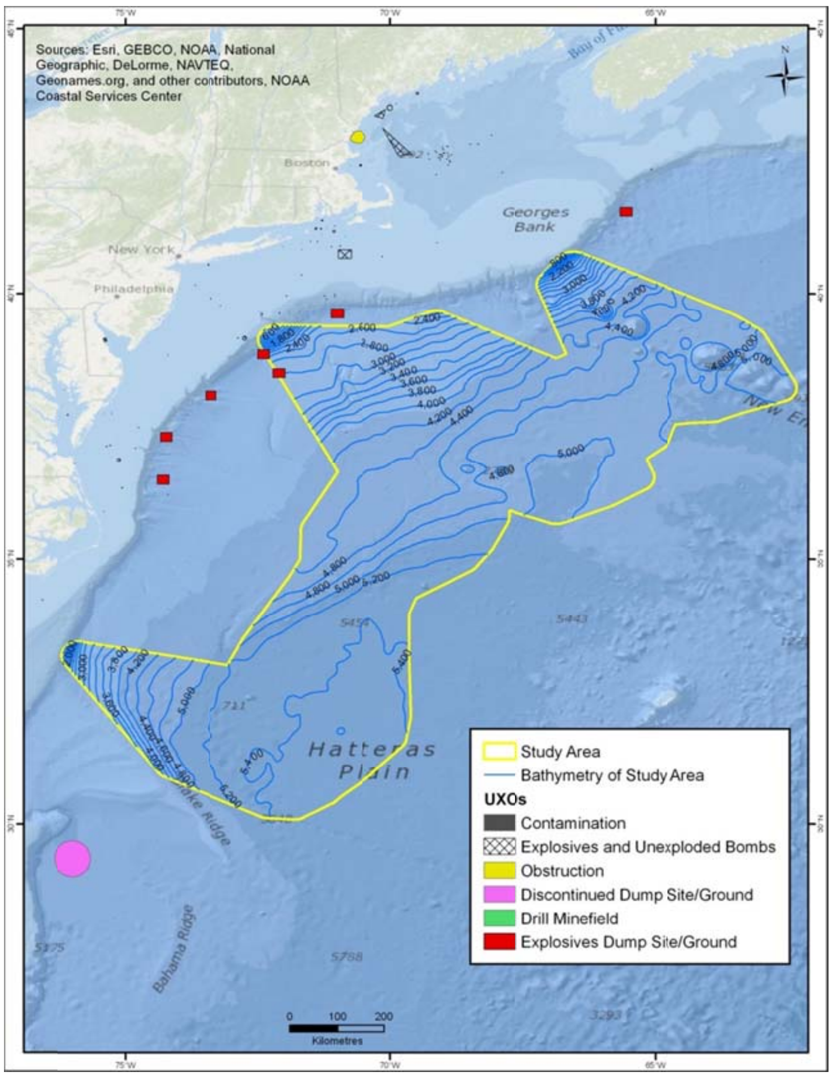

Figure 24: Unexploded Ordnance

3.10.2 Marine Traffic

Shipping and marine transportation is covered in Sections 4.1.1 and 5.10.1.1 of BOEM, 2012 Biological Assessment.

Marine traffic within the proposed Study Area and in adjacent waters includes commercial, military, and recreational shipping and marine transportation. Large commercial ships have designated shipping fairways and navigation channels along the inner shelf (Figure 25).

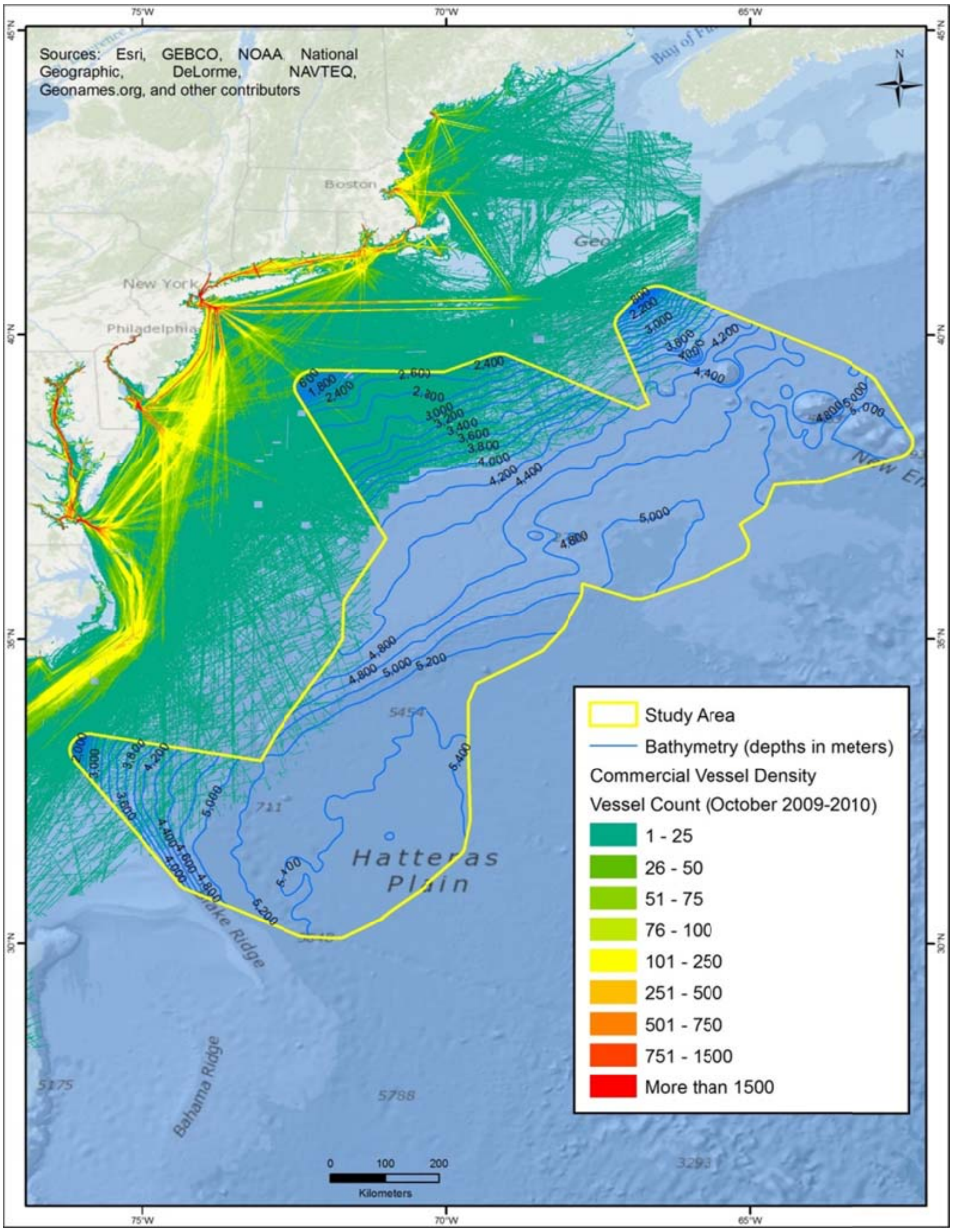

Figure 25: Marine Traffic

The proposed Study Area's western boundary is 808 mi (1300 km) long and runs somewhat parallel to the Atlantic Seaboard and six large, commercial ports: New York/New Jersey, Boston, Baltimore, Norfolk, Virginia (Port of Virginia), Wilmington (North Carolina), and Charleston. As noted previously, however, the proposed tracks are generally greater than 99 miles (159 km) from the coast, where port traffic is expected to be heaviest.

The smaller ports and terminals (Figure 26) located in the Delaware River include Wilmington, DE, and Philadelphia, which are accessed via the Delaware Bay. Delaware Bay is about 140 mi (225 km) west of the northwestern extent of the Study Area. Chesapeake Bay, 252 mi (405 km) west of the Study Area boundary, provides access to the Port of Baltimore, including numerous smaller ports in Maryland and Virginia.

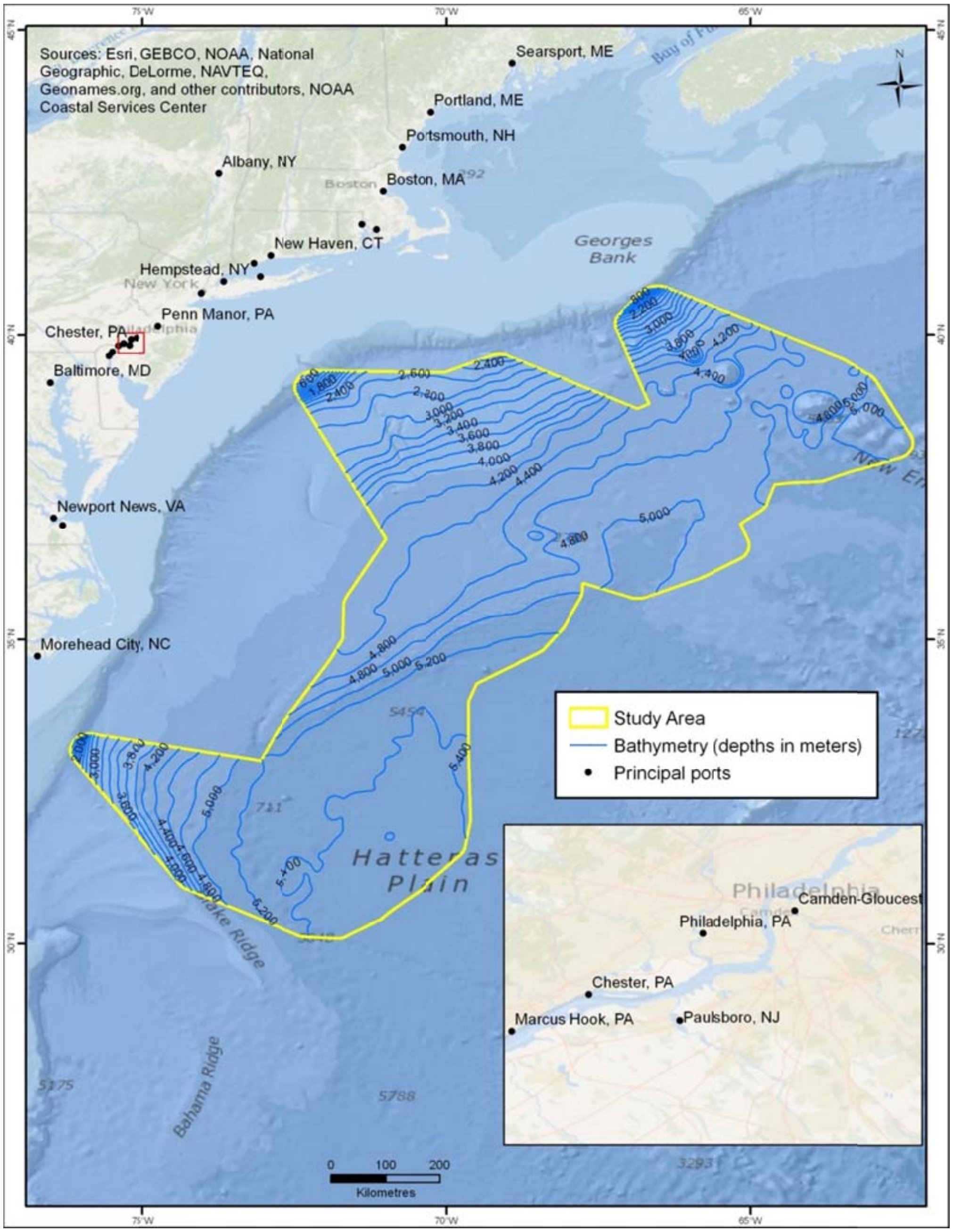

Figure 26: Ports and Terminals

3.10.3 Petroleum

Oil and Gas

Oil and gas exploration and development is covered in Section 4.1.6 of BOEM (2012) Biological Assessment. There are currently no active oil and gas leases or oil and gas exploration, development or production activities on the Atlantic OCS. This lack of activity is expected to be the status quo for the duration of this project. On July 23, 2014, BOEM issued a Record of Decision (ROD) for the Atlantic OCS Proposed Geological and Geophysical Activities, Mid-Atlantic and South Atlantic Planning Areas, Final Programmatic Environmental Impact Statement (PEIS).

Liquefied Natural Gas

Liquefied Natural Gas (LNG) is covered in Section 4.1.7 and Section 5.10.1.3 of BOEM (2012) Biological Assessment. Since BOEM (2012), an application from Liberty Natural Gas LLC was received by the Maritime Administration (MARAD) for all Federal authorization required for a license to construct, own, and operate an LNG deepwater port, known as Port Ambrose (Figure 27). This application was received on September 28, 2012. The port would be situated in Federal waters approximately 17 nm (31.4 km) southeast of Jones Beach, New York, approximately 24 nm (44.4 km) east of Long Branch, New Jersey, and about 27 nm (50 km) from the entrance to New York Harbor, in a water depth of approximately 103-ft (31.4 m). The application was deemed complete in June 2013 and public scoping meetings were held during the summer of 2013.

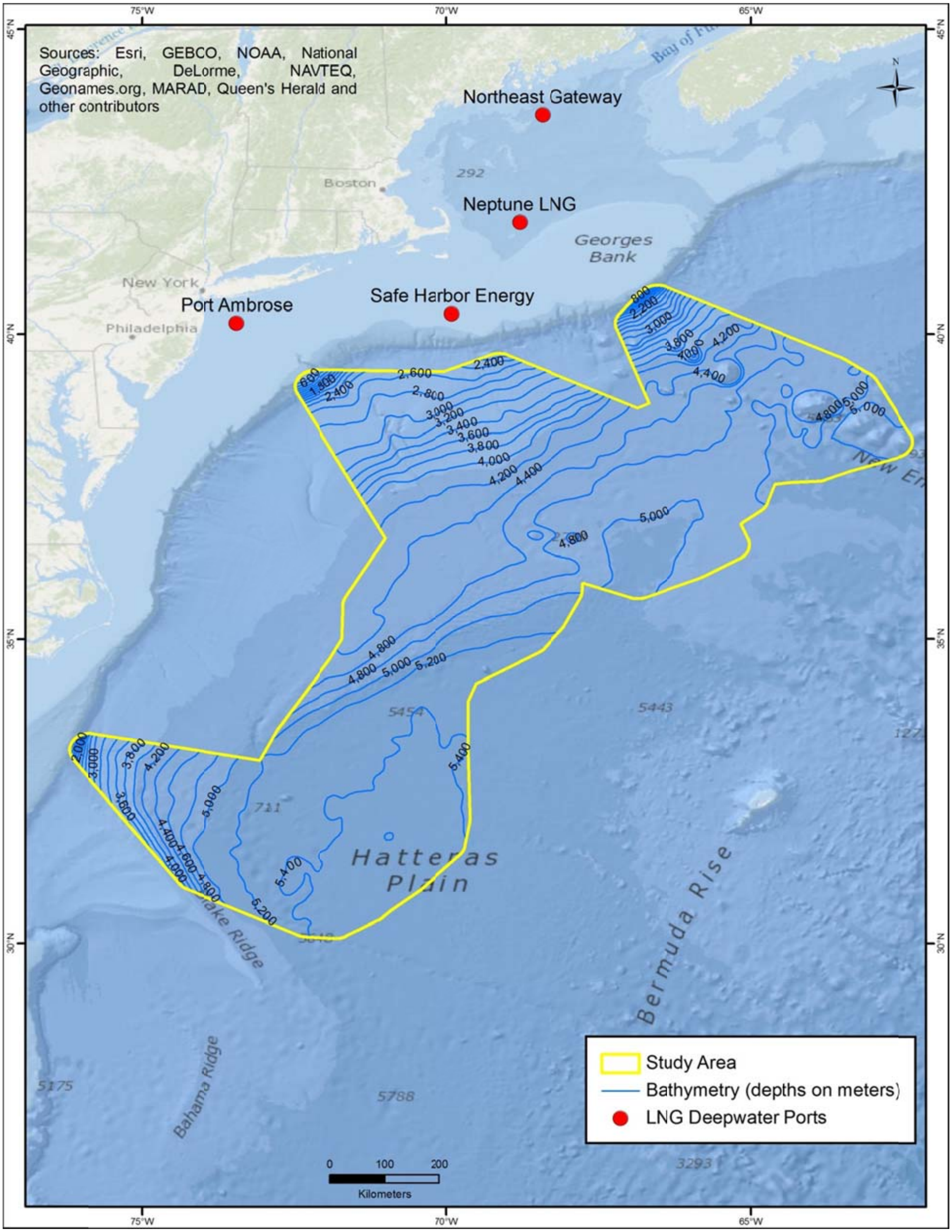

Figure 27: LNG Deepwater Ports

Also since BOEM (2012) PEIS was published, the operational LNG deepwater port, Neptune requested by letter dated May 24, 2012, that the MARAD allow a temporary five-year suspension of operations at the Deepwater Port. The MARAD issued an amended deepwater port license to allow the five-year suspension of operations.

Therefore, for this project's operation period of 2014 and 2015, it is expected that only one LNG deepwater port (Northeast Gateway) would be in operation. Figure 27 delineates the three LNG deepwater ports relative to the Study Area.

3.10.4 Submarine Cables

The submarine cable industry has been around for approximately 150 years and includes copper telegraph cables, telephone cables and fiber-optic cables. Figure 28 depicts the locations of these submarine cables in and around U.S. navigable waters, including in the Proposed Study Area. The interactive map indicates that there are at least 12 active submarine cables within the proposed Study Area. The majority of the cables are found in the northern extent of the Study Area.

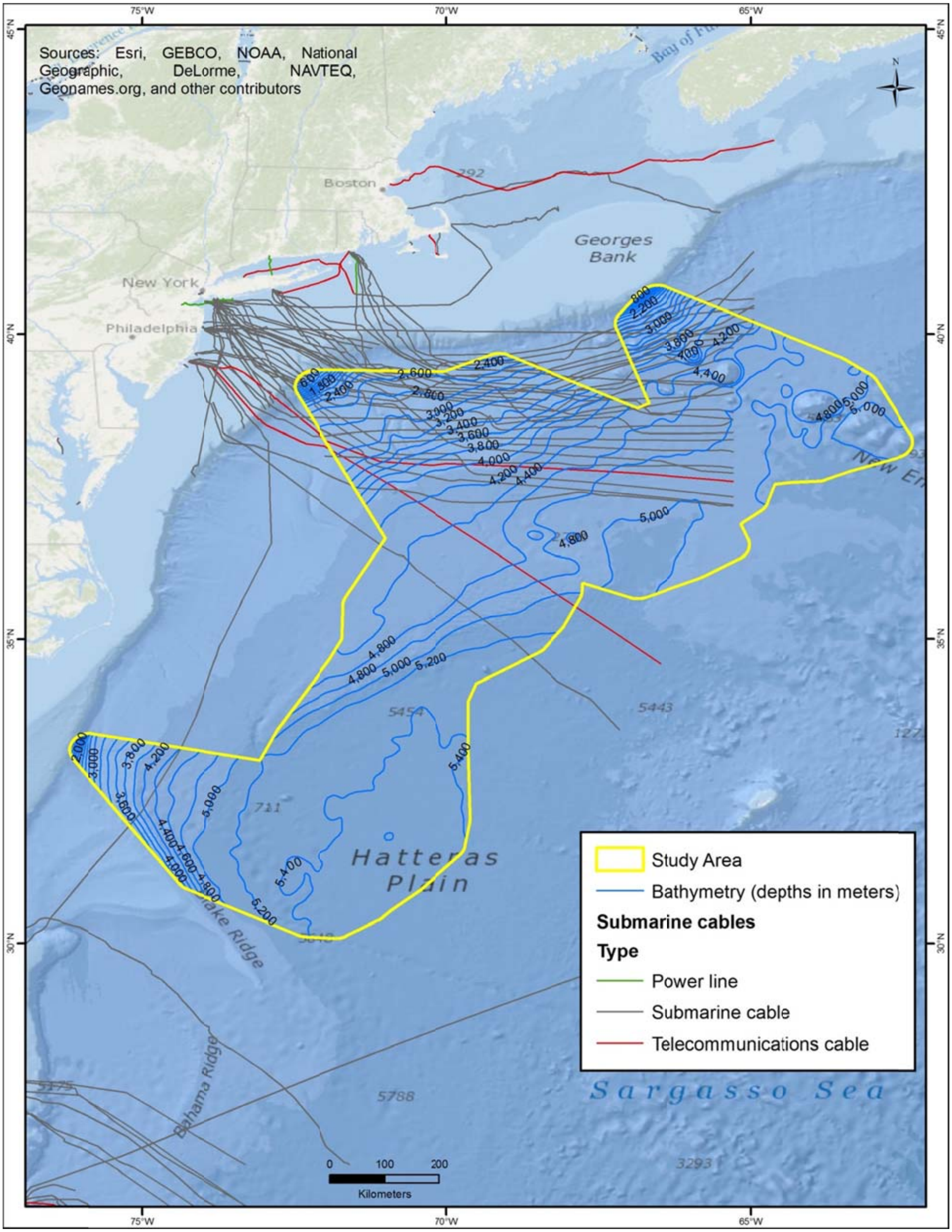

Figure 28: Submarine Cables

According to the interactive map found at (http://www.submarinecablemap.com/) and maintained by TeleGeography, the 6,524 mi (10,500 km) cable with a ready-for-service date of 2015 is planned between Brazil and New York by Seaborn Networks. The cable route intersects the proposed Study Area, therefore, there is a very remote possibility of interaction between the seismic vessel and the cable laying vessel.

Given that there is no bottom-founded activity associated with seismic surveying, the project would neither impact existing cable operations, nor be impacted by existing submarine cables.

3.10.5 Commercial and Recreational Fisheries

The Project area supports nationally and internationally important commercial fisheries. Because of the distance from shore, recreational fishing effort and landings for the Project area are extremely limited. As a result, some of the information provided in this section includes recreational catch data as reported by U.S. (NOAA) and international organizations, such as the 2012 Stock Assessment and Fishery Evaluation (SAFE) Report for Atlantic Highly Migratory Species. From 2008-2012, commercial fishermen, using multiple gear types, recorded over 1.2 million hours fishing, landing approximately 114,000 metric tons (252 million pounds) of fish from the 14 NMFS Statistical Areas that are associated with the Project area (NOAA 2013a). In further offshore portions of the Project area, the primary commercial species sought are classified as highly migratory species (HMS), i.e., species that are generally found in the offshore pelagic environment beyond the continental shelf. HMS are characterized as having vast geographical distributions, with extensive individual migrations often spanning entire oceans (Lynch et al,. 2011). The National Marine Fisheries Service (NMFS) works with other nations through the International Commission for the Conservation of Atlantic Tuna (ICCAT) to manage these globally distributed species through a catch quota system for each member country. In the U.S., tuna and billfish recommendations from ICCAT are implemented by the NMFS division of HMS under the Atlantic Tuna Convention Act and Magnuson-Stevens Act. The Fishery Conservation Amendments of 1990 classified tuna and billfish to be highly migratory species. In 1996, the Sustainable Fisheries Act modified the Magnuson Fishery Conservation and Management Act to create advisory panels that aid in creating fishery management plans to manage billfishes and HMS. Responsibilities of the panels include lowering bycatch and mortality related to bycatch, and stopping overfishing (NOAA 2009).

Another commercial species sought just within the Project area is the deep-sea red crab (*Chaceon quinquedens*). The red crab occurs in a patchy distribution from Nova Scotia to Florida and is found primarily within a 200 to1,800-meter depth band along the continental shelf and slope, but the highest densities and biomass occur between 320 and 910 meters (Figure 29) (New England Fishery Management Council [NEFMC], 2011). The species is also reported to occur in the deep-water canyons along the coast, including Norfolk, Hudson, Hydrographer, and Oceanographer Canyons. In 2002, the NEFMC implemented the Deep Sea Red Crab Fishery Management Plan (NEFMC, 2002). Under the plan, a limited access fishery was implemented, with the fishery authorized to operate with a target total allowable catch (TAC) of 2,688 mt (5.928 million pounds), a 780 days-at-sea allocation, and a trip limit of 34 mt (75,000 pounds). The red crab population in U.S. North Atlantic waters, between Georges Bank and Cape Hatteras, is managed as a single stock.

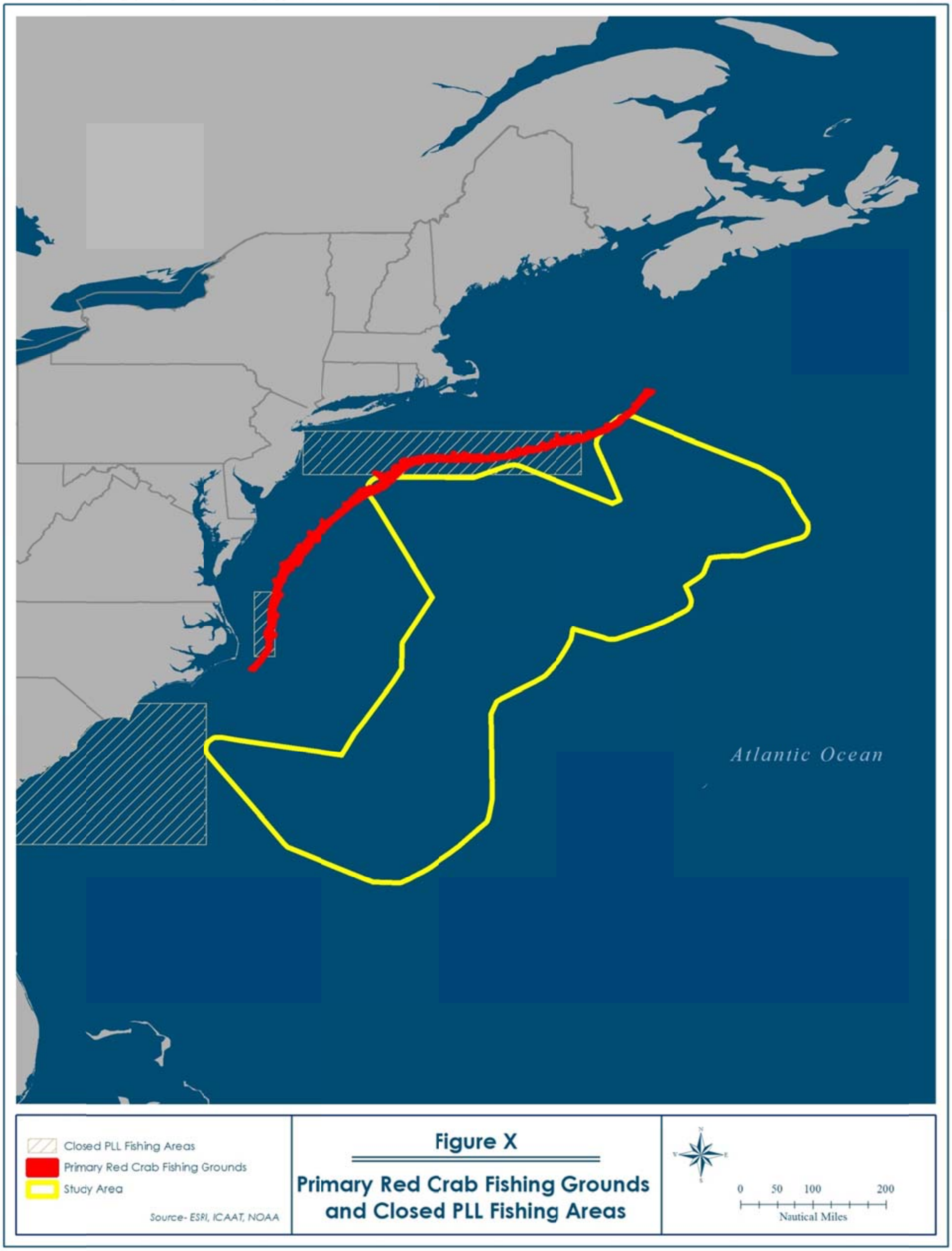

Figure 29: Primary Red Crab Fishing Grounds and Closed PLL Areas

3.10.5.1 Highly Migratory Species

Commercial HMS fisheries in the Project area primarily use pelagic long line (PLL) fishing gear, but other fishing gears include purse seines, handgear (handlines and harpoons), and gillnets (i.e., for sharks). Traps were historically used for HMS, but this method is not employed currently. The list of authorized fishing gear used in HMS fisheries became effective December 1, 1999 (64 FR 67511) and has been modified several times in subsequent final rules. As stated in the rule, “no person or vessel may employ fishing gear or participate in a fishery in the exclusive economic zone (EEZ) not included in this List of Fisheries without giving 90 days’ advance notice to the appropriate Fishery Management Council (Council) or, with respect to Atlantic HMS, the Secretary of Commerce (Secretary).” The greatest cumulative percentage of landings within the Project area is associated with PLL, purse seining, and hand gear. As such, only these three fishing methods are discussed in detail in later sections.

The primary species taken in HMS fisheries include swordfish, wahoo, dolphin, eight tuna species (albacore [*Thunnus alalunga*], Atlantic bluefin tuna [*Thunnus thynnus*], bigeye tuna [*Thunnus obesus*], blackfin tuna [*Thunnus atlanticus*], bonito [*Sarda sarda*], little tunny (*Euthynnus alletteratus*), skipjack tuna [*Katsuwonus pelamis*], and yellowfin tuna [*Thunnus albacares*]), and various species of pelagic sharks (e.g., shortfin mako shark [*Isurus oxyrinchus*]).

In order to minimize bycatch and bycatch mortality in the domestic PLL fishery, NMFS implemented regulations to close certain areas of the Atlantic to this gear type (see Figure 29). Historic (1950’s-2010) catch levels for predominant species by gear type within portions of the Project area are presented in Figure 30, Figure 31 and Figure 32.

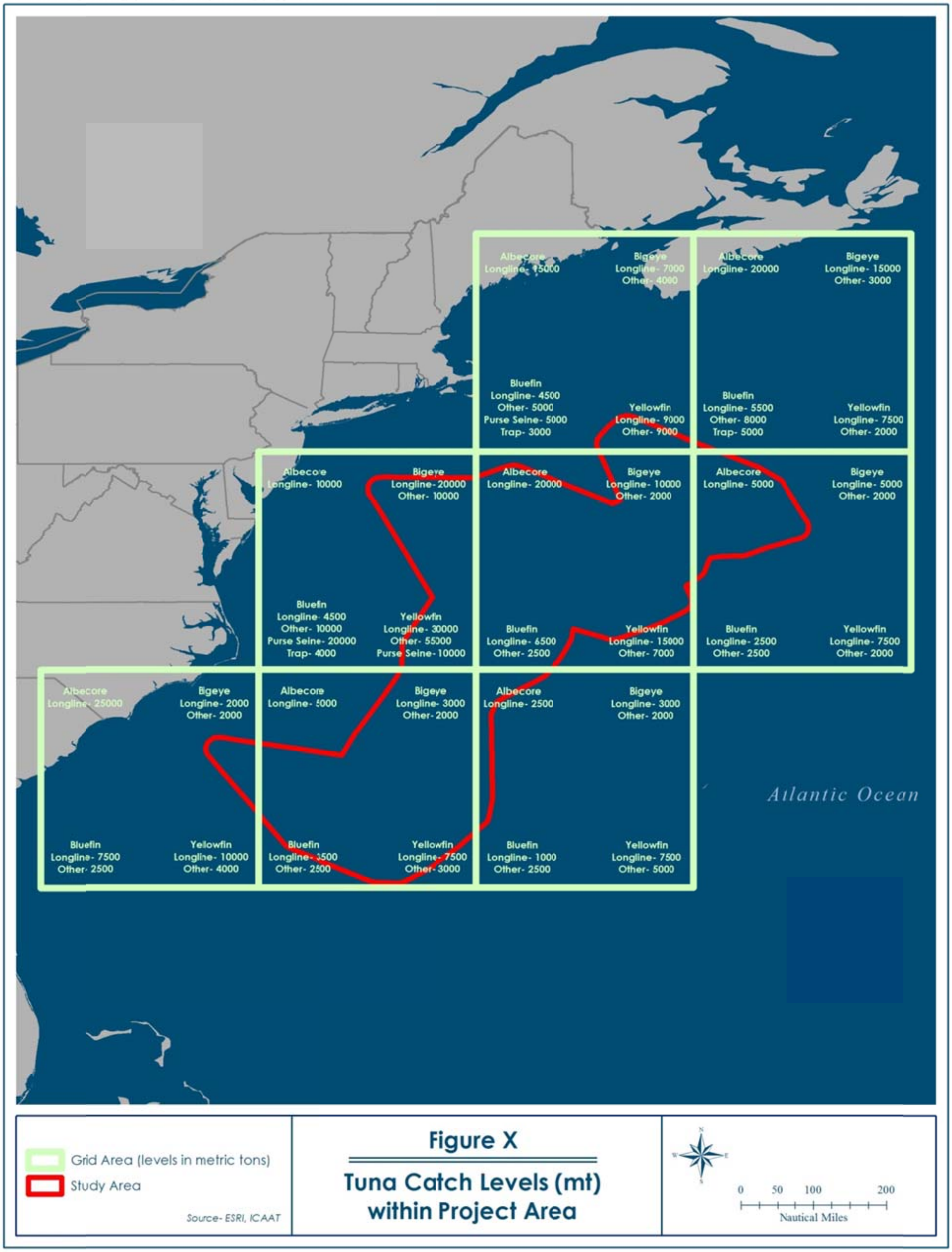

Figure 30: Tuna Catch Levels (mt) within the Project Area

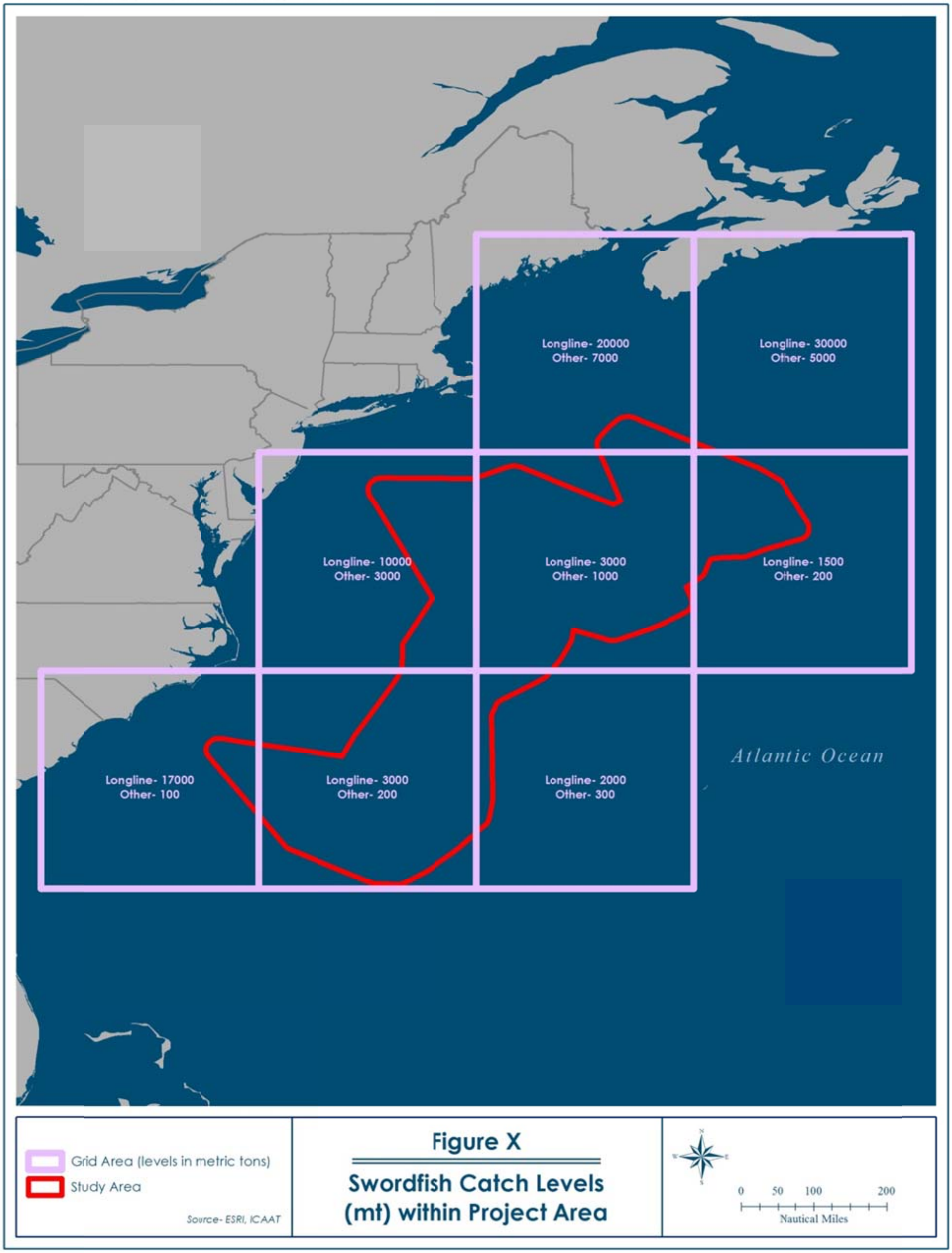

Figure 31: Swordfish Catch Levels (mt) within the Project Area

Figure 32: Marlin Catch Levels (mt) within the Project Area

3.10.5.2 Pelagic Longlines (PLL)

The PLL fishery for Atlantic HMS primarily targets swordfish, blue fin tuna, yellowfin tuna, and bigeye tuna in various areas and seasons. Secondary target species include dolphin, albacore tuna, and, to a lesser degree, sharks. Although this gear can be modified (e.g., depth of set, hook type, hook size, bait, etc.) to target swordfish, tunas, or sharks, it is generally a multi-species fishery. PLL vessel operators are opportunistic, switching gear style and making subtle changes to target the best available economic opportunity on each individual trip. PLL gear sometimes attracts and hooks non-target finfish with little or no commercial value as well as regulated species, e.g., billfish, which cannot be retained by commercial fishermen. PLL gear may also interact with protected species such as marine mammals, sea turtles, and seabirds. Thus, this gear has been classified as a Category I fishery with respect to the MMPA. Any species that cannot be landed due to fishery regulations (or undersized catch of permitted species) is required to be released, regardless of whether the catch is dead or alive.

Commercial fishing vessels set PLL gear to target swordfish at sunset and retrieve gear around sunrise, while the opposite pattern is followed for tuna; gear is set at sunrise and retrieved in the afternoon before sunset. The longline fishery for tuna and swordfish is active year-round in the Project area, but most of the commercial fishing effort is in the spring through fall, when the weather is better. Commercial fishermen targeting HMS fisheries with pelagic longline gear generally set their gear in association with the Gulf Stream; PLL sets can be made on the east or west side of the Gulf Stream current, which varies daily. PLL fishing vessels are mobile, so commercial fishing activity can occur far away (370 to 555 km [200 to 300 nm]) from their respective ports of call.

The U.S. PLL fleet represents a small fraction of the international PLL fleet that competes on the high seas for catches of tuna and swordfish. In recent years, the proportion of U.S. PLL landings of HMS, for the fisheries in which the U.S. participates, has remained relatively stable in proportion to international landings (NOAA 2012). Historically, the U.S. fleet has accounted for less than 0.5% of the landings of swordfish and tuna from the Atlantic Ocean south of 5° N. Lat. U.S. Atlantic PLL catch is primarily associated with vessel characteristics and gear configuration. Table 13: provides a summary of U.S. Atlantic PLL landings, as reported to the ICCAT. Catch levels using PLL for predominant species in portions of the Project area are presented in Figure 30, Figure 31 and Figure 32.

Within the area where the U.S. PLL fleet operates, longline landings still represent a limited fraction of total landings. In recent years (2002 to 2011), U.S. landings have averaged only 5% of total Atlantic longline landings. In 1998, U.S. fishermen accounted for only 1% to 3% of the Atlantic billfish fishing mortality (depending on species). The U.S. fishery accounts for variable proportions of the Atlantic-wide tuna mortality: 47% for West Atlantic bluefin tuna, almost 4% for yellowfin tuna, and a much smaller proportion of skipjack, bigeye tuna, and albacore tuna mortality. The U.S. accounts for approximately 25% of the North Atlantic swordfish catch as described below in Table 13: .

Table 13: Reported Landings (mt) in the U.S. Atlantic Pelagic Longline Fishery (2002-2011)

Species	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Yellowfin tuna	2,573.0	2,164.0	2492.2	1,746.2	2,009.9	2,394.5	1,324.5	1,700.1	1,188.8	1,468.6
Skipjack tuna	2.5	1.4	0.7	0.6	0.2	0.02	1.45	0.5	1.4	0.7
Bigeye tuna	535.8	283.9	310.1	311.9	520.6	380.7	407.7	430.1	443.2	627.1
Bluefin tuna*	49.9	133.9	180.1	211.5	204.6	164.3	232.6	335.0	238.7	220.4
Albacore tuna	155.0	107.6	120.4	108.5	102.9	126.8	126.5	158.3	159.9	267.6
Swordfish North Atlantic.*	2,598.8	2,756.3	2,518.5	2,272.8	1,960.8	2,474.0	2,353.6	2,691.3	2,206.2	2,681.2
Swordfish South Atlantic.*	199.9	20.5	15.7	0.0	0.0	0.0	0.0	0.0	0.3	0.0

*Includes landings and estimated discards from scientific observer and logbook sample programs.
As reported in NOAA 2012.

The U.S. percentage of regional and total catch of HMS species is presented here to provide a basis for comparison of the U.S. catch relative to other nations/entities (Table 14:). International catch levels and U.S. reported catches for HMS (other than sharks) are taken from the 2012 Standing Report for ICCAT's Standing Committee for Research and Science (SCRS 2012). Because the SCRS data collection is reported by species, Table 14: represents a summary of U.S. and international HMS catches by species rather than gear type. Catch of billfish includes both recreational landings and dead discards from commercial fisheries; bluefin tuna includes commercial landings and dead discards and recreational landings; and swordfish includes recreational landings and commercial landings and dead discards. Data necessary to compare the U.S. regional and total percentage of international catch levels for most Atlantic shark species are currently unavailable.

Table 14: U.S. vs. International Catch of HMS Reported to ICCAT in 2011

Species	Total International Reported Catch (mt ww)	Region	Total Regional Catch (mt ww)	U.S. Catch (mt ww)	U.S. Percentage of Regional Catch	U.S. Percentage of Total Atlantic Catch
Atlantic swordfish	25,599	North Atlantic South Atlantic	12,836 12,763	2,887 0	22.5 0.0	11.20
Atlantic bluefin tuna	11,765	West Atlantic East Atlantic/Med.	1,986 9,779	883 0	44.4 0.0	7.50
Atlantic bigeye tuna	77,795	Atlantic/Med.	77,795	746	0.95	0.95
Atlantic yellowfin tuna	100,277	West Atlantic East Atlantic/Med.	19,408 80,869	3,015 0	15.5 0.0	3.00
Atlantic albacore tuna	48,733	North Atlantic South Atlantic/Med.	19,995 28,738	449 0	2.24 0.0	0.92
Atlantic skipjack tuna	212,668	West Atlantic East Atlantic/Med.	39,324 173,344	84 0	0.2 0.0	0.03
Atlantic blue marlin	1,918	North Atlantic South Atlantic	927 991	56 0	6.0 0.0	2.90
Atlantic white marlin	346	North Atlantic South Atlantic	165 181	25 0	15.1 0.0	7.20
Atlantic sailfish	1,623	West Atlantic East Atlantic	566 1,057	14 0	2.5 0.0	0.90
Blue sharks	29,362	North Atlantic South Atlantic/Med.	11,548 17,814	1,183 0	10.2 0.0	4.00
Porbeagle sharks	94	North Atlantic South Atlantic/Med.	72 21	12 0	16.6 0.0	12.80
Shortfin mako sharks	3,855	North Atlantic South Atlantic/Med.	2,154 1,701	408 0	19.0 0.0	10.60

Source: SCRS 2012.

3.10.5.3 Purse Seine

Purse seine gear consists of a floated and weighted encircling net that is closed by means of a drawstring, known as a purseline, threaded through rings attached to the bottom of the net. The efficiency of this gear can be enhanced by the assistance of spotter planes used to locate schools of tuna. The bluefin tuna baseline percentage quota share for the purse seine category is 18.6% of the U.S. quota. The purse seine fishery is managed under a limited entry system with non-transferable individual vessel quotas (IVQ), excluding any new entrants into this category. Vessels participating in the Atlantic tunas purse seine fishery are required to target the larger size class bluefin tuna—more specifically—the giant size class (≥ 81 inches) and are granted a tolerance limit for large medium size class bluefin tuna (73 to < 81 inches) (i.e., large medium catch may not exceed 15% by weight of the total amount of giant bluefin tuna landed during a season). These vessels may begin fishing on July 15 of each year and may continue through December 31, provided the vessel has not fully attained its IVQ. Over the last few years the purse seine category has not fully harvested its allocated bluefin tuna quota. In 2008, 2010, and 2011, the purse seine category did not harvest any Atlantic tunas (Table 15). The U.S. purse seine fleet has historically accounted for a small percentage of the total international Atlantic tuna landings. Table 15 shows that since 2004, the U.S. purse seine fishery has contributed to less than 0.10% of the total purse seine landings reported to ICCAT. Historic (1950s to 2010) catch levels of predominant species using purse seines in portions of the Project Area are presented in Figure 30, Figure 31 and Figure 32.

Table 15: Estimated International Atlantic Tuna Landings (mt ww) for the Purse Seine Fishery in the Atlantic and Mediterranean (2004-2011)

Species	2004	2005	2006	2007	2008	2009	2010	2011
Bluefin tuna	19,895	23,524	20,356	22,980	12,641	9,479	4,985	4,293
Yellowfin tuna	62,228	61,410	62,761	52,733	70,047	77,757	74,172	69,802
Skipjack tuna	93,284	89,704	71,215	81,335	73,080	84,494	125,467	149,307
Bigeye tuna	18,417	18,595	16,457	17,553	15,536	22,658	23,769	27,544
Albacore	717	949	3,432	1,289	169	259	213	192
Total	**194,541**	**194,182**	**174,221**	**175,890**	**171,473**	**194,659**	**228,606**	**251,138**
U.S. total	32	178	4	28	0	11	0	0
U.S. percentage	0.02	0.09	<0.01	0.02	0	<0.01	0	0

Source: SCRS 2012

3.10.5.4 Commercial Handgears

Commercial handgears, including handline, harpoon, rod and reel, buoy gear and bandit gear, are used to fish for Atlantic HMS on private vessels, charter vessels, and headboat vessels. Rod and reel gear may be deployed from a vessel that is anchored, drifting, or under way (trolling). In general, trolling consists of dragging baits or lures through, on top of, or even above the water's surface. While trolling, vessels often use outriggers to assist in spreading out or elevating baits or lures and to prevent fishing lines from tangling. In the Project area, handgear fisheries for all HMS are typically most active during the summer and early fall. The availability of Atlantic tunas at a specific location and time is highly dependent on environmental variables that fluctuate from year to year.

Fishing usually takes place outside of the proposed Study Area, generally between 8 and 200 km from shore, and for those vessels using bait, the baitfish typically includes herring, mackerel, whiting, mullet, menhaden, ballyhoo, butterfish, and squid. The commercial handgear fishery for bluefin tuna has historically occurred mainly in New England, but more recently off the coast of southern Atlantic states, such as Virginia, North Carolina, and South Carolina. The majority of U.S. commercial handgear fishing activities for bigeye, albacore, yellowfin, and skipjack tunas take place in the northwest Atlantic.

The proportion of domestic HMS landings harvested with handgear varies by species, but Atlantic tunas comprise the majority of the commercial landings. In 2011, bluefin tuna commercial handgear landings accounted for approximately 66% of the total U.S. bluefin tuna landings, and 87% of commercial bluefin tuna landings. Historic (1950s-2010) catch levels using hand gear (designated as other), for predominant species, within portions of the Project area are presented in Figure 30, Figure 31 and Figure 32.

3.10.5.5 Pot and Trap Gear

Commercial fishing for deep-sea red crab uses pots or traps. These are rectangular, square, or cylindrical enclosed devices with one or more gates or entrances set on the bottom to target benthic invertebrates such as the deep-sea red crab. Pots/traps are usually marked at the surface with a buoy (float) that is attached to the pot or trap by a rope. This type of gear is usually set in string near natural or artificial structure or hard bottom. Pots are connected by “mainlines” that either float off the bottom or sink to the bottom (Stevenson et al., 2004).

Annual U.S. commercial landings of deep sea red crab during 1982 to 2005 ranged from 466 mt (1996) to 4,000 mt (2001); no fishing took place in 1994, as there was no targeted fishery for the species that year. Since 2002, when the fishery management plan was implemented, landings have been stable at about 2000 mt per year. A small portion of red crab landings are taken as bycatch in the offshore lobster fishery. There is no recreational fishery for red crabs. Discards consist of female crabs (which cannot be landed by regulation) and male crabs too small to sell. Discards have not been well quantified, but are likely substantial for both males and females in the red crab fishery. Since 2002, U.S. landings for deepsea red crabs have been almost exclusively (99%) at ports in Massachusetts. Landings for 2002 to 2012 totaled 7,132 mt, with a value of almost $15 million (NOAA, 2013a).

The red crab fishing grounds lie almost entirely outside of the Study Area and therefore interaction with proposed activities are highly unlikely.

4 ENVIRONMENTAL CONSEQUENCES

4.1 PROPOSED ACTION

The proposed action to conduct a seismic survey program using the *Langseth* airgun array would introduce pulsed sounds into the ocean and could produce incidental takes of marine mammals and endangered species. The bulk of the analysis in this section covers the anticipated impacts of this seismic source.

Although the NSF/USGS PEIS presents general environmental consequences for airgun sounds from actions similar to the one proposed in this EA, there are new scientific studies and publications since that document was finalized. These new studies update the background information and environmental consequences for mysticetes, odontocetes, fish, and habitats (for example, Cato, 2013; Castellote et al., 2012; Ellison et al., 2012; Finneran, 2013; Hawkins, 2013; Ketten, 2013; Kight and Swaddle, 2011; Lokkeborg et al., 2012; Nowacek, 2013; Nowacek et al., 2013; Richardson, 2013; Southall et al., 2013a; Southall et al., 2013b). Much of the recent scientific literature and the importance of these studies to environmental consequences are presented in the ENAM Draft EA (NSF, 2014), and are incorporated by reference into this EA as if fully set forth herein. Additionally the NMFS EA (NMFS 2014) also addresses recent scientific literature published since the PEIS and addresses the importance of these studies to environmental consequences and are incorporated by reference into this Final EA as if fully set forth herein.

The ENAM survey is in the same geographic region as the survey proposed in this EA (see NSF ENAM Draft EA, figure 6), uses similar size airgun source and receiver, and is scheduled to take place immediately following the USGS survey proposed here. Many of the effects described and updated in the NSF ENAM Draft EA are generic with respect to acoustic effects on the environment and are applicable to our EA. However, the specific location of the proposed USGS tracklines are further offshore and cover a larger region of deep water along the U.S. margin than the ENAM survey (see NSF ENAM Draft EA, figure 6). Hence, the environmental consequences of the proposed actions may differ between the two surveys (e.g., types and numbers of marine species potentially impacted).

The new studies do not fundamentally change the way the airgun modeling is performed (Appendix A) or how the incidental takes are estimated (Appendix B). The acoustic modeling has been done to be consistent with modeling used for other EAs and has been deemed to be acceptable for estimating takes under MMPA and defining exclusion zones associated with the 160 dB re 1 μPa_{rms} and 180 dB re 1 μPA_{rms} isopleths used to estimate Level B and Level A takes respectively.

4.2 NOISE EMISSIONS

The majority of noise emitted during the proposed action would be due to the seismic airgun array. The Langseth airgun array is a tuned acoustic source that emits sound energy primarily below 200 Hz at frequencies useful for identifying the base of the sediments in the deep waters off the U.S. Atlantic continental margin, but which also overlaps with the hearing ranges of some marine species (further described below). The airgun array produces an impulsive sound one to three times per minute, and is not a continuous noise.

Additional noise emissions could come from operation of the Kongsberg EM122 MBES and the Knudsen Chirp 3260 SBP, which would be operated simultaneously with the airgun array. These acoustic systems are described in the NSF/USGS PEIS (§ 2.2.3.1) and a summary of new scientific studies and their potential significance has been updated in the NSF ENAM Draft EA and the NMFS EA (NMFS 2014) and are incorporated by reference as if fully set forth herein. These more recent studies do not change the basic conclusions of the NSF/USGS PEIS that operation of this equipment might produce localized, temporary, or minor behavior changes in some marine species, but is unlikely to be geographically extensive or long lasting.

The survey vessel itself contributes very little to the overall noise field. This noise is also described in the NSF/USGS PEIS (§ 2.2.3.1) with a summary of new scientific studies on vessel noise and their potential significance given in the NSF ENAM Draft EA. These more recent studies do not change the basic conclusions of the NSF/USGS PEIS that vessel noise would not be at levels that would cause anything more than localized and temporary behavioral changes in marine mammals. Further, large vessel traffic is so common in the oceans of the world that it is considered a usual source of background (i.e., ambient) noise.

4.2.1 Sound Effect Criteria

The potential for anthropogenic underwater noise to affect marine species depends on the species' ability to hear the sounds produced (Ireland et al., 2007). Noises are less likely to disturb animals if they are at frequencies outside the animal's range of hearing. An exception is when the sound pressure is so high that it can cause physical injury. For non-injurious sound levels, frequency weighting curves based on audiograms may be applied to weight the importance of sound levels at particular frequencies in a manner reflective of the receiver's sensitivity to those frequencies (Nedwell and Turnpenny, 1998).

The NMFS/NOAA considers two levels of harassment to the marine mammals: Level A (auditory injury by way of the onset of permanent threshold shift, or PTS) and Level B (disturbance by way of temporary threshold shift, TTS, and/or behavior impacts). According to the 1994 Amendments to the Marine Mammal Protection Act (MMPA) of 1972, Level A Harassment is defined as "any act that injures or has the potential to injure a marine mammal or marine mammal stock in the wild." Level B Harassment is defined as "any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or altered."

NMFS (2000) specified that Level A Harassment for pulsed sources occurs when an animal is exposed to sound pressure levels of 180 dB re 1 µPa rms (for cetaceans) or 190 dB re 1 µPa rms (for pinnipeds). The criterion of 160 dB re 1 µPa rms is considered to induce Level B Harassment for both mammal groups for pulsed sources. More recently, the Noise Criteria Group was established, sponsored by NMFS, resulting in new recommendations for updated exposure criteria using the best available science (Southall et al,. 2007). In December 2013, NOAA issued revised draft Acoustic Guidance for public comment. However, these recommendations have not been made final. These guidelines propose to update the acoustic threshold levels for which TTS and PTS are predicted to occur in marine mammal species, incorporating the dual metrics of cumulative sound exposure level (SEL_{cum}) and peak sound pressure level (SPL). Frequency weighting functions are also incorporated to account for differences between various hearing groups: low- mid and high-frequency cetaceans, otarid and phocid pinnipeds.

USGS would be prepared to revise its operational mitigation protocols outlined by new guidance from NMFS.

The current NOAA/NMFS acoustic threshold levels for Level A and Level B harassment and behavior sound effects for cetaceans are shown in Table 16.

Table 16: Injury and Behavior Exposure Criteria for Cetaceans

Group	Level A (Injury) Pressure (dB re 1 μPa rms)	Level B (Behavior) Pressure (dB re 1 μPa rms)
Cetaceans	180	160

The SBP and MBES systems would be operated only in conjunction with the seismic source (i.e. not during transits). An EZ or FMZ for those instruments would lie within the limits for those defined for the seismic source. Therefore, no further modeling or analysis of those systems was required.

4.2.2 Exclusion Zone

The proposed survey would use an array volume of 6,600 in^3. Project site-specific modeling has not been completed for that array; however, received sound levels recorded during calibration in the Gulf of Mexico have been predicted by L-DEO's model (included here as Appendix A) as a function of distance from the airguns, for the 36-airgun array at any tow depth. Although the study provides caveats on its applicability (water temperature, salinity, sound speed, and sediment not taken into account), the Gulf of Mexico calibration measurements demonstrate that, although simple, the L-DEO model is a robust tool for estimating mitigation radii. The energy output (zero to peak) for the 6,600 in^3 array is 258.5 dB re 1 μPa at 1m.

Table 17: summarizes the L-DEO model (Appendix A) predicted distance in water depth >1000 m relative to sound level criteria (≥190, 180 and 160 dB re 1 μPa_{rms}) that are expected to be received during the proposed survey on the East Coast margin in 2014 and 2015.

Table 17: Predicted radii distances to the NMFS >190, 180 and 160 dB SPL (rms) Criteria for single 40 in^3 airgun and 6,600 in^3 Airgun Array at 9 m tow depth

Array	Predicted Safety Radii (m)		
	190 dB	180 dB	160 dB
Single Bolt 40 in3 airgun	100[1]	100	338
36 air gun array, total volume 6,600 cu. in.	286	927	5780

[1] Exclusion Zone for the small airgun is 100 m per NSF/USGS PEIS

The sound exposure levels for mitigation radii were calculated using the transmission loss modeling results and corresponding source level for each modeled source expressed in SPL (rms) units of dB re: 1 .µPascal m. As a result of consultation with NMFS, the 166 dB re 1 µPa RMS limit (for sea turtles) was estimated to be 3740 m for water depths greater than 1000 m, i.e., for water depths for the proposed USGS survey.

Mitigation procedures would require a power-down of the airgun array should a marine mammal or sea turtle approach or appear within the airgun EZ. During these power-downs, a single 40 in^3 airgun would continue to be operated as a mitigation gun, unless the animal proceeded to approach the EZ for the mitigation airgun, in which case all airguns would be shut down until the EZ were cleared and the power-up (e.g., ramp up) procedure initiated. The mitigation airgun would also be used for maintenance of the airgun array that might last up to 3 hours. For longer, maintenance of the seismic equipment, the mitigation gun would not be used and the entire system would be shut down.

4.2.3 Direct Effects on Mysticetes, Odontocetes, and Pinnipeds

Because the studies that describe direct effects of noise, including airgun sounds, on marine mammals are given for species in the NSF/USGS PEIS and the NSF ENAM Draft EA, this section identifies some of the direct effects, proposed mitigation, and estimated takes associated with this proposed action. Appendix 2 (Request for Incidental Harassment Authorization under the Marine Mammal Protection Act) gives the detailed analyses that support estimates of the marine mammals that could be taken by the proposed action of this Final EA, together with the number of requested takes.

4.2.3.1 Mysticetes

The seven species of mysticetes that occur in the proposed study area have been observed infrequently to rarely compared to their coastal presence (Figures 9 and 10), and when they have been observed, are generally along the western (continental slope and upper continental rise) regions of the survey. Although the distribution observations have large uncertainties, the low densities of animals suggest that much of the survey area occurs in a region where mysticetes are not widespread and encounters would be minimal.

Hearing (temporary and permanent effects) - The mysticete auditory system is sensitive to low frequencies. Section 3.6.4.2 and Appendix B and E of the NSF/USGS PEIS (2011) provides details of potential effects on mysticete cetaceans from the predominantly low-frequency energy produced by the proposed airgun source of 6,600 in^3.

There has been no specific documentation that temporary hearing impairment (temporary threshold shift, TTS) occurs for marine mammals exposed to sequences of airgun pulses during operational seismic surveys (NSF/USGS PEIS 2011 Appendix E) and in the newer scientific studies discussed in the NSF ENAM Draft EA and NMFS EA (NMFS, 2014). Mysticetes tend to avoid operating airguns, and these deviations reduce or eliminate the risk of temporary hearing effects. However, the low distribution of mysticetes in the survey area means it is possible that small numbers of mysticetes would be exposed to the Langseth airgun pulses that theoretically could cause TTS. These exposures are discussed in Appendix B.

NMFS's policy regarding exposure of marine mammals to high-level sounds is designed to eliminate the risk of permanent hearing damage (permanent threshold shift, PTS). This policy has been that cetaceans should not be exposed to impulsive sounds ≥180 dB re 1 μPa_{rms} (NMFS, 2000). This criterion has been used in defining the exclusion zone (shut-down radii) - which was modeled at 927 m for these water depths in the Study Area - for cetaceans. Monitoring and mitigation measures are designed to detect marine mammals occurring near the seismic source array to avoid exposing them to sound pulses that might cause permanent threshold shifts. Hence the proposed action is designed to make it highly unlikely that mysticetes would have permanent injury from the airgun operations. Hence, Level A effects would be highly unlikely with appropriate mitigation measures (described in section 6, Summary of Mitigation).

The potential sensitivity of mysticetes to the mid- to high-frequency Knudsen SBP and the higher frequency EM122 MBES is believed to be more variable and generally less sensitive among species, as described in the NSF/USGS PEIS and the more recent scientific studies in the NSF ENAM Draft EA and NMFS EA (NMFS, 2014). Because of the lower exposure relative to the airgun array, and the intermittent, and downward directed nature of these sounds, individuals would not be expected to be exposed to more than one or two pings from the moving vessel should they be in the ensonified area.

Masking - Studies of how anthropogenic sound, particularly seismic sounds, masks cetacean sounds, are limited and results are variable (summarized in Table 3.6-5 and Appendix E of the NSF/USGS PEIS 2011 together with more recent studies in the NSF ENAM Draft EA and NMFS EA (NMFS, 2014)). The airgun signal is intermittent (one to three pulses per minute) and the amplitude of the signal falls rapidly with distance and time, making the "noise" intervals relatively small time periods during the survey. Masking of marine mammal calls and other natural sounds by the pulsed sounds of the Langseth airgun would be limited, particularly with proposed mitigation of ramp up, shut down, PSVO observing, and PAM (see section 6, Summary of Mitigation).

Marine mammal communications would not be significantly masked by MBES signals given their low duty cycle and the brief period when an individual mammal would potentially be within the MBES or SBP beam from a moving vessel. Both of these signal types are predominantly or entirely at frequencies >11 kHz, i.e., higher than the predominant frequencies in mysticete calls, reducing any potential for masking. Similarly, mysticete communications would not be masked appreciably by the SBP signals given their downward directionality and the brief period when an individual mammal could be within the SBP beam.

Behavior - Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable among species, locations, whale activities, oceanographic conditions affecting sound propagation, etc. (Appendices B and E in the NSF/USGS PEIS 2011 and the more recent studies described in the NSF ENAM Draft EA and NMFS EA (NMFS, 2014)). For the proposed Langseth airgun array, behavior changes are possible and takes are estimated appropriately (Appendix B).

Herding of mysticetes is a behavior that could occur in canyon regions if the ship were to proceed onshore from deep water. For 2014, the ship track would depart from Brooklyn, NY so the northern line on the margin would be going from onshore to offshore. Note that this is opposite to the numbering scheme shown in Figure 3, which implies the cruise starts in the south (line 1) and ends in the north. The southern line going from offshore to onshore is in a region of no canyons (the closest canyon is ~200 km further north). The order of ship tracks for the 2015 cruise is not decided, but consideration of herding behavior would be taken into account when and if the cruise occurs and ports are determined.

4.2.3.2 Odontocetes

The distribution of the 27 species of odontocetes that could occur is irregular and infrequent throughout the survey area, with concentrations more common along the continental slope and upper rise of the Atlantic margin (Figures 12-15). Hence odontocetes are expected to be more commonly found in the area than mysticetes, although still not abundantly.

Hearing (temporary and permanent effects) – The Langseth airgun array would likely be audible to odontocetes, although odontocetes in general have hearing and vocalization frequencies that are much higher than the predominant 200 Hz (or lower) frequencies of the Langseth airgun array. Odontocetes are considered less sensitive to the predominant low frequencies produced by low frequency airgun arrays similar to that of the Langseth, as described in the NSF/USGS PEIS and from more recent studies described in the NSF ENAM Draft EA and NMFS EA (NMFS, 2014).

Some odontocetes show avoidance of the area where received levels of airgun sounds are high enough such that TTS could potentially occur. In those cases, the avoidance responses of the animals themselves reduce or (most likely) eliminate any possibility of TTS. If some odontocetes did experience temporary hearing impairment, the TTS effects would (by definition) be fully recoverable.

NMFS's policy regarding exposure of marine mammals to high-level sounds has been that cetaceans should not be exposed to impulsive sounds ≥180 dB re 1 μPa (rms) (NMFS 2000). This policy is designed to avoid permanent hearing effects (PTS) for cetaceans, including odontocetes. This criterion has been used in defining the exclusion zone (shut-down radii), which was modeled at 927 m for these water depths in the Study Area, for all cetaceans. Monitoring and mitigation measures are designed to detect marine mammals occurring near airguns to avoid exposing them to sound pulses that might cause PTS. Hence the proposed action is designed to avoid a situation in which the odontocetes would have permanent hearing injury.

Sound frequencies produced by the EM 122 MBES and Knudsen SBP overlap the range of most sensitive hearing of many odontocetes, and all odontocetes can presumably hear these sounds based on what is known about their hearing, sound production, and ear structure. However, because of the low duty cycle and downward directed orientation of these sound sources, the anticipated effects should be limited to one to two pings from the moving vessel, i.e., of limited temporal and geographic range.

Masking – As described in the NSF/USGS PEIS and the updated information in the NSF ENAM Draft EA, Odontocetes are considered less sensitive to masking by low-frequency sounds than are mysticetes. Potential effects are considered minimal because the dominant low-frequency components of the airgun sounds do not overlap dominant frequencies produced by odontocetes and because vessels movement would be transient.

Odontocete communications would not be masked appreciably by the EM 122 MBES or Knudsen SBP signals given their low duty cycles, the brief period (i.e., seconds) when an individual mammal would potentially be within the downward-directed MBES or SBP beam from a transiting vessel. Temporary localized masking of odontocete calls by project vessel sound is possible although it would be short lived and of geographically limited extent.

Behavior – Odontocetes, and particularly delphinids show some limited avoidance of seismic vessels operating large airgun arrays (Appendix E in NSF/USGS PEIS 2011 and the more recent scientific studies summarized in NSF ENAM Draft EA and NMFS EA (NMFS, 2014)). Results for porpoises appear to vary by species. In most cases, the animals do not show strong avoidance (i.e., they do not leave the area) and they continue to call. Controlled exposure experiments in the Gulf of Mexico indicate that foraging effort is apparently somewhat reduced upon exposure to airgun pulses from a seismic vessel operating in the area, and there may be a delay in diving to foraging depth. Odontocete reactions to large arrays of airguns are variable and, at least for delphinids and some porpoises, seem to be confined to a shorter distance than has been observed for mysticetes.

Behavioral responses of marine mammals, including odontocetes, to MBES sounds is treated in the NSF/USGS PEIS and updated in the NSF ENAM Draft EA and NMFS EA (NMFS, 2014). No information exists on the disturbance of odontocetes from operation of the MBES (Southall et al., 2013). The short ping duration of the MBES, its narrow fore-and-aft beam width, its generally downward directed beam orientation, and the forward movement of the vessel would reduce the sound energy received by any individual animals that might be within the ensonified zone. The newer information does not alter the findings of the NSF/USGS PEIS (§3.4.7., §3.6.7, and §3.7.7) that operation of MBES and SBP is not likely to impact either mysticetes or odontocetes. Exposure of individual odontocetes is likely brief in duration (<1 sec; 1 or at most 2 pings) given that these devices are located on a moving seismic vessel and the pings are intermittent and directed downward.

Herding of odontocetes is a behavior that could occur in canyon regions if the ship were to proceed onshore from deep water. For 2014, the ship track would depart from Brooklyn, NY, so the northern line on the margin would be going from onshore to offshore. Note that this is opposite to the numbering scheme shown in Figure 3, which implies the cruise starts in the south (line 1) and ends in the north. The southern line going from offshore to onshore is in a region of no canyons (the closest canyon is ~200 km further north). The order of ship tracks for the 2015 cruise is not decided, but consideration of herding behavior would be taken into account when and if the cruise occurs and ports are determined.

4.2.3.3 Pinnipeds

Pinnipeds have not been observed in the survey area (see §3.5). Because they are coastal inhabitants, they are not expected to be effected by the operation of the Langseth airgun array in the deep-water continental margin areas of the study area. In the unlikely event pinnipeds are observed during the survey, appropriate mitigation would be undertaken as per NMFS guidance for pinnipeds.

4.2.3.4 Summary of Direct Effects on Mysticetes, Odontocetes, and Pinnipeds

The proposed seismic project (involving the use of a 6,600 in^3 airgun array, a Kongsberg EM 122 MBES and a Knudsen 3260 SBP) would introduce pulsed sounds into the ocean that, with the proposed mitigation measures, could result in a small number of animals coming within the areas identified where temporary hearing changes, masking of vocalizations/communications, and minor behavioral changes could occur. Hence a small number of Level B harassment effects could occur. Level A effects, using the proposed mitigation procedures, would be highly unlikely.

As part of the IHA consultation process, NMFS reviewed the take estimates proposed in Table 18 of the Final EA. NMFS reestimated the take calculations for five Mysticete species and nine Odontocete species for which density model outputs within the SERDP/NASA/NOAA and OBIS-SEAMAP database were not available, or for those species with density outputs that did not extend into the planned study area at all (i.e., all four pinniped species and sei whale), but for which OBIS sightings data within or adjacent to the study area exist. Mean group sizes were determined based on data reported from the Cetacean and Turtle Assessment Program (CeTAP) surveys (CeTAP, 1982) as well as reports from the Atlantic Marine Assessment Program for Protected Species (AMAPPS, 2010, 2011, 2012, 2013). The mean group size is weighted by effort and rounded up.

The Mysticete species for which NMFS reestimated takes were: Humpback Whale, North Atlantic Right Whale, Blue Whale, Bryde's Whale, and Sei Whale. The Odontocete species are: the Atlantic White-sided Dophin, Killer Whale, Spinner Dolphin, Fraser's Dolphin, Harbor Porpoise, False Killer Whale, Pygmy Whale, Melon-headed Whale, and Northern Bottlenose Whale. One Mysticete species (Blue Whale) and three Odontocete species (Atlantic White-sided Dolphin, Killer Whale, and Clymene Dolphin) had smaller take estimates as a result of this recalculation. USGS Estimated takes and NMFS proposed takes for the remaining species were identical. The proposed take estimates by NMFS use the smaller of the take estimates using the mean group sizes, rather than the larger estimates from USGS.

Final proposed take estimates proposed by NMFS use the smaller of the take estimated from mean group size, or which ever USGS requested take is higher for the summer (Table 18 of the Final EA) or spring (Table 19 of the Final EA).

Table 18, reproduced from Appendix B and modified by consultation with NMFS, presents the estimated takes by USGS, revised estimated takes by NMFS using mean group sizes for species for which density estimates were not initially available, and NMFS proposed takes for mysticetes and odontocetes species for the full (i.e., 2014 and 2015) proposed action.

Table 19 presents the estimated takes and requests for takes for mysticetes and odontocetes species that could be encountered during a 2015 program that was scheduled in the spring (March, April, May). Two species show increased estimated takes in the spring as opposed to the summer (the potential take of humpback whales increases by 38 and the possible take of Bottlenose dolphin increases by 11). Ten species show decreased estimate of takes in the spring, and all other species show no change in estimated takes. The larger of the take numbers from this table or the mean group size numbers in Table 18 are used for the proposed estimate of 2015 take by NMFS.

NMFS does not provide specific guidance or requirements for IHA applicants or for Section 7 consultation for the development of take estimates and multiple exposure analysis; therefore, variation in methodologies and calculations are likely to occur. During the consultation, USGS, NSF, and NMFS also discussed using the Navy Marine Species Density Database maps (Department of Navy, 2012) to estimate densities of species for takes. However, after further discussion with the Navy, they advised that "The maps in the technical report are a classified image, a representation of the underlying data, not the actual data. Digitizing these images is a misrepresentation of the actual data and in my opinion would not represent best available science." (Andrew DiMatteo, Personal Communication, July 23, 2014).

USGS, NSF, and LDEO would adhere to the requirements of the Incidental Take Statement (ITS) and the IHA and associated take levels issued.

Table 18: Densities and Estimates of Possible Numbers of Individuals That Could be Exposed to 160 dB re 1 μPA_{RMS} During Each of Proposed Summer (June, July, August) 2014 and 2015 2-D Seismic Surveys

Species	Mean Density (#/km^2)[a]	Ensonified Area (km^2)	Calcu-lated Take[b]	% of Regional Population[c]	Mean Group Size[d]	Level B Proposed Take[e] USGS	NMFS
Mysticetes							
Fin Whale	0.0000610	36,600	3	0.0113		3	3+3=6
Humpback Whale	N/A	36,600	0	0.0259	1.7	3[f]	3+38=41
Minke Whale	0.0000360	36,600	2	0.0014		2	2+2=4
North Atlantic Right Whale	N/A	36,600	0	0.6593	2.3	3[f]	3+3=6
Blue Whale	N/A	36,600	0	0.2339	1.3	2[f]	1+1=2
Bryde's Whale	N/A	36,600	0	N/A	3	3[f]	3+3=6
Sei Whale	N/A	36,600	0	0.0291	1.7	3[f]	3+3=6
Odontocetes							
Atlantic White-sided Dolphin	N/A	36,600	0	0.1106	32.40	54[f]	33+33=66
Atlantic Spotted Dolphin	0.0288400	36,600	1056	2.3616		1056	1056+1056=2112
Bottlenose Dolphin	0.0066470	36,600	244	0.3147		244	244+255=499
Long-Finned Pilot Whale	0.0190400	36,600	697	0.0894		697	697+697=1394
Short-Finned Pilot Whale	0.0190400	36,600	697	0.0894		697	697+697=1394
Pantropical Spotted Dolphin	0.0197600	36,600	724	21.7222		724	724+724=1448
Risso's Dolphin	0.0093180	36,600	342	1.8740		342	342+342=684
Shorted-beaked Common Dolphin	0.0055320	36,600	203	0.1170		203	203+203=406
Striped Dolphin	0.1343000	36,600	4,916	8.9697		4,916	4916+4916=9832
Sperm Whale	0.0022510	36,600	83	0.6293		83	83/83=166
Killer whale	N/A	36,600	0	N/A	5.40	7[f]	6+6=12
Clymene Dolphin	0.0093110	36,600	0	N/A	51.26	346	52+341=393
Spinner Dolphin	N/A	36,600	0	N/A	65	65[f]	65+65=130
Rough-Toothed Dolphin	0.0004260	36,600	16	5.5351		16	16+16=32
Fraser's Dolphin	N/A	36,600	0	N/A	100	100[f]	100+100=200
Harbor Porpoise	N/A	36,600	0	0.0010	3.19	5[f]	4+4=8
False Killer Whale	N/A	36,600	0	N/A	15	15[f]	15+15=30
Pygmy Killer Whale	N/A	36,600	0	N/A	25	25[f]	25+25=50
Dwarf Sperm Whale	0.0008970	36,600	33	0.8719		33	33+33=66
Pygmy Sperm Whale	0.0008970	36,600	33	0.8719		33	33+33=66
Melon-Headed Whale	N/A	36,600	0	N/A	100	100[f]	100+100=200
Sowerby's Beaked Whale	0.0022870	36,600	84	1.1844		84+84=168	
Blainville's Beaked Whale	0.0022870	36,600					
Gervais' Beaked Whale	0.0022870	36,600					
True's Beaked Whale	0.0022870	36,600					
Cuvier's Beaked Whale	0.0022870	36,600		1.2860			
Northern Bottlenose Whale	N/A	36,600	0	N/A	1.91	2[f]	2+2=4
Pinnipeds							
Harbor seal	0	36,600	0	N/A		0	
Gray seal	0	36,600	0	N/A		0	
Harp seal	0	36,600	0	N/A		0	
Hooded Seal	0	36,600	0	N/A		0	

[a] Source: OBIS-SERDP-Navy NODE 2007a and 2007b (for those species where density data were available).
[b] Calculated take is estimated density multiplied by the 160-db ensonified area. These calculations do not include any contingency as the survey will be conducted as one continuous line.
[c] Requested takes expressed as percentages of the larger regional populations, where available; where not available (most odontocetes–see Table 2), Draft 2013 SAR population estimates were used; N/A means not available
[d] Mean Group Size provided by NMFS during consultation for those speicies for which density model outputs were not available or for which density model outputs did not extend into the study area in both spring and summer.
[e] Proposed (i.e., requested) take authorization by USGS (Final EA) and NMFS (during consultation).
[f] USGS - Average group size from CeTAP 1984. NMFS - Take size recommended by NMFS based on summer and spring proposed takes by USGS or by NMFS revised group sized (see comment d).

Table 19: Densities and Estimates of Possible Numbers of Individuals That Could be Exposed to 160 dB re 1 μPA_{RMS} During Spring (March, April, May) 2015 2-D Seismic Survey

Species	Mean Density (#/km^2)[a]	Ensonified Area (km^2)	Calculated Take[b]	% of Regional Population[c]	Requested Level B Take Authorization
Mysticetes					
Fin Whale	0.0000600	36,600	3	0.113	3
Humpback Whale	0.0010170	36,600	38	0.3276	38
Minke Whale	0.0000350	36,600	2	0.0014	2
North Atlantic Right Whale	N/A	36,600	0	0.6593	3[d]
Blue Whale	N/A	36,600	0	0.2339	2[d]
Bryde's Whale	N/A	36,600	0	N/A	3[d]
Sei Whale	N/A	36,600	0	0.0291	3[d]
Odontocetes					
Atlantic White-sided Dolphin	N/A	36,600	0	0.1106	54[d]
Atlantic Spotted Dolphin	0.0285700	36,600	1046	2.3393	1046
Bottlenose Dolphin	0.0069560	36,600	255	0.3289	255
Long-Finned Pilot Whale	0.0108000	36,600	396	0.0408	396
Short-Finned Pilot Whale	0.0108000	36,600	396	0.0508	396
Pantropical Spotted Dolphin	0.0194900	36,600	714	21.422	714
Risso's Dolphin	0.0092150	36,600	338	1.8520	338
Shorted-beaked Common Dolphin	0.0053940	36,600	198	0.1141	198
Striped Dolphin	0.1330000	36,600	4,868	8.8817	4,868
Sperm Whale	0.0019050	36,600	70	0.5307	70
Killer whale	N/A	36,600	0	N/A	7[d]
Clymene Dolphin	0.0093110	36,600	341	N/A	341
Spinner Dolphin	N/A	36,600	0	N/A	65[d]
Rough-Toothed Dolphin	0.0004200	36,600	16	5.9041	16
Fraser's Dolphin	N/A	36,600	0	N/A	100[d]
Harbor Porpoise	N/A	36,600	0	0.00010	5[d]
False Killer Whale	N/A	36,600	0	N/A	15[d]
Pygmy Killer Whale	N/A	36,600	0	N/A	25[d]
Dwarf Sperm Whale	0.0008850	36,600	33	0.8719	33
Pygmy Sperm Whale	0.0008850	36,600	33	0.8719	33
Melon-Headed Whale	N/A	36,600	0	N/A	100[d]
Sowerby's Beaked Whale	0.0021370	36,600	79	1.1139	79
Blainville's Beaked Whale		36,600			
Gervais' Beaked Whale		36,600			
True's Beaked Whale		36,600			
Cuvier's Beaked Whale		36,600		1.2094	
Northern Bottlenose Whale	N/A	36,600	0	N/A	2[d]
Pinnipeds					
Harbor seal	0	36,600	0	N/A	0
Gray seal	0	36,600	0	N/A	0
Harp seal	0	36,600	0	N/A	0
Hooded Seal	0	36,600	0	N/A	0

[a] Source: OBIS-SERDP-Navy NODE 2007a and 2007b (for those species where density data were available).

[b] Calculated take is estimated density multiplied by the 160-db ensonified area. These calculations do not include any contingency as the survey will be conducted as one continuous line.

[c] Requested takes expressed as percentages of the larger regional populations, where available; where not available (most odontocetes–see Table 2), Draft 2013 SAR population estimates were used; N/A means not available

[d] Requested take authorization was increased to average group size for species for which densities were not available but have been sighted near or have the potential to be observed within the Study Area. Average group size from CeTAP 1984.

4.2.4 Direct Effects on Marine Birds

Of the seabirds, waterfowl, and shorebirds identified that could be in the study area (§3.6), a subset of seabirds have been sighted regularly in the survey area. It is not possible to use quantitative sound-energy criteria to assess impacts of these sources on seabirds because there are no measured or predicted underwater audiograms for any seabird species, published or otherwise, or quantitative noise criteria used to characterize effects of airgun noise on seabirds, such as auditory thresholds corresponding to TTS or PTS levels caused by underwater noise. There are no documented adverse effects directly or indirectly on seabirds as reported by offshore observers or research. The NSF/USGS PEIS (Section 3.5.4) and the more recent NSF ENAM Draft EA addressed the effects of seismic surveys on seabirds and indicated that there are no scientific data indicating or suggesting that seabirds are adversely affected by seismic airguns or other sound sources used during the proposed seismic surveys.

During the proposed seismic surveys, dedicated PSVO's would monitor and record marine birds observed in the study area. Seismic activities would shut down for any ESA seabirds observed diving and/or foraging within the EZ. . 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, USGS and NSF received concurrence from USFWS that the proposed activities "may affect" but "are not likely to adversely affect" species under their jurisdiction (Appendix E).

4.2.5 Direct Effects on Marine Fish, Marine Shellfish, and Essential Fish Habitat

Approximately 600 species of demersal and pelagic fish could occur in the survey area (§3.7). The NSF/USGS PEIS and the updated studies summarized in the NSF ENAM Draft EA (incorporated by reference as if set forth herein) concluded that the effects of marine sound on marine fish and their fisheries could result in non-lethal, temporary impacts, including short-term changes in behavior, and that there could be injury or mortal impact to a small number of individuals within several (10) meters of the Langseth airgun array (Appendix D, Section D.2.2). It further concluded that there would be no long-term effects on populations of fish.

The hearing capability of fish is not known well and varies with species (NSF/USGS PEIS, Appendix D, Section D.2.2, and the updated information in NSF ENAM Draft EA. McCauley et al. (2000) conducted trials with captive fish and found that increases in swimming behavior occurred when seismic sound levels reached 156 dB re 1 μPa_{rms}. During the activity proposed by USGS, noise levels should attenuate to 160 dB about 5780 m from the survey vessel. The hearing capability of Atlantic salmon indicates a rather low sensitivity to sound (Hawkins and Johnstone, 1978). Laboratory experiments yielded responses only to 0.58 kHz and only at high sound levels. Poor hearing by salmon is likely due to the lack of a link between the swim bladder and inner ear (Jorgensen et al., 2004). Sturgeon (*Acipenser fulvescens*) were found to be responsive to sounds with frequencies from 100 to 500 Hz, generally at the higher end of the frequencies produced by the *Langseth* airgun array. Based on the known or presumed hearing ranges of ESA-listed salmonids and sturgeon, airgun arrays could contribute to localized, transitory masking of sound detection by these species. However, in general, the potential for masking effects would be limited and localized in extent given the brief, pulsed nature of the seismic survey sounds and the transiting seismic vessel relative to individual fish; related effects would not be measureable at the population scale.

The use of the *Langseth* MBES is extremely unlikely to result in population-level effects on any marine fish species as it operates at 10.5-13 kHz, frequencies that are above the known hearing ranges of most marine fish species (Table 3.3-3 in the NSF/USGS PEIS) and above the known hearing ranges of ESA-listed salmonids and sturgeon. Alosidae fishes can detect ultrasonic (>20 kHz) signals (Mann et al. 2001), but exposures of individual fish (those not very close to the MBES) would be very brief (less than one minute). The frequencies of the SBP are within the hearing range of some species in the order Clupeiformes. The exposures of most individual fish (those not very close to the SBP) would be brief. No other marine fish are currently known to hear as high as 2.5 kHz (Table 3.3-3). The narrower along-track beam of the Langseth MBES and SBP would affect a much smaller area than the broader areas affected by the airguns and arrays; as a result, a given fish location near the transiting source would be ensonified for only one to several brief pings at most, lasting less than a minute in duration.

Direct effects on essential fish habitats (see §3.8.2), either the substrate or the water column, would not be expected, because the seismic signals do not physically change the substrate or the water column. Potential indirect effects from the vessel and proposed survey are described in §4.2.8.

Sargassum mats, which are floating algae that serve as nurseries for sea turtles and habitat for some marine fish and birds, occurs primarily to the south and east of the survey area in the Sargasso Sea, but could be found in the survey area. The main potential impact associated with the proposed seismic survey would be the direct effects on the animals (marine mammals and sea turtles, as discussed above), rather than on the habitat.

In summary, the direct effects of the seismic survey and its associated sound may have minor effects on marine fisheries that are generally reversible, of limited duration, magnitude, and geographic extent when considering individual fish, and not measureable at the population level. There would be no anticipated negative impacts on Essential Fish Habitat (EFH). No mitigation would be needed for marine fish or EFH.

4.2.6 Direct Effects on Sea Turtles

Five species of sea turtle — the leatherback, loggerhead, green, hawksbill, and Kemp's Ridley — could be encountered in the proposed Study Area. Only foraging or migrating individuals would occur. Their occurrence in the study area is relatively small compared to their distribution and many observations on the shelf or near the upwelling of the shelf-slope break (see figures 18-22).

Based on what is known regarding sea turtle hearing (Section 3.4.4.2 NSF/USGS PEIS 2011) and more recent studies summarized in the NSF ENAM Draft EA, sound from the Langseth airguns would be detectable but the MBES and SBP signals would not be detectable by sea turtles. Sounds from an airgun array such as the *Langseth* array might cause temporary hearing impairment in sea turtles if they do not avoid the (uncertain) radius where TTS occurs. Research (Section 3.4.4.3 NSF/USGS PEIS, 2011) generally suggests that sea turtles showed localized avoidance during large and small-source surveys when the airgun arrays were operating. Sea turtles generally respond to seismic survey sound with behavioral changes such as startling, increasing swimming speed, swimming away from, and/or locally avoiding the source. Studies indicate that exposure to seismic sounds results in short-term behavioral changes and localized avoidance by sea turtles. Available evidence suggests that the zone of avoidance around seismic sources is a few kilometers or less (McCauley et al., 2000a, b; Holst et al,. 2006; Weir, 2007).

Potential interactions between sea turtles and the project could be adverse in the study area. However, tendency of sea turtles to avoid seismic operations suggest it is unlikely that sea turtles would be exposed to sound levels of sufficient strength and for sufficient duration to cause physiological effects. Section 3.4.7 of the NSF/USGS PEIS concluded that with implementation of the proposed monitoring and mitigation measures, 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. Ramp up procedures would also serve to further minimize direct effects on marine turtles.

4.2.7 Direct Effects on Fisheries

The survey area is within national and international commercial fisheries (§3.10.5). Potential impacts on commercial fisheries are more likely to be behavioral effects from the *Langseth* airgun array that could cause a small reduction in fish catch or temporary changes in distribution, migration, and reproduction due to behavioral effects on fish from seismic survey operations. For some fish species, behavioral changes from seismic survey operations may result in changes in vertical or horizontal distribution. These short-term behavioral effects would be localized.

Preclusion of fishermen from productive fishing grounds constitutes a space-use conflict. The size of the Study Area precluded to fishing would be limited to the area immediately surrounding the seismic vessel and gear. Seismic vessels such as *Langseth* operate under a 'restricted ability to maneuver' designation, which means other vessels in the path of the survey vessel must give way.

The degree of impact from the proposed action would depend upon the relative mobility of the fishing operation (MMS 2004). Fixed gear (e.g., traps) is most vulnerable, and mobile gear such as hook-and-line fishing from drifting (or trolling) boats is least vulnerable. Because of the large water depths, non-fixed gear would be the more prevalent equipment used within the proposed survey area. Many gear types require considerable time to deploy and retrieve, decreasing the mobility of larger and deeper ocean fishing vessels. Surface currents and wind greatly influence the movement of longlines and other drifting gear (e.g., purse seines) but these natural impacts could also affect the Langseth receiver array. A longline deployed upstream of a geophysical survey grid could drift into the path of the survey vessel and become entangled in either the airgun array or the streamer receiver. Surface longlines are generally allowed to drift for 4 to 5 hours before a 10- to 12-hour retrieval period (MMS 2004). Minimizing potential adverse effects on fisheries may be accomplished by adjusting tracklines and communicating with fisherman about respective locations of vessels, equipment, and rater of travel or drift.

Although it is expected that recreational fishing would be extremely limited in the Study Area, impacts on recreational fishing would typically be similar to those described for commercial fishing. However, since most recreational fishing uses mobile gear such as hook-and-line fishing from drifting (or trolling) boats, the potential for impacts would generally be less than those described for commercial fishing operations.

In summary, potential adverse environmental effects on commercial and recreational fisheries would be mitigated through the implementation of various standard mitigation measures, including: communications with fishing vessels in the survey area during seismic operations, monitoring of fishing gear locations, and possible slight trackline adjustments that maintain safety and avoid entanglement.

4.2.8 Indirect Effects on Marine Mammals and Sea Turtles

The primary impact that could be expected for habitats or the food sources used by marine mammals and sea turtles would be temporarily elevated noise levels from the Langseth airgun array, MBES, and SBP. These impacts are expected to be short-term and of limited geographic extent. At any one time, only a very small area of available habitat or food supply would be ensonified at any one time. The proposed survey would have negligible impact on the ability of marine mammals and sea turtles to feed.

A special case exists for sargassum habitat (which has been proposed as a critical habitat for juvenile loggerhead sea turtles (FR 78(138) 18 July 2013). The proposed survey area is at the northern extent of the Sargasso Sea, and no observations exist for determining the likelihood of sargassum in the study area. Because sargassum occurs in patchy clumps, it is possible that the ship transiting across a clump would break it apart, but multiple clumps are how sargassum occurs. Hence the ship's transit would create an effect that is identical to currents, which also separate and combine these clumps. The way the tracks are laid out in single long lines means that any sargassum in the ship track would not be affected by more than the single traverse.

4.2.9 Conclusions for Marine Mammals and Sea Turtles

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. NMFS has proposed to issue an IHA, 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 Draft Biological Opinion reviewed by USGS and NSF, NMFS has proposed that the level of incidental take is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. The proposed issuances of the IHA and the Biological Opinion further verifies that significant impacts would not be anticipated from the proposed activities.

4.2.10 Conclusions for Invertebrates, Fish and Fisheries

In decades of seismic surveys carried out by Langseth and its predecessor, R/V Ewing, Protected Species Observers (PSOs) and other crew members have not seen seismic sound-related fish or invertebrate injuries or mortality.

4.2.11 Conclusions for Seabirds

In decades of seismic surveys carried out by Langseth and its predecessor, R/V Ewing, Protected Species Observers (PSOs) and other crew members have not seen seismic sound-related seabird injuries or mortality. Furthermore, USGS received concurrence from USFWS that the proposed activities “may affect” but “are not likely to adversely affect” species under their jurisdiction (Appendix D).

4.2.12 Conclusions for Essential Fish Habitat

Although adverse impacts to EFH were not anticipated, USGS consulted with the NMFS Southeast and Northeast offices of the Greater Atlantic Region under the Magnuson-Stevens Act for EFH. The NMFS Greater Atlantic Regional Fisheries Office concluded that the proposed activities may at some level adversely affect EFH. NMFS also noted, however, “Upon considering the design and nature of the survey we have no EFH conservation recommendations to provide pursuant to Section 305(b)(2) of the Magnuson-Stevens Act at this time.”(Appendix D).

4.3 NON-ACOUSTIC DIRECT EFFECTS

Although the noise from the airguns is expected to be the primary direct effect on the environment, operating a large ship at sea could result in other effects. This section summarizes those effects.

4.3.1 Disturbance by Vessel Presence

Ocean going vessels, such as *R/V Langseth,* are common on nearly all of the world’s oceans. Noise or lights from a large vessel such as *Langseth* could affect marine animals in the proposed study area. At survey speed (approximately 4.2 knots), the vessel would cover about 200 km per day, and would not be in one area long enough for the effects to be lasting. The NSF/USGS PEIS concluded that the normal vessel sounds and lights could not be expected to cause more than localized, short-term, or temporary changes in behavior of marine animals, similar to the effects that any large commercial vessel might have.

4.3.2 Collisions

The risk of collision of seismic vessels or towed/deployed equipment with marine mammals exists but is extremely unlikely. This is based on the relatively slow operating speed (typically 4-5 kt or 7-9 km/h) of the vessel during seismic operations, and the generally straight-line movement of the seismic vessel. Collisions between cetaceans and seismic gear have not been reported during previous seismic vessel activities.A seismic vessel would travel faster during transits to and from seismic survey sites (approximately 10 kt or 18 km/h), and movement would be predominantly in a straight line, with typically gradual changes in orientation. As noted in the NSF/USGS PEIS (§3.4.4.4 and (§3.6.4.4), collisions between vessels and/or their towed gear with marine mammals or sea turtles is extremely unlikely.

The planned monitoring and mitigation procedures are designed to minimize, if not eliminate, risk of collision.

4.3.3 Entanglement with Towed/Deployed Gear

The NSF/USGS PEIS (§3.4.4.4 and §3.6.4.4) concluded that the risk of entanglement of towed/deployed equipment with marine mammals and sea turtles could occur but would be extremely unlikely. Entanglement of marine mammals in seismic equipment is not likely since streamers are equipped with no tangle gear and marine mammals and sea turtles are expected to avoid the vessel during operations. Rare incidents have been reported of a turtle becoming entangled in tail-buoys off Africa (Weir, 2007), and a single incident occurred when an olive ridely turtle was found in a deflector foil of the seismic equipment during *Langseth* operations off Costa Rica in 2011 (in a region of abundant turtles). Deflector foils are deployed for 3D seismic surveys, and will not be deployed for these 2D surveys. No other incidents of entanglement have occurred in more than a decade of seismic surveys of *Langseth* operations or those of its predecessor NSF vessel *R/V Maurice Ewing*.

The planned monitoring and mitigation procedures are designed to minimize, if not eliminate, risk of and entanglement.

4.3.4 Waste Discharges

R/V Langseth could produce a variety of discharges and emissions, as described in Table 20 below, together with the regulations and actions that would minimize or eliminate their effects.

Table 20: Summary of Seismic Vessel Related Emissions and Discharges

Discharge/ Emission	Description and Handling/Disposal Procedures
Grey and Black Water	There may be up to 55 persons on the seismic vessel at any one time. Grey water discharge (showers, dishwashing, deck drains, etc.) could be 40 m^3/d and that black water discharge (sanitary waste) would be 19 m^3/day. All liquid discharges would be treated in accordance with the IMO standards prior to ocean discharge.
Ballast Water	On survey vessel, ballast water is 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 (International Convention for the Prevention of Pollution from Ships, 1973, and the Protocol of 1978 related thereto), IMO.

Bilge Water	Bilge water often contains oil and grease that originate in the engine room and machinery spaces. Before discharge, bilge water is treated in accordance with MARPOL 73/78, IMO using an oil/water separator. The extracted water is tested to ensure that the discharges contain no more than 15 mg/L of oil.
Discharges from Machinery Spaces	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.
Solid Waste	Most solid waste is transferred to shore for disposal at an approved disposal facility. Compliance with vessel waste management plan, Clean Water Act, and MARPOL 73/78 for all solid waste discharges. Combustible materials (e.g., oily rags, paint cans) are handled separately in hazardous materials containers. Recycling programs would comply with local state regulatory requirements.
Chemicals and Hazardous Materials	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. All hazardous waste would be brought to shore for treatment and/or disposal. The seismic vessel is equipped with solid-streamer technology, as this type of streamer is not reliant on flotation fluid to achieve a neutral ballast state, thus eliminating the risk of an accidental spill.
Lights	The survey vessel would carry operational, navigation and warning lights. Working areas would be illuminated with floodlights as required for compliance with occupational health and safety standards and would be fully equipped with emergency lighting.

Atmospheric Emissions	The major emission source from the proposed surveys is the seismic vessel. Operational atmospheric emissions may include vessel exhaust, exhaust fumes from diesel generators and operational emission of halons during firefighting or maintenance of air conditioning and refrigeration systems. These emissions would be minimized through best vessel management practices and preventative maintenance procedures. Survey emissions would not exceed any applicable air quality standards or guidelines. There are limited emission sources and few receptors likely to be affected. To ensure that air emissions are minimized, L-DEO would implement the following mitigation measures: • properly maintaining and routinely inspecting ship equipment • minimizing vapor loss from fuel tanks • minimizing idling of equipment when not in use • complying with the air quality regulations (Clean Air Act) • adhere to MARPOL Annex VI, Regulations for the Prevention of Air Pollution from Ships

With proper attention to regulations governing these emissions, development of appropriate action plans, and safe operation of the vessel, which is normal operating procedure the risk from these waste emissions should be minimized or eliminated.

4.3.5 Potential Malfunctions and Accidental Events

There are unplanned situations that may be encountered during the proposed action. Potential hazards such as fuel spills, loss of seismic gear, or vessel collisions are addressed during site-specific planning as part of emergency response planning. Procedures are developed by L-DEO to ensure that such events are managed in a safe and environmentally sound manner. L-DEO has policies, plans, and procedures to prevent or mitigate effects of malfunctions and accidents. These policies, plans, and procedures would be located on the seismic vessel, and in the L-DEO shore office. During the proposed action, there would be limited amounts of marine fuel and lube oil onboard that could potentially be accidentally spilled to the ocean. The *Langseth* operates on diesel fuel. The fuel (marine gas oil) capacity of the *Langseth* is 1,340 m^3 (353,760 gal). Any accidental spill would be reported to the US Coast Guard immediately.

The *Langseth* would be equipped with solid-streamer technology, as this type of streamer does not rely on flotation fluid to achieve a neutral ballast state, thus eliminating the risk of an accidental spill from a damaged streamer.

Other accidental events could include damage or loss of seismic equipment, entanglement of seismic equipment with fishing gear, and vessel collisions. Best management practices and communications would be used on the survey vessel to avoid equipment loss or damage. Gear would be retrieved from the water if wave heights reach or exceed unacceptable limits. In case of severe weather, the vessel may return to shore until conditions improve.

4.3.6 Additional Safety concerns for *R/V Langseth*

In the Northwest Atlantic, marine operations are affected primarily by wind, waves, currents, visibility, and to a lesser extent, air and sea temperatures. The time of year is a factor in determining the level of risk or impact any of these environmental parameters may have on operational efficiency or success. Planning and executing activities safely requires due consideration of the seasonally variable hazards which may be encountered.

Project activities are planned to take place between in August and September, 2014 and between April and August, 2015. This section characterizes the range of conditions likely to be encountered within this time frame, and some of the potential associated adverse effects. Vessels, equipment and materials used by the project must be rated to function within the expected conditions and adhere to all standards and codes for safety and data quality.

Wind and waves have the potential to increase stress on vessels, disrupt operations and scheduling, and to affect survey data quality. Vessels such as *R/V Langseth* and its equipment must be able to withstand the range of normal and extreme wind and wave conditions expected. Seismic survey operations are typically limited by wind or sea conditions due to loss of data quality in high seas and potential damage to equipment.

Thunderstorms and major storm systems occur in the region most often during summer and fall as hot, humid air masses collide with passing fronts (Joyce, 1987). Tropical cyclones, which occur during summer and fall, are severe but infrequent. Extratropical cyclones occur frequently during winter and may produce unfavorable conditions during winter and spring. Most major storms, including hurricanes, occur during the North Atlantic hurricane season from June through November. The *Langseth* is built as a global ocean vessel able to withstand the stresses that could occur in high winds and heavy seas.

While the summer to early fall period generally favors calm seas, visibility may be reduced due to formation of fog and could affect operations because of limited visibility. Limited visibility is accounted for in the mitigation procedures.

Warm and cold core rings are features of the Gulf Stream and described in detail in Appendix F of the NSF/USGS PEIS (2011). Upwellings occur in the western part of the study area from wind driven water current from slopes along the shelf break. Both oceanography features can create strong currents that increase the potential for entanglement on the streamers trailing behind the *Langseth*. These circumstances occur in all oceanographic environments that seismic surveys must accommodate and present no greater risk to this Langseth cruise than other seismic cruises utilizing long streamers.

4.4 ANALYSIS OF ALTERNATIVES – 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 first cruise (21 days in August to September, 2014, the dates for the 2015 survey are yet to be scheduled) are the dates when the personnel and equipment essential to meet the overall project objectives are available.

Additionally, the U.S. Interagency Task Force on the Extended Continental Shelf (ECS), under leadership of the Department of State, has established a Project Office to complete work on delineating the outer limits of the U.S. ECS in 5 years from 2014-2019. Delineating the Atlantic margin ECS takes two field surveys (as proposed in this action), at least two years of analysis and interpretation following data acquisition, as well as one year to develop the appropriate technical documentation for Article 76 of the Law of the Sea Convention. Delaying the proposed 2014 field program by a year jeopardizes completing the necessary steps to meet the 5-year Project Office deadline.

Marine mammals and sea turtles are expected to be found throughout the proposed Study Area and throughout the time period during which the project may occur. Most marine mammal species are year-round residents in the North Atlantic, based on the number of OBIS sightings in the Study Area and adjacent waters, so altering the timing of the proposed project likely would result in no net benefits for those species.

Scheduling ship time is challenging, in which the demands of the various scheduled and funded activities require compromises. The proposed dates for the 2014 survey are the dates when the equipment and personnel essential to meet the overall project objectives are available. The 2014 survey is also scheduled so that the subsequent proposed *Langseth* GeoPRISMS/ENAM cruise (mid-September to early October) does not overlap with Northern Right Whale migrations.

Weather conditions in the Atlantic and ship schedules also constrain the possible survey time window to April through September. Because of generally higher sea states in winter, winter is an unsafe time for conducting experiments when ship maneuverability is limited, as it is towing an 8-km-long streamer. Scheduling the survey in mid-summer when daylight hours are maximized and sea states are generally minimal facilitates observations and identifications of marine wildlife.

4.5 ANALYSIS OF ALTERNATIVES – 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. The U.S would not be able to define the ECS and therefore not be able to exercise its sovereign rights over the seafloor and sub-seafloor because it would lack the data to determine the extent of its sovereign rights. Nor would the USGS have an important data set to contribute to its accurate assessment of submarine landslide and tsunami hazards along the east coast. The No-Action Alternative would not meet the purpose and need for the proposed activities.

5 CUMULATIVE EFFECTS

The Council on Environmental Quality (CEQ) regulations (40 CFR sec. 1500 - 1508) for implementing NEPA define cumulative effects as the impact on the environment that 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). The NSF/USGS PEIS addresses scientific research activities within the 2012-2020 time-frame, and a cumulative activity scenario has been developed for the same period as recommended by the CEQ (1997) guidelines. The reasonably foreseeable future activities described below are part of the cumulative scenario. Individual environmental effects could accumulate and interact to result in cumulative environmental effects. A critical step in the environmental assessment is determining what other projects or activities have reached a level of certainty (e.g., "would be carried out") such that they must be considered in an environmental assessment. Certain requirements must be met to consider cumulative environmental effects:

- there must be a measurable environmental effect of the project being proposed;
- the environmental effect must be demonstrated to interact cumulatively with the environmental effects from other projects or activities; and
- it must be known that the other projects or activities have been, or would be, carried out and are not hypothetical.

5.1 CUMULATIVE EFFECTS OF PROPOSED TWO-CRUISE (2014, 2015) SEISMIC PROGRAM

The proposed action would occur in two parts. The two parts would occur at least seven months apart and may be closer to one year apart. The nature of each survey is that the vessel would be continuously moving, covering different parts of the seafloor, except for occasionally crossing tracklines, which is a required component of the seismic cruise plan. The seismic tracks are laid out to satisfy the requirements of Article 76 of the United Nations Convention on the Law of the Sea for substantiating the sediment thickness formula line. Because the sounds generated by seismic surveys are transient and do not "accumulate" in the environment, the most likely cumulative effects would be associated with other concurrent activities (e.g., cargo ships, tankers, other seismic surveys, or fishing vessels). The cumulative effects of the proposed two-part seismic program would be short term, intermittent and localized, with respect to effects on marine mammal species and sea turtles.

The individual seismic survey vessel activity and noise would constitute a temporary and minor contribution to the overall noise generated by other such sources and and would be of short duration in local areas. Based on current knowledge, and especially with the proposed mitigation procedures in place, the proposed project is not expected to result in, or contribute to, cumulative impacts on marine mammals or sea turtles, including threatened or endangered species.

5.2 METHODOLOGY FOR THE CUMULATIVE EFFECTS ANALYSIS

- The scoping exercise was undertaken to identify past, ongoing, and reasonably-foreseeable human activities that are likely to interact cumulatively with environmental effects from exploration activities. The next step was to assess the potential impact of cumulative effects on each environmental factor.
- The other projects and activities considered in this assessment include those that are likely to proceed (such as those listed in the Federal Register), and those which have been issued permits, licenses, leases or other forms of approval. Past, present, and future activities that may impact cumulatively with the project are outlined in Table 21.

Table 21: Scoping of Offshore Activities and Interactions with the Survey Project

Activity	Description	Temporal Interaction with Project	Spatial Interaction
Offshore Petroleum	Exploration Drilling, Development Drilling or Production	Future	No Interaction. Anticipated leasing within the Mid-Atlantic and Southern Atlantic OCS planning areas is not anticipated until well after the 2016 time frame (USDOI, BOEM, 2011c). Nine applications for Geological and Geophysical (G&G) activities by geophysical companies are registered on the BOEM website; all applications have expired on exploration survey schedule. It is not anticipated that any of these permits would be issued before 2015. Given the separation in time with the proposed

Activity	Description	Temporal Interaction with Project	Spatial Interaction
			activities (and perhaps survey overlap), no cumulative effects would be anticipated.
ECS Bathymetric and Geophysical Research	The U.S. Interagency Task Force on the Extended Continental Shelf (ECS) has a multiyear strategy for acquiring data along the U.S. margins in order to define the outer limits of the U.S. ECS beyond 200 nm. Multibeam bathymetry (most margins, led by NOAA and University of New Hampshire) and multichannel seismic reflection and refraction data (selected margins, including the Atlantic, led by USGS)	Present, Future	No spatial overlap with additional ECS surveys is forecast
NSF-sponsored seismic research	In 2014, the *Langseth* is scheduled to conduct two NSF-supported seismic surveys off the Atlantic seaboard to study sea-level changes and geologic framework. These are described in Appendix C: 1. The proposed NJ Margin survey area is located between ~39.3–39.7°N and ~73.2–73.8°W in the Atlantic Ocean, ~25–85 km off the coast of New Jersey. Water depths in the survey area are 30–75 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 3 June–9 July 2014. Some minor deviation from these dates is possible, depending on logistics and weather.	Present	No spatial overlap as survey programs would be consecutive using the same vessel of opportunity, *R/V Langseth*

Activity	Description	Temporal Interaction with Project	Spatial Interaction
	2. The proposed East North America Margin (ENAM) survey area is located between ~32–37°N and ~72–76.5°W in the Atlantic Ocean ~6–430 km off the coast of Cape Hatteras. Water depths in the survey area are 30–4300 m. The seismic surveys would be conducted outside of state waters and mostly within the U.S. EEZ, and partly in International Waters, and is scheduled to occur for ~38 days during 15 September–22 October 2014. Some minor deviation from these dates is possible, depending on logistics and weather. Separate EAs are being prepared for those activities. Neither survey would overlap with the proposed USGS ECS Study Area.		
Future Geophysical Research	Other seismic research projects could be proposed in the region in the future, however none are currently planned by the USGS or NSF. Therefore, it is not reasonably foreseeable to assume future research cruises in the region.	Future	The duration of a typical seismic research cruise ranges from 2 to 4 weeks with approx. 1 to 2 weeks of transit and/or preparation between cruises. Seismic operations may last 30-800 hr during a seismic survey. Consecutive cruises may occasionally occur in the same location or the same region, but they would not be expected to occur

Activity	Description	Temporal Interaction with Project	Spatial Interaction
			simultaneously in the same location.
Marine Traffic Shipping (domestic, international, tourism)	Over the 2014 to 2015 time period shipping and marine transportation activities in the Study Area may increase above the present level, due in part to the expansion of the Panama Canal, which is expected to be complete in 2014 and which would double its capacity	Past, Present, Future	Interaction could occur
Commercial Fishing	Fishing effort is diverse and shifting in response to stock locations	Past, Present, Future	Interaction could occur
Military	Over the 2014-2015 time period, there may be increases in military uses of the Study Area above present levels (BOEM PEIS, 2014).	Past, Present, Future	Interaction could occur
Submarine Cables	Seaborn Networks Seabras-1 telecommunication cable installation, with Ready For Service in 2015	Future	Interaction could occur with cable laying vessel

In addition to consideration of these projects and activities, the cumulative effects assessment also considers past biological and/or anthropogenic pressures that may have contributed to existing conditions within the Project Area (i.e., commercial whaling). Where applicable, these pressures and the resulting effects are reflected in the description of existing conditions. Table 22 22 provides an assessment of cumulative effects for those concurrent activities scoped above. Additionally, it is not anticipated that the proposed action would result in any noticeable contributions to climate change. Relevant information about potential effects of climate change in the region is discussed in the Cumulative Effects Section of a site specific NMFS EA for a Maine Geophysical Survey in the Northwest Atlantic Ocean (NMFS 2014) and is incorporated into this Final EA by reference as if fully set forth herein.

Table 22: Assessment of Cumulative Effects

Environmental or Socio-Economic Factor	Cumulative Effects Assessment
Marine Mammals	Because the sounds generated by seismic surveys are transient and do not "accumulate" in the environment, the most likely cumulative effects would be associated with other concurrent activities (e.g., cargo ships, tankers, other seismic surveys and fishing vessels). The cumulative effect is short term (< 1 month), intermittent, and localized, with respect to effects on ESA-listed marine mammal species. The individual seismic survey vessel activity and noise would constitute a minor contribution to the overall noise generated by other such sources and space-user conflict, and would be of short duration in local areas. Based on current knowledge, and especially with the proposed mitigation procedures in place, the proposed project is not expected to result in, or contribute to, cumulative impacts on marine mammals, including threatened or endangered species.
Sea Turtles	Because sea turtles can be visually difficult to detect, the mitigation of visual avoidance may be less effective than for marine mammals. However, the source array would be shut down if a sea turtle is observed within the Exclusion Zone. PSVO's would maintain records of marine turtles sighted. Given the lack of systematic surveys for marine turtles in the Study Area, this opportunity for observation of sea turtles could add to the understanding of their distribution in the area.
Marine Fish	Marine fish populations in the Study Area may be affected by natural factors, such as changes in prey and predator populations in areas within their natural range that may occur outside the Study Area. Certain populations of marine fish are more vulnerable to changes in their environment. This is especially true of species of special concern. The distribution of most fish species varies seasonally in response to physical or chemical changes in the surrounding environment (e.g., depth, substrate, salinity, temperature) and as a result of seasonal habitat requirements (e.g., spawning, feeding). This shift is becoming more apparent to fishers with climate change influence resulting in water temperature and mass changes. Long annual migrations are undertaken by groundfish species, such as cod, halibut, shrimp and crab; and pelagic species such as tunas, swordfish, Atlantic salmon and sharks. The project would not change the physical or chemical requirements that dictate fish presence, and their ability to

Environmental or Socio-Economic Factor	Cumulative Effects Assessment
	reproduce. The residual effects of the project components on fin fish that may be cumulative with the effects of other human activities in the region are expected to be very limited, consisting primarily of short-term avoidance behavior. The predicted cumulative effects of the proposed seismic survey with noise from vessel traffic, and commercial fishing are similar to those discussed in the assessment above. Seismic surveys produce repetitive, localized and short-term increases in ambient noise levels, with the period between potential exposures ranging from hours to days. Beyond the FMZ, sound from a seismic survey is similar to commercial vessels (MMS 2004). With mitigation and monitoring procedures in place, the project components are predicted to have minimal interaction with fish species and are not anticipated to result in any cumulative adverse effects to any marine fish species The main cumulative impact on fish population would be the fishing activities that could occur at the same time as the seismic exploration. Research indicates that adverse seismic related effects are largely of a temporary behavioral level effect. Therefore, seismic surveys would not contribute adversely to cumulative effects to fish and shellfish. In general, the cumulative effect on fish populations would be short-term and localized. The proposed project would not be expected to result in or contribute to cumulative impacts on fish species.
Marine Birds	The *R/V Langseth* would comply with discharge regulations established by IMO and thus would not add to short-term or long-term effects of oil spillage on marine avifauna. Overall, there would be no cumulative adverse effects of this seismic exploration project expected to occur on the distribution, abundance, breeding status and general well-being of marine avifauna in or near the Study Area.
Marine Protected Areas	This seismic program would not encroach on any Marine Protected Areas, and therefore not contribute to any cumulative effects.
Marine Traffic	Effects from vessel traffic under the cumulative scenario are potentially adverse but minimal. With respect to vessel activity levels, the proposed seismic survey would represent a small portion of total vessel activity on the Atlantic OCS. Commercial fishing, commercial shipping and ocean study activities also would contribute to the cumulative vessel activity in the Study Area. The cumulative incremental impact attributed to the project vessel

Environmental or Socio-Economic Factor	Cumulative Effects Assessment
	operations would be negligible.
Commercial Fisheries	Cumulative effects on commercial fisheries would be related to the space-use conflicts and noise associated with other users of the offshore resources. Possible conflicts include the *Langseth*'s streamer entangling with fixed fishing gear and temporary displacement of fishers within the immediate vessel operating area. Little fixed fishing gear would be anticipated in the Study Area; however if encountered during operations, the Langseth would attempt avoidance. Fishing activities could occur within the Study 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 through publication of a Notice to Mariners about operations in the area. No damage would be anticipated to result from the project with proposed mitigation, and the project would thus not increase economic risk to fishing vessels. In general, because the sounds generated by seismic surveys are intermittent and non-stationary, the most likely cumulative effects would be associated with other concurrent activities (e.g., cargo ships, tankers, other seismic surveys, and fishing vessels). The cumulative effect would be expected to be short term, intermittent and localized. In general, the seismic survey vessel activity and noise would constitute a minor incremental contribution to the overall noise generated by other such sources and space-user conflict, and would be of short duration in local areas. Based on current knowledge, and especially with the proposed mitigation procedures in place, the proposed project would not be expected to result in or contribute to cumulative effects on commercial fisheries.

6 SUMMARY OF MITIGATION

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 well as possible the nature and extent of any effects. The planned monitoring and mitigation measures would minimize the possibility of any injurious effects to marine species and reduce the environmental disruption.

Table 23: Environmental Factor-Specific Mitigation Measures and Follow-Up

Environmental Factor	Mitigation Measures	Follow up and Monitoring
Marine Mammals and Turtles	Before start of the operations, vessel operator would review sail lines, scheduling, anticipated fishing vessels and gear types, mitigation measures, expectations of all parties and Emergency Response Plans. PSVO's would be onboard the vessel throughout the duration of the survey and would record sightings of marine mammals and sea turtles per the IHA. Use of Passive Acoustic Monitoring (PAM) to detect possible presence of marine mammals. A 30 minute ramp-up procedure would be undertaken for seismic surveys. Ramp-up would be delayed if a marine mammal were observed in the Exclusion Zone. PSVO's would ensure the delay or shut down of seismic operations if ESA-listed mammals or turtles are present within the Exclusion Zone. Collision avoidance practices, including speed and course adjustment. Ramp-up of seismic data acquisition only when EZ is entirely visible.	PSVO reports would be available to NMFS and USFWS and the public. 90-day report required by NMFS summarizes all PSVO observations and mitigation actions.
Sea Birds	PSVO's would monitor for foraging sea birds within the EZ.	See 90-day report above
Marine Fish and Shellfish	None required	No follow up or monitoring required for routine activities
Marine Protected Areas	None required	No follow up or monitoring required for routine activities
Commercial Fisheries	A Notice to Mariners on the location and scheduling of seismic activities would be issued. The bridge crew on the vessel would monitor fishing activity in the vicinity of the seismic vessel and serve as a liaison between the fishing vessels and the seismic vessel. Commence deployment of seismic system only if deployment area confirmed to be clear of fixed fishing	No follow up or monitoring required for routine activities

Environmental Factor	Mitigation Measures	Follow up and Monitoring
	gear or floating longline gear.	
Marine Traffic/ Military	A Notice to Mariners on the location and scheduling of seismic activities would be issued.	No follow up or monitoring required

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9 APPENDIX A: ACOUSTIC MODELING OF SEISMIC SOURCE

Helene Carton, PhD, L-DEO

The airgun array that would be used for the USGS East coast survey is the full 4-string 6600-in^3 array, which is described and illustrated in § 2.2.3.1 of the NSF/USGS PEIS (hereafter NSF/USGS PEIS). It would be towed at a depth of 9 m. The shot interval would be 50 meters (20 to 22 seconds).

Received sound levels have been predicted by L-DEO's model (Diebold et al. 2010 provided as in the NSF/USGS PEIS Appendix H), as a function of distance from the airguns, for the 36-airgun array at any tow depth and for a single 1900LL 40-in^3 airgun, which would be used during power downs. This modeling approach uses ray tracing 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). In addition, propagation measurements of pulses from the 36-airgun array at a tow depth of 6 m have been reported in ~1600 m water depth (deep water), 50 m depth (shallow water) and a slope site (intermediate water depth) in the Gulf of Mexico in 2007–2008 (Tolstoy et al. 2009; Diebold et al. 2010), while propagation measurements of pulses from the 18-airgun 2-string array also at a tow depth of 6 m have been reported for the same shallow and deep sites (Diebold et al. 2010).

For deep and intermediate-water cases, these field measurements cannot be used readily to derive mitigation radii, as at those sites the calibration hydrophone was located at a roughly constant depth of 350-500 meters, which may not intersect all the sound pressure level (SPL) isopleths at their widest point from the sea surface down to the maximum relevant water depth for marine mammals of ~2000 meters. Figures 2 and 3 in the NSF/USGS PEIS Appendix H show how the values along the maximum SPL line that connects the points where the isopleths attain their maximum width (providing the maximum distance associated with each sound level) may differ from values obtained along a constant depth line. At short ranges, where the direct arrivals dominate and the effects of seafloor interactions are minimal, the data recorded at the deep and slope sites are suited for comparison with modeled levels at the depth of the calibration hydrophone. At larger ranges, the comparison with the mitigation model - constructed from the maximum SPL through the entire water column at varying distances from the airgun array - is the most relevant. The results are summarized below.

In deep and intermediate-water environments, comparisons at short ranges between sound levels for direct arrivals recorded by the calibration hydrophone and model results for the same array tow depth are in good agreement (Figures 12 and 14 in the NSF/USGS PEIS Appendix H). As a consequence, isopleths falling within this domain can be reliably predicted by the L-DEO model, while they may be imperfectly sampled by measurements recorded at a single depth. At larger distances, the calibration data show that seafloor reflected and sub-seafloor refracted arrivals dominate, while the direct arrivals become weak and/or incoherent (Figures 11, 12 and 16 in the NSF/USGS PEIS Appendix H). Aside from local topography effects, the region around the critical distance (~5 km in Figures 11 & 12, and ~4 km in Figure 16 in the NSF/USGS PEIS Appendix H) is where the observed levels rise very close to the mitigation model curve. However, the observed sound levels are found to fall almost entirely below the mitigation model curve (Figures 11, 12 and 16 in NSF/USGS PEIS Appendix H). Thus, analysis of the GoM calibration measurements demonstrates that although simple, the L-DEO model is a robust tool for estimating mitigation radii.

The proposed survey on the East coast margin would acquire data with the 36-airgun array at a tow depth of 9 m. The survey would take place entirely in deep water (> 1000 m). We use the deep-water radii obtained from 9-m tow depth L-DEO model results down to a maximum water depth of 2000 meters (Figure A1).

Measurements have not been reported for the single 40-in^3 airgun. The 40-in^3 airgun fits under the NSF/USGS PEIS low-energy sources. In § 2.4.2 of the NSF/USGS PEIS, Alternative B (the Preferred Alternative) conservatively applies a 100-m exclusion zone (EZ) for all low-energy acoustic sources in water depths >100 m. This approach is adopted here for the single Bolt 1900LL 40-in^3 airgun that would be used during power downs. In addition, L-DEO model results are used to determine the 160 and 190 dB radii for the 40-in^3 airgun in deep water (Figure A2).

Table A1 shows the distances at which the 160, 180 and 190 dB RMS sound levels are expected to be received for the 36-airgun array and the single (mitigation) airgun.

The 180-dB re 1 μPa_{rms} distance is the safety criterion as specified by NMFS (2000) for cetaceans. The 180-dB distance would also be used as the exclusion zone for sea turtles, as required by NMFS in most other recent seismic projects (e.g., Smultea et al. 2004; Holst and Beland 2008; Holst and Smultea 2008). If marine mammals or sea turtles are detected within or about to enter the appropriate exclusion zone, the airguns would be immediately powered down (or shut down if necessary).

Southall et al. (2007) made detailed recommendations for new science-based noise exposure criteria. Although USGS is aware that NOAA is revising acoustic guidance for marine mammals, at the time of preparation of this Final EA, NOAA has not issued an official revised version of that policy. As such, this Final EA has been prepared in accordance with the current NOAA acoustic guidance and the procedures are based on best practices noted by Pierson et al. (1998) and Weir and Dolman (2007).

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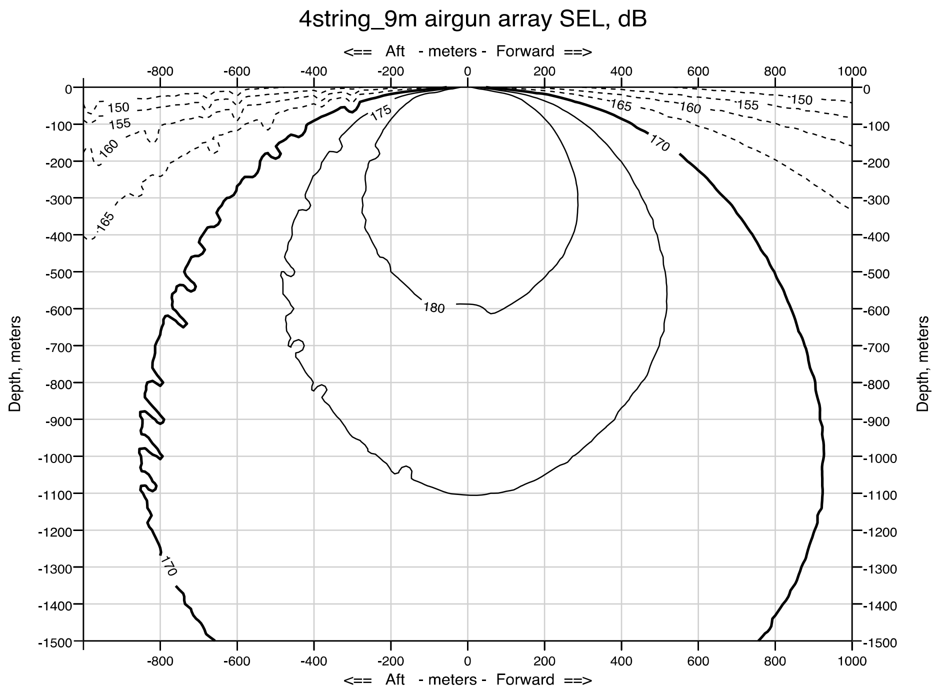


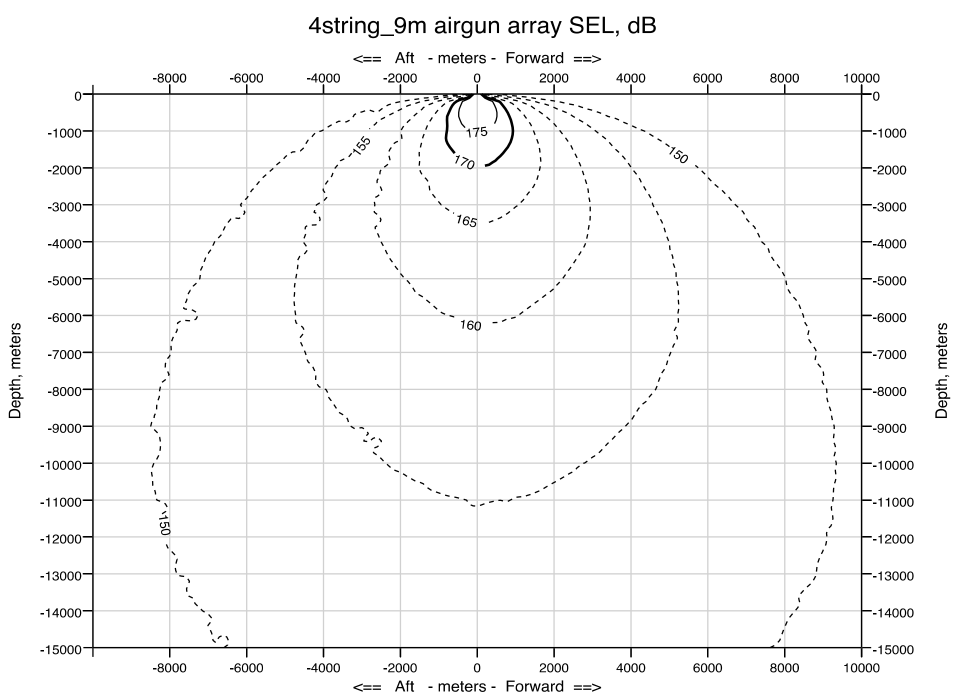
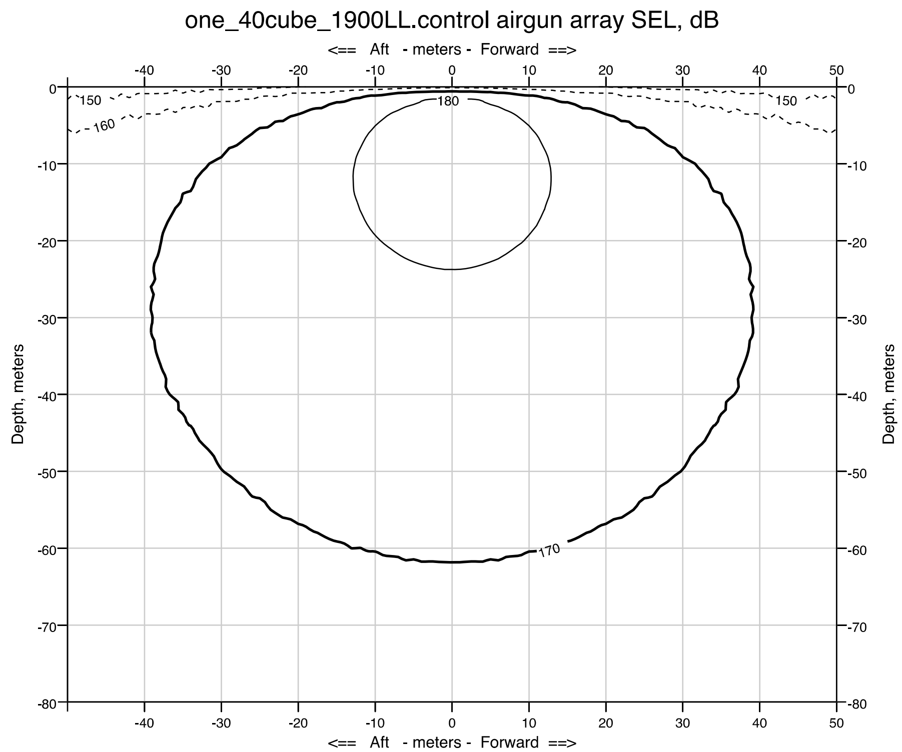


FIGURE A1. Modeled deep-water received sound levels (SELs) from the 36-airgun array planned for use during the survey, at a 9-m tow depth. Received RMS levels (SPLs) are expected to be ~10 dB higher. Plot at the top provides radius to the 170 dB SEL isopleths as a proxy for the 180 dB RMS isopleths and plot at the bottom provides radius to the 150 dB SEL isopleth as a proxy for the 160 dB RMS isopleth.



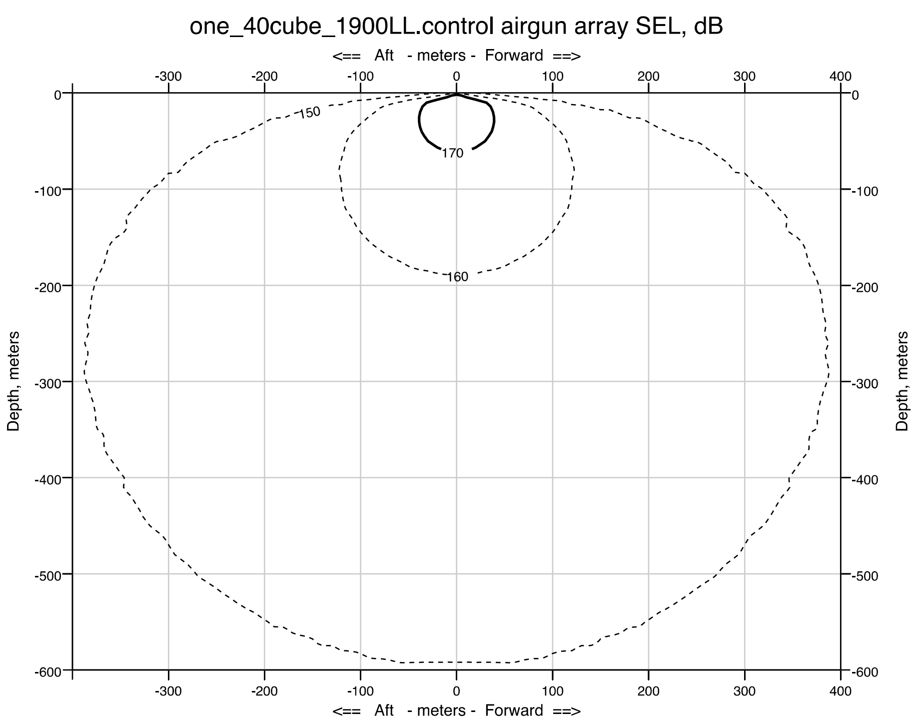


FIGURE A2. Modeled deep-water received sound levels (SELs) from a single 40-in^3 airgun towed at 9 m depth, which is planned for use as a mitigation gun during the proposed survey. Received RMS levels (SPLs) are expected to be ~10 dB higher. Plot at the top provides radius to the 170 dB SEL isopleths as a proxy for the 180 dB RMS isopleths and plot at the bottom provides radius to the 150 dB SEL isopleth as a proxy for the 160 dB RMS isopleth.

TABLE A1. Predicted distances to which sound levels ≥190, 180 and 160 dB re 1 μPa_{rms} are expected to be received during the proposed survey on the East coast margin in 2014 and 2015. For the single mitigation airgun, the EZ represents the conservative EZ for all low-energy acoustic sources in water depths >100 m defined in the NSF/USGS PEIS.

Source and Volume	Water Depth (m)	Predicted RMS Radii (m)		
		190 dB	180 dB	160 dB
Single Bolt airgun, 40 in^3	>1000 m	13	100	388
36-gun array totaling 6600 in^3	>1000 m	286	927	5780

10 APPENDIX B: REQUEST FOR AN INCIDENTAL HARASSMENT AUTHORIZATION

Request for an Incidental Harassment Authorization under the Marine Mammal Protection Act

by
U.S. Geological Survey

2-D Seismic Reflection Scientific Research Survey Program: Mapping the U.S. Atlantic Seaboard Extended Continental Shelf Region and Investigating Tsunami Hazards, August-September 2014 and April-August, 2015

Request for an Incidental Harassment Authorization under the Marine Mammal Protection Act

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2-D Seismic Reflection Scientific Research Survey Program: Mapping the U.S. Atlantic Seaboard Extended Continental Shelf Region and Investigating Tsunami Hazards, August-September 2014 and April-August, 2015

March 2014

Submitted to:

National Marine Fisheries Service
Office of Protected Resources
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ACRONYMS AND ABBREVIATIONS

µ	micro
2-D	two dimensional
BOEM	Bureau of Ocean Energy Management
CeTAP	Cetaceans and Turtle Assessment Program
dB	decibel
ECS	extended continental shelf
EEZ	Exclusive Ecomonic Zone
EIS	*Environmental Impact Statement*
ESA	Endangered Species Act
EZ	exclusion zone
IHA	Incidental Harassment Authorization
in^3	cubic inch(es)
kHz	kiloHertz
kw	kilowatt(s)
L-DEO	Lamont-Doherty Earth Observatory
MBES	multibeam echosounder
NASA	National Aeronautics and Space Administration
NEFSC	Northeast Fisheries Science Center
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NODE	(U.S. Department of the) Navy Operating Area (OPAREA) Density Estimates
NSF	National Science Foundation
OBIS	Ocean Biogeographic Information System
OEIS	*Overseas Environmental Impact Statement*
OPAREA	Operating Area
Pa	Pascal
PAM	Passive acoustic monitoring
PEIS	*Final 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* (June 2011)
PSAO	Protected Species Acoustic Observer

ACRONYMS AND ABBREVIATIONS, CONTINUED

PSVO	Protected Species Visual Observer
PTS	permanent threshold shift
R/V Langseth	*Research Vessel Marcus G. Langseth*
RMS	root-mean-squared
SAR	Stock Assessment Report
SBP	sub-bottom profiler
SEFSC	Southeast Fisheries Science Center
SEL	sound exposure level
SERDP	Strategic Environmental and Development Program
SPL	sound pressure level
TTS	temporary threshold shift
UME	Unusual Mortality Event
USGS	United States Geological Survey

I. DESCRIPTION OF THE ACTIVITY

A detailed description of the specific activity or class of activities that can be expected to result in incidental taking of marine mammals.

1.1 Overview of the Activity

The United States Geological Survey (USGS), Coastal and Marine Geology Program (Debbie Hutchinson, Principal Investigator), plans to conduct a regional marine two dimensional (2-D) seismic survey in the northwest Atlantic Ocean within the U.S. Exclusive Economic Zone (EEZ) and extending into International Waters as far as 350 nautical miles from the U.S. coast (Study Area) (**Figure 1**). Water depths in the Study Area range from approximately 1,400 meters to 5,400 meters. The proposed USGS survey is planned to be conducted in two phases; one survey during August and September, 2014, and the second survey is expected to take place between April 1 and August 31, 2015 (specific dates to be determined). The activities for both Phase 1 and Phase 2 are included in this application (**Figure 2**).

USGS plans to use conventional marine seismic methodology to: (1) establish the outer limits of the U.S. continental shelf, also referred to as the Extended Continental Shelf (ECS) as defined by Article 76 of the Convention of the Law of the Sea; and (2) study the sudden mass transport of sediments down the continental shelf as submarine landslides that may pose significant tsunamigenic (i.e., earthquake potential along the subduction zone) hazards to the Atlantic and Caribbean coastal communities.

The proposed survey will use the *Research Vessel Marcus G. Langseth* (*R/V Langseth*) as the sole source vessel. To conduct the proposed survey, the *R/V Langseth* will deploy a 36-airgun array as the energy source and one 8-kilometer multichannel hydrophone cable as the receiving system. The hydrophone cable will receive the returning acoustic signals from the towed airgun array and the data will be processed on-board the *R/V Langseth* as the survey occurs.

Each proposed surveys (2014 and 2015) will each consist of a 17- to 18-day leg (exclusive of transit and equipment deployment and recovery) comprising approximately 1,700 nautical trackline miles (approximately 3,165 kilometers) of 2-D seismic reflection coverage. The airgun array will operate continuously during the survey with shutdowns only for repairs and marine mammal and sea turtle mitigation. Data will continue to be acquired between line changes. The successive track segments can be surveyed as almost one continuous line. Turns of no greater than 120 degrees will be required to move from one line segment to the next. The 2014 proposed survey design consists primarily of the track lines that run along the periphery of the overall Study Area, including several internal track lines (**Figure 2**). The proposed 2014 survey will occur in water depths ranging between 1,450 meters and 5,400 meters. The 2015 proposed survey consists of additional dip and tie lines. (Dip lines are lines that are perpendicular to the north-south trend of the continental margin. Strike lines are parallel to the margin. Tie lines are any line that connects other lines.) The 2015 survey design may be modified based on the 2014 results.

Along with the airgun operations, two additional acoustical data acquisition systems will be operated during the survey. A Kongsberg EM122 multibeam echosounder (MBES) and a Knudsen Model 3260 Chirp sub-bottom profiler (SBP) will be operated continuously during the seismic operations in order to map the ocean floor. MBES and SBP will not operate during transits at the beginning and end of the survey.

The Langseth has been used to conduct research seismic surveys world-wide since 2008. All of the seismic surveys have been operated under incidental harassment authorizations issued by NMFS. Environmental assessments, IHA's and post-cruise reports environmental impact for most of these cruises cruises can be found on the NMFS Protected Resource website. Many of these reports and applications were prepared by LGL Limited, Environmental Research Associates, under contract to Lamont Doherty Earth Observatory or the USGS. Because material from earlier documents is owned by the U.S. Government and in the public domain, some material common to these documents may have been used verbatim herein without attribution. The USGS acknowledges role of LGL in preparing material that has been used.

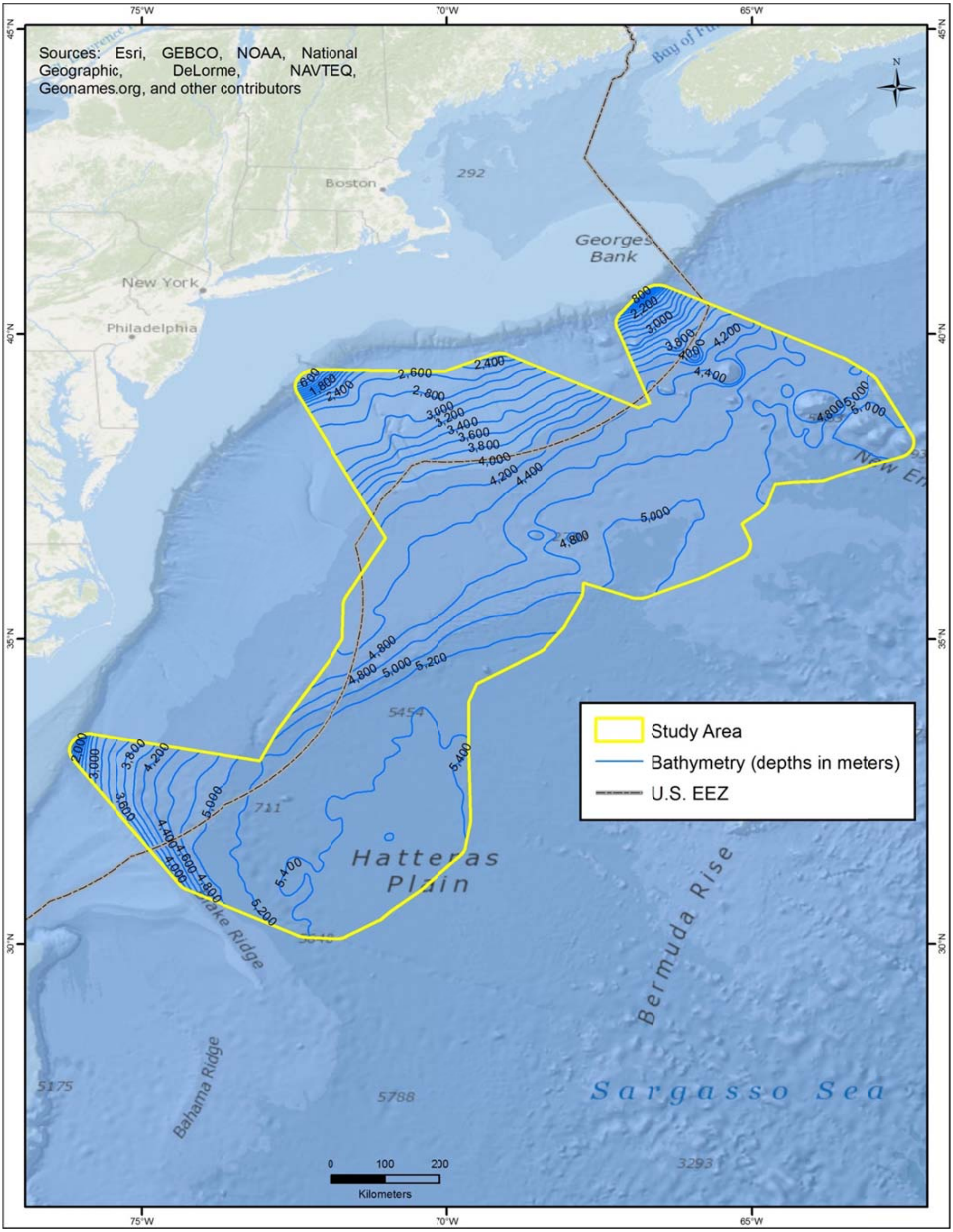


Figure 1 Proposed USGS Study Area

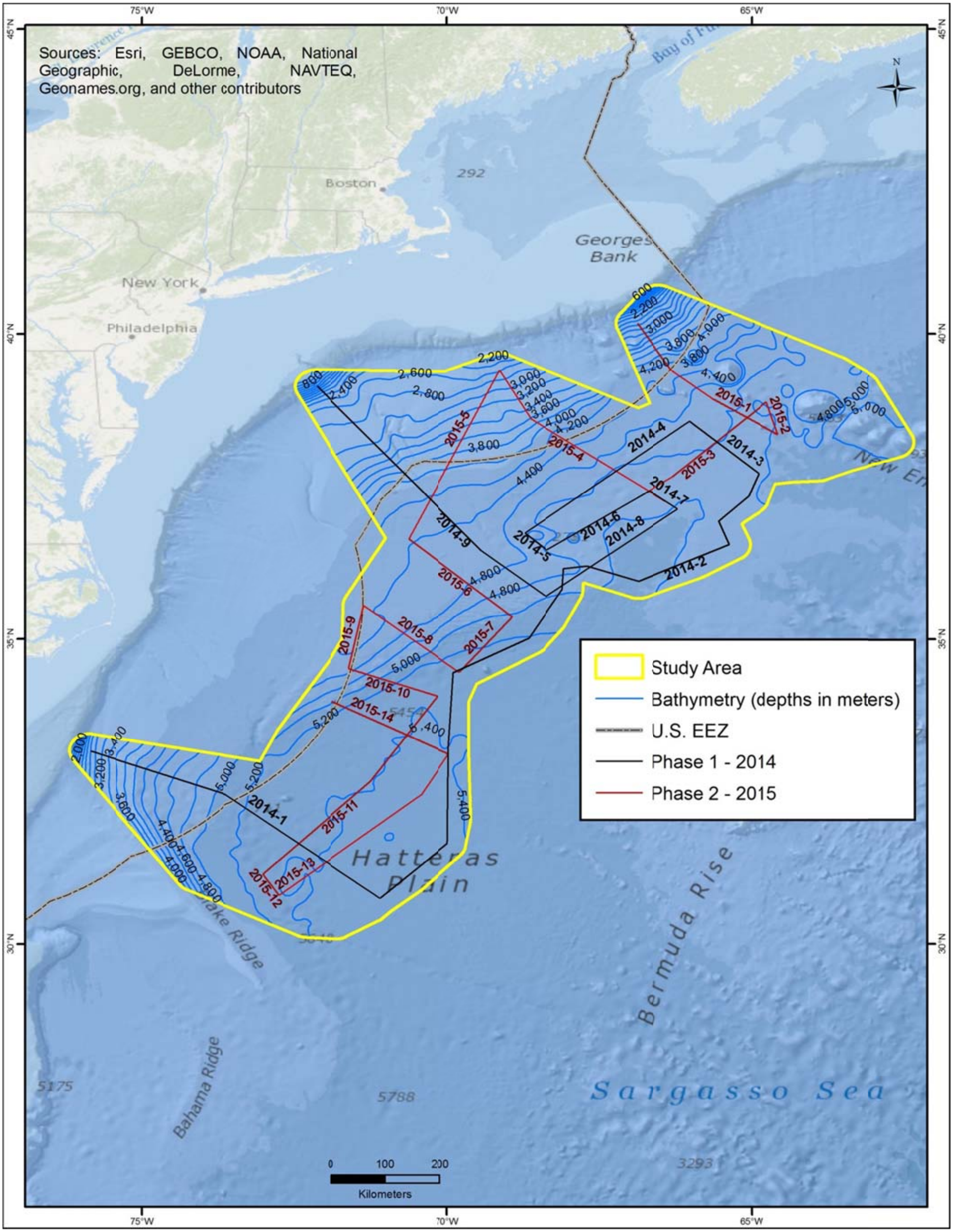


Figure 2 Proposed Seismic Survey Lines, Phases 1 and 2

1.2 Vessel Specifications

The *R/V Marcus G. Langseth* will be used as the source vessel; it is owned by the NSF and operated by Lamont-Doherty Earth Observatory (L-DEO) of Columbia University. The *R/V Langseth* was designed as a seismic research vessel with a quiet propulsion system to avoid interference with the seismic signals. The operation speed during seismic acquisition is typically 7.8 to 8.3 kilometers per hour (4.2 to 4.5 knots). When not towing seismic survey gear, the *R/V Langseth* can cruise at 20 to 24 kilometers per hour (11 to 12 knots). The *R/V Langseth* was further described in Section 2.2.2.1 of the *Final 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* (June 2011; referred to herein as the PEIS) and the Record of Decision (June 2012).

1.3 Airgun Description

During the proposed 2-D survey, the airgun array to be used will consist of 36 airguns (plus 4 spare airguns), with a total volume of approximately 6,600 cubic inches (in^3). The airgun array and configuration are described and illustrated in the PEIS in Section 2.2.3.1 and on Figure 2.11, respectively. For the 2014 and 2015 proposed survey, the airgun array will be towed at a depth of 9 meters and shot intervals will be 50 meters (approximately 20 to 24 seconds). The firing pressure of the array is 2,000 pounds per square inch.

1.4 **Predicted Sound Levels**

The airgun array that will be used for the USGS East Coast survey is the full 4-string 6,600-in^3 array, which is described and illustrated in the PEIS in Section 2.2.3.1.

Received sound levels have been predicted by L-DEO's model (Diebold et al. 2010, provided as Appendix H of the PEIS) as a function of distance from the airguns, for the 36-airgun array at any tow depth and for a single 1900LL 40-in^3 airgun (i.e., the mitigation gun), which will be used during power-downs. This modeling approach uses ray tracing 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). In addition, propagation measurements of pulses from the 36-airgun array at a tow depth of 6 meters have been reported in approximately 1,600 meters water depth (deep water), 50 meters depth (shallow water) and a slope site (intermediate water depth) in the Gulf of Mexico in 2007–2008 (Tolstoy et al. 2009; Diebold et al. 2010), while propagation measurements of pulses from the 18-airgun 2-string array also at a tow depth of 6 meters have been reported for the same shallow and deep sites (Diebold et al. 2010).

For deep water and intermediate water depth cases, these field measurements cannot be used readily to derive mitigation radii because at those sites, the calibration hydrophone was located at a roughly constant depth of 350 to 500 meters, which may not intersect all the sound pressure level (SPL) isopleths at their widest point from the sea surface down to the maximum relevant water depth for marine mammals of approximately 2,000 meters. Figures 2 and 3 in Appendix H of the PEIS show how the values along the maximum SPL line that connects the points where the isopleths attain their maximum width (providing the maximum distance associated with each sound level) may differ from values obtained along a constant depth line. At short ranges, where the direct arrivals dominate and the effects of seafloor interactions are minimal, the data recorded at the deep and slope sites are suited for comparison with modeled levels at the depth of the calibration hydrophone. At larger ranges, the comparison with the mitigation model—constructed from the maximum SPL, through the entire water column at varying distances from the airgun array—is the most relevant. The results are summarized below.

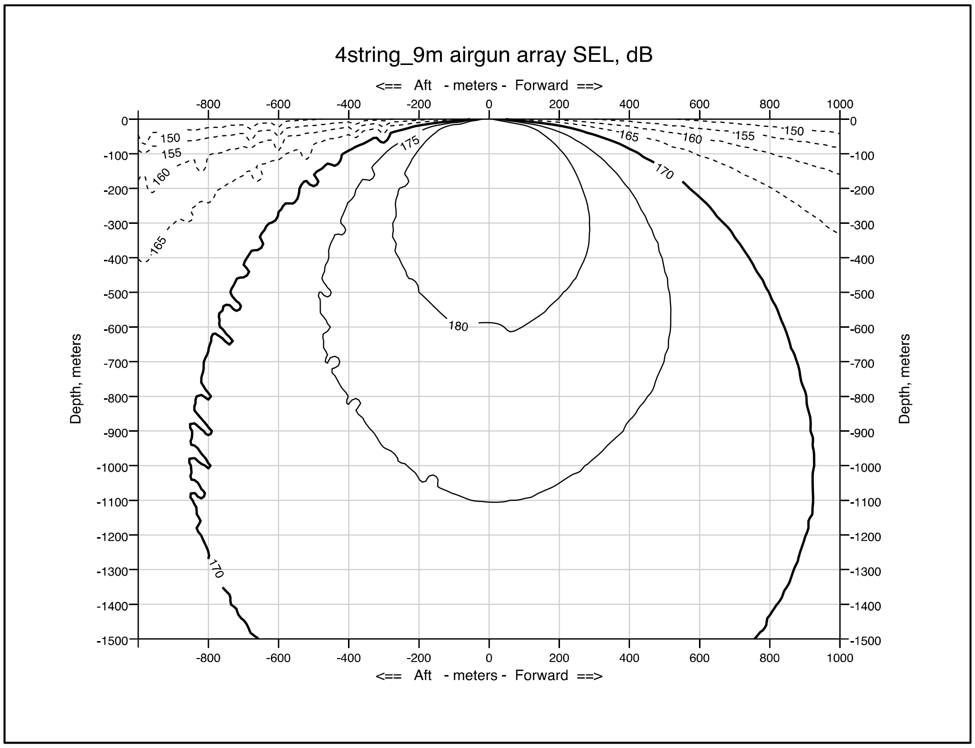
In deep water and intermediate depth water environments, comparisons at short ranges between sound levels for direct arrivals recorded by the calibration hydrophone and model results for the same array tow depth are consistent (Figures 12 and 14 in Appendix H of the PEIS). Consequently, isopleths falling within this domain can be reliably predicted by the L-DEO model, while they may be imperfectly sampled by measurements recorded at a single depth. At larger distances, the calibration data show that seafloor reflected and sub-seafloor refracted arrivals dominate, while the direct arrivals become weak and/or incoherent (Figures 11, 12 and 16 in Appendix H of the PEIS). Aside from local topography effects, the region around the critical distance (approximately 5 kilometers in Figures 11 and 12, and approximately 4 kilometers in Figure 16, in Appendix H of the PEIS) is where the observed levels rise very close to the mitigation model curve. However, the observed sound levels fall almost entirely below the mitigation model curve (Figures 11, 12 and 16 in Appendix H of the PEIS). Thus, analysis of the Gulf of Mexico calibration measurements demonstrates that although simple, the L-DEO model is a robust tool for estimating mitigation radii.

The proposed survey on the East Coast margin will acquire data with the 36-airgun array at a tow depth of 9 meters. The survey will take place entirely in deep water (greater than 1,000 meters). The deep-water radii obtained from 9-meter tow depth L-DEO model results will be used down to a maximum water depth of 2,000 meters (**Figure 3**).

Measurements have not been reported for the single 40-in^3 airgun. The 40-in^3 airgun would be considered under the low-energy sources category in the PEIS. In Section 2.4.2 of the PEIS, Alternative B (the Preferred Alternative) conservatively applies a 100-meter exclusion zone (EZ) for all low-energy acoustic sources in water depths greater than 100 meters. This approach is adopted here for the single Bolt 1900LL 40-in^3 airgun that will be used during power-downs. In addition, L-DEO model results are used to determine the 160- and the 190-decibel (dB) radii for the 40-in^3 airgun in deep water (**Figure 4**).

Table 1 shows the distances at which the 160-dB, 180-dB, and 190-dB root-mean-squared (RMS) sound levels are expected to be received for the 36-airgun array and the single (mitigation) airgun.

The 180-dB re 1 micro (μ) pascal (Pa) $_{RMS}$ distance is the safety criterion as specified by the National Marine Fisheries Service (NMFS) (2000) for cetaceans. If marine mammals or sea turtles are detected within or about to enter the appropriate exclusion zone, the airguns would be immediately powered down (or shut down if necessary).



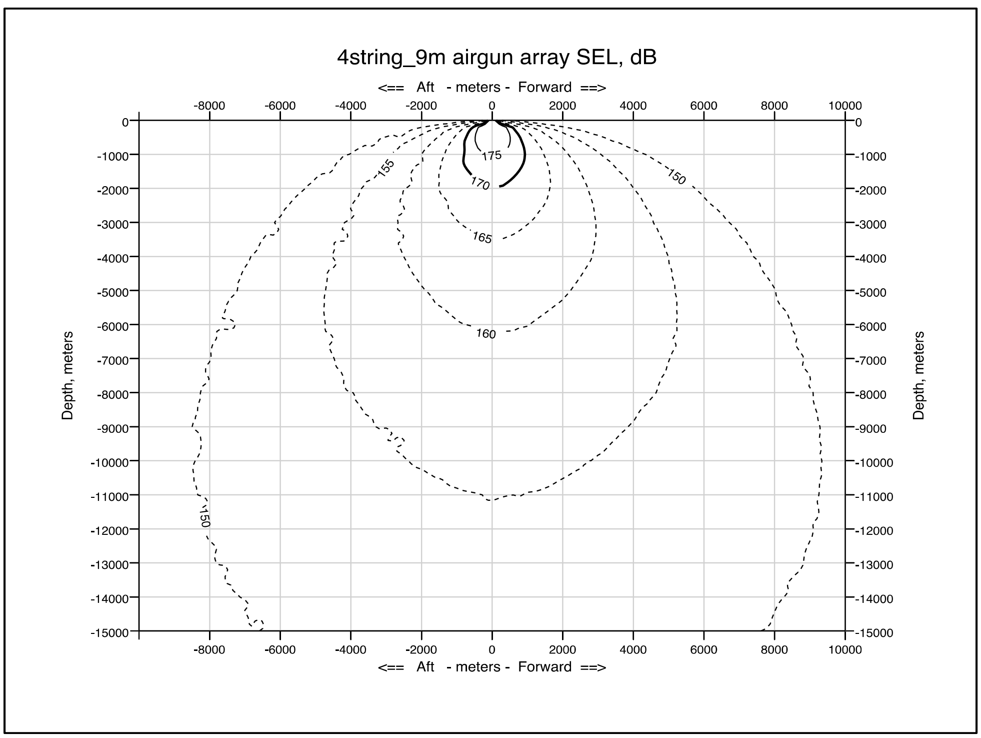
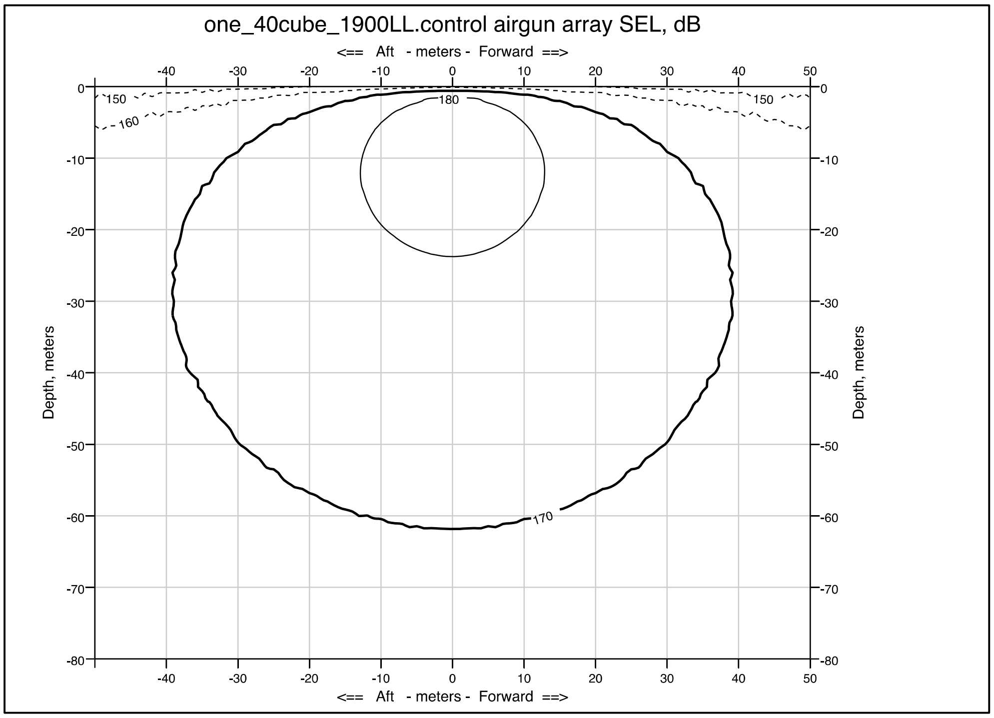


Figure 3 Modeled Deep-Water Received Sound Exposure Levels (SELs) from the 36-Airgun Array Towed at 9 Meters Depth

Modeled deep-water received sound exposure levels (SELs) from the 36-airgun array planned for use during the survey, at a 9-meter tow depth. Received RMS levels (SPLs) are expected to be ~10 dB higher. Plot at the top provides radius to the 170 dB SEL isopleths as a proxy for the 180 dB RMS isopleths and plot at the bottom provides radius to the 150 dB SEL isopleth as a proxy for the 160 dB RMS isopleth.



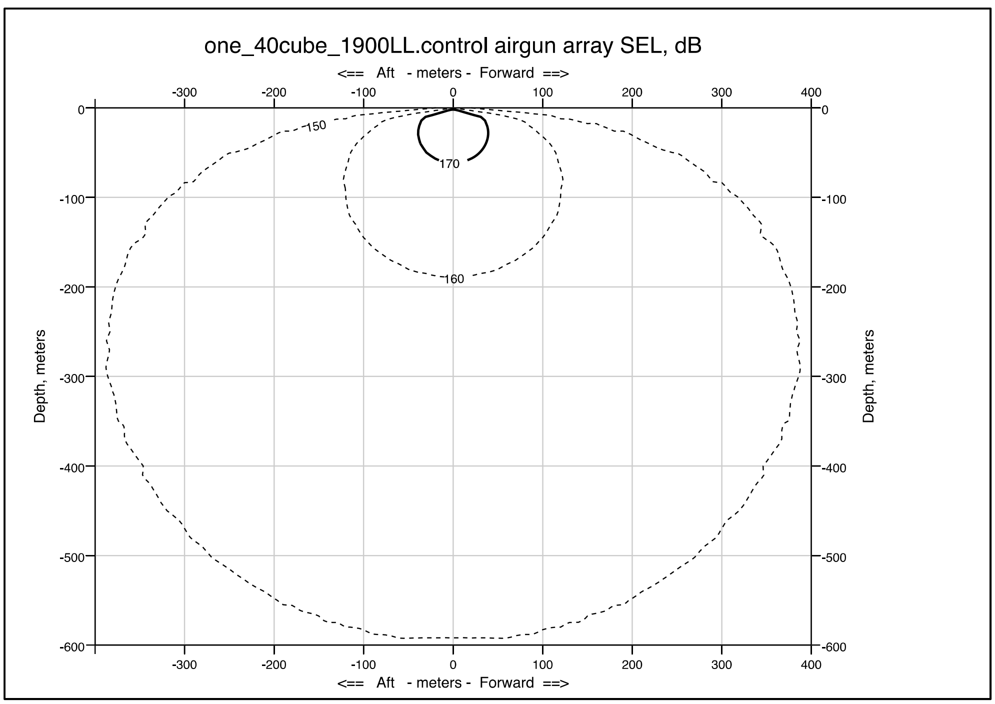


Figure 4 Modeled Deep-Water Received Sound Exposure Levels (SELs) from a Single 40-in^3 Airgun Towed at 9 Meters Depth

Modeled deep-water received SELs from a single 40-in^3 airgun towed at 9 meters depth, which is planned for use as a mitigation gun during the proposed survey. Received RMS levels (SPLs) are expected to be ~10 dB higher. Plot at the top provides radius to the 170 dB SEL isopleths as a proxy for the 180 dB RMS isopleths and plot at the bottom provides radius to the 150 dB SEL isopleth as a proxy for the 160 dB RMS isopleth.

Table 1 Predicted Distances to Sound Levels ≥ 190, 180 and 160 dB re 1 μPa_{RMS}

Predicted distances to which sound levels ≥190, 180 and 160 dB re 1 μPa_{RMS} are expected to be received during the proposed survey on the East Coast margin in 2014 and 2015. For the single mitigation airgun, the EZ is the conservative EZ for all low-energy acoustic sources in water depths >100 meter defined in the PEIS.

Source and Volume	Water Depth (meters)	Predicted RMS Radii (meters)		
		190 dB	180 dB	160 dB
Single Bolt airgun, 40 cubic-inch	>1,000	13	100	388
36-gun array totaling 6,600 cubic inches	>1,000	286	927	5,780

Southall et al. (2007) provided detailed recommendations for new science-based noise exposure criteria. Although the NSF is aware that the National Oceanic and Atmospheric Administration (NOAA) is revising acoustic guidance for marine mammals, at the time of preparation of this Incidental Harassment Authorization (IHA) application, NOAA has not issued an official revised version of that policy. As such, this IHA application has been prepared in accordance with the current NOAA acoustic guidance and the procedures are based on best practices noted by Pierson et al. (1998) and Weir and Dolman (2007).

1.5 Description of Operations

During the survey, the source vessel, the R/V *Marcus G. Langseth,* will tow a standard 36-airgun array at a depth of 9 meters. The *R/V Langseth* also will tow one 8-kilometer long hydrophone streamer cable. As the airgun array is towed along the survey lines, the hydrophone streamer cable will receive and record the returning acoustic signals from the towed airgun array and the data will be processed on-board the *R/V Langseth* as the survey occurs.

During the 2014 survey, 1,700 nautical track line miles (approximately 3,165 kilometers) of 2-D survey lines will be shot (**Figure 2**). All water depths will be greater than 1,000 meters. Due to the almost continuous nature of the 2014 and 2015 survey track line segments (**Figure 2**), full turns will not be required. Only 90 to 120-degree turns will be conducted with 2-D seismic data being collected continuously during the turns. In addition to the operations of the airgun array during the 2-D survey, a MBES and a SBP also will run continuously. The plan for the 2015 (**Figure 2**) survey is similar in all respects to the 2014.

1.6 Multibeam Echosounder and Sub-bottom Profiler

Along with the airgun operations, two additional acoustical data acquisition systems will be operated during the survey. The ocean floor will be mapped with the Kongsberg EM 122 MBES and a Knudsen Chirp 3260 SBP. These sound sources will be operated from the *R/V Langseth* continuously throughout the survey.

The Kongsberg EM 122 MBES operates at 10.5 to 13 (usually 12) kiloHertz (kHz) and is hull-mounted on the *R/V Langseth*. The maximum source level is 242 dB re 1 μPa_{RMS}. The Knudsen Chirp 3260 SBP normally is operated to provide information about the sedimentary features and the bottom topography that is being mapped simultaneously by the MBES. The SBP is capable of reaching water depths of 10,000 meters and penetrating tens of meters into the sediments. The nominal power output is 10 kilowatts (kw), but the actual maximum radiated power is 3 kW or 222 dB re 1 µPa m.

II. DATES, DURATION, AND REGION OF ACTIVITY

The date(s) and duration of such activity and the specific geographical region where it will occur.

The proposed survey area would be bounded by the following geographic coordinates:

40.5694° N / -66.5324° W
38.5808° N / -61.7105° W
29.2456° N / -72.6766° W
33.1752° N / -75.8697° W
39.1583° N / -72.8697° W

The proposed 2014 survey activities will generally occur within the outer portions of the Study Area. The proposed 2015 survey will in-fill more of the Study Area. The track lines proposed for both years occur primarily within International Waters (approximately 80% in 2014 and 90% in 2015, **Figure 2**). Water depths range between approximately 1,450 meters and 5,400 meters; no survey lines will extend to water depths less than 1,000 m. The exact dates of the survey are dependent on logistics and weather conditions; however, the *R/V Langseth* is expected to depart Newark, New Jersey, on August 16, 2014, and transit to the survey area, returning to Norfolk, Virginia, on September 6, 2014. The seismic operations will take approximately 16 days to complete. Approximately one day transit will be required at the beginning and end of the program. The survey schedule is inclusive of weather and other contingency (e.g. equipment failure) time.

The proposed 2015 survey will be virtually identical to the program planned for 2014. Geographic area, duration, and trackline coverage are similar. Exact dates for the survey in 2015 are uncertain, but are scheduled to occur within the April to August time frame.

III. SPECIES AND NUMBERS OF MARINE MAMMALS IN AREA

The species and numbers of marine mammals likely to be found within the activity area.

Thirty-eight marine mammal species could occur within the Study Area. To avoid redundancy and consolidate species-specific information, required information regarding species and numbers of species as is required under Section III, is included below in Section IV

IV. STATUS, DISTRIBUTION, AND SEASONAL DISTRIBUTION OF AFFECTED SPECIES OR STOCKS OF MARINE MAMMALS

A description of the status, distribution, and seasonal distribution (when applicable) of the affected species or stocks of marine mammals likely to be affected by such activities.

Sections III and IV are integrated here to minimize repetition.

Forty-five species of marine mammals, including 30 odontocetes, 7 mysticetes, 7 pinnipeds, and 1 sirenian are known to occur in western North Atlantic Ocean (Waring et al. 2013; Read et al. 2009). Of those 45 species of marine mammals, 34 cetaceans and 4 pinnipeds could be found within the Study Area during the summer months (see **Table 2**). Six of the cetaceans are listed as ***Endangered*** under the Endangered Species Act (ESA) (sei, blue, fin, North Atlantic right, humpback, and sperm whales). Fourteen of the 34 cetacean species, although present in the wider western North Atlantic Ocean, are considered rare in the survey area; however, due to the chance that an individual could be found within the Study Area during the proposed survey, they are discussed in this document. The four pinniped species (harbor seal, harp seal, gray seal, and hooded seal) also are considered rare within the Study Area. All pinnipeds known to occur within the North Atlantic Ocean are considered coastal species and any sightings would be considered extralimital; however, due to the limited chance that they could occur within the Study Area during the summer months, similar to the rare cetacean species, they are discussed in this document.

General information on the taxonomy, ecology, distribution, seasonality and movements, and acoustic capabilities of mysticetes, odontocetes, and pinnipeds are provided in Sections 3.6.1, 3.7.1, and 3.8.1 respectively, of the PEIS. The general distribution of mysticetes, odontocetes, and pinnipeds in the North Atlantic is discussed in Sections 3.6.3.4, 3.7.3.4, and 3.8.3.4, respectively, of the PEIS. In addition, Section 3.1 of the *Atlantic OCS Proposed Geological and Geophysical Activities Mid-Atlantic and South Atlantic Planning Areas Final Programmatic Environmental Impact Statement* (Bureau of Ocean Energy Management 2012) reviews similar information for all marine mammals that may occur within the Study Area.

The rest of this section deals specifically with their distribution within the Study Area and near the proposed 2014 survey area. Various surveys have been conducted throughout the western North Atlantic, including within sections of the Study Area. The main source of information used here is the Ocean Biogeographic Information System (OBIS) database hosted by Rutgers and Duke Universities (Read et al. 2009). This database includes survey data collected during the

Cetaceans and Turtle Assessment Program (CeTAP) conducted between 1978 and 1982 and consisted of both aerial and vessel-based surveys between Cape Hatteras, North Carolina, and the Gulf of Maine. The database also includes survey data collected during the NOAA Northeast Fisheries Science Center (NEFSC) and the NOAA Southeast Fisheries Science Center (SEFSC) stock assessment surveys conducted in 2004 (which surveys between Nova Scotia, Canada, and Florida).

Table 2 The Habitat, Range, Seasonality, Regional Abundance, and Conservation Status of Marine Mammals that Could Occur In or Near the Study Area

Species	Occurrence Near Study Area	Habitat	Range along U.S. East Coast	Seasonality	Regional/SAR abundance estimates[1]	Population Status[1]	ESA[2]	MMPA
ORDER CETACEA								
***Suborder Mysticeti* (Baleen Whales)**								
Fin Whale *(Balaenoptera physalus)*	Regular	Coastal, banks	Canada to North Carolina	Year round	26,500[3] / 3,522	Unable to determine	EN	Depleted
Humpback Whale *(Megaptera novaeangliae)*	Regular	Coastal, banks	Canada to Caribbean	High-latitude summer feeding; low-latitude winter breeding/calving in coastal waters; some remain in high latitudes year round.	11,600[4] / 823[5]	Increasing	EN	Depleted
Minke Whale *(Balaenoptera acutorostrata)*	Regular	Coastal, banks, shelf	Arctic to Caribbean	Spring and Summer – widespread and common occurrence throughout range. Most abundant in New England waters at this time. Fall and Winter – lesser occurrence to largely absent from New England Waters Winter - potential distribution in the Caribbean and south and east of Bermuda	138,000[6] / 20,741	Unable to determine	NL	--
North Atlantic Right Whale (*Eubalaena glacialis)*	Regular	Coastal and shelf waters	Canada to Florida	Spring and Summer – Canada and New England Fall and Winter – migrating along U.S. east cast states and in Southeastern U.S. waters	455 / 455[7]	Increasing	EN	Depleted
Blue Whale (*Balaenoptera musculus*)	Rare	Coastal, shelf, and pelagic	Arctic to Florida	Year round	855[8] / 440[7]	Unable to determine[6]	EN	Depleted
Bryde's Whale (*Balaenoptera edeni*)	Rare	Coastal, offshore	N/A	Unknown	N/A	N/A	NL	--

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Species	Occurrence Near Study Area	Habitat	Range along U.S. East Coast	Seasonality	Regional/SAR abundance estimates[1]	Population Status[1]	ESA[2]	MMPA
Sei Whale *(Balaenoptera borealis)*	Rare	Mostly pelagic, some offshore	Canada to Massachusetts	Year round	10,300[9] / 357[10]	Unable to determine	EN	Depleted
Suborder Odontoceti (Toothed Whales, Dolphins, and Porpoises)								
Atlantic White-sided Dolphin (*Lagenorhynchus acutus*)	Regular	Shelf and slope	Central West Greenland to North Carolina	January – May in Georges Bank to Jeffrey's Ledge June – September primarily in Bay of Fundy to George's Bank October - December in Gulf of Maine to George's Bank Year round from Massachusetts to North Carolina	10s–100s of 1000s[11] / 48,819[7]	Unable to determine	NL	--
Atlantic Spotted Dolphin *(Stenella frontalis)*	Regular	Shelf, offshore	Massachusetts to Caribbean	Year round	N/A / 44,715	Unable to determine	NL	--
Bottlenose Dolphin (*Tursiops truncatus*)	Regular	Coastal, shelf, pelagic	Canada to Florida	Year round	N/A / 77,532[12]	Unable to determine	NL	--
Long-Finned Pilot Whale *(Globicephala melas)*	Regular	Mostly pelagic	Canada to North Carolina	Year round	780,000[13] / 26,535	Unable to determine	NL	--
Short-Finned Pilot Whale *Globicephala macrorhynchus)*	Regular	Mostly pelagic, high relief	North Carolina to Florida	Year round	780,000[13] / 21,515	Unable to determine	NL	--
Pantropical Spotted Dolphin (*Stenella attenuata*)	Regular	Coastal, shelf and slope	Massachusetts to Florida	Year round	N/A / 3,333	Unable to determine	NL	--
Risso's Dolphin *(Grampus griseus)*	Regular	Shelf, slope, seamounts	Canada to Florida	Spring, summer and Fall in George's Bank to North Carolina Winter in the mid-Atlantic Bight out to oceanic waters	N/A / 18,250	Unable to determine	NL	--

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Species	Occurrence Near Study Area	Habitat	Range along U.S. East Coast	Seasonality	Regional/SAR abundance estimates[1]	Population Status[1]	ESA[2]	MMPA
Shorted-beaked Common Dolphin *(Delphinus delphis)*	Regular	Shelf, pelagic, high relief	Canada to Georgia	Mid-January – May in George's Bank to North Carolina Mid-summer and Autumn in George's Bank and Scotian shelf	N/A / 173,486	Unable to determine	NL	--
Striped Dolphin *(Stenella coeruleoalba)*	Regular	Offshore convergence zones and upwellings	Canada to Caribbean	Year round	N/A / 54,807	Unable to determine	NL	--
Sperm Whale *(Physeter macrocephalus)*	Regular	Pelagic, slope, canyons	Canada to Caribbean	Winter – concentrated east and northeast of North Carolina Spring – widespread in central portion of the mid-Atlantic Bight and southern George's Bank Summer – widespread in central portion of the mid-Atlantic Bight and east and north of George's Bank Fall – south of New England and throughout the mid-Atlantic Bight	13,190[14] / 2,288	Unable to determine	EN	Depleted
Killer whale *(Orcinus orca)*	Rare	Coastal, pelagic	Arctic to Caribbean	Unknown	N/A / N/A	Unable to determine	NL	--
Clymene Dolphin *(Stenella clymene)*	Rare	Coastal, shelf and slope	North Carolina to Florida	Unknown	N/A / N/A	Unable to determine	NL	--
Spinner Dolphin (*Stenella longirostris*)	Rare	Mainly nearshore	Maine to Caribbean	Year round	N/A / N/A	Unable to determine	NL	--
Rough-Toothed Dolphin *(Steno bredanensis)*	Rare	Mostly pelagic	Virginia to Florida	Unknown	N/A / 271	Unable to determine	NL	--
Fraser's Dolphin *(Lagenodelphis hosei)*	Rare	Shelf and slope	North Carolina to Florida	Unknown	N/A / N/A	Unable to determine	NL	--

Table 2 The Habitat, Range, Seasonality, Regional Abundance, and Conservation Status of Marine Mammals that Could Occur In or Near the Study Area

Species	Occurrence Near Study Area	Habitat	Range along U.S. East Coast	Seasonality	Regional/SAR abundance estimates[1]	Population Status[1]	ESA[2]	MMPA
Harbor Porpoise *(Phocoena phocoena)*	Rare	Shelf, coastal, pelagic	Canada to North Carolina	October – December and April – June in Maine through New Jersey January – March in Canada to North Carolina July – September in northern Gulf of Maine and Southern Bay of Fundy	~500,000[15] / 79,833[9]	Unable to determine	NL	--
False Killer Whale *(Pseudorca crassidens)*	Rare	Pelagic	N/A	Unknown	N/A / N/A	N/A	NL	--
Pygmy Killer Whale *(Feresa attenuata)*	Rare	Pelagic	N/A	Unknown	N/A / N/A	Unable to determine	NL	--
Dwarf Sperm Whale *(Kogia sima)*	Rare	Deep waters off shelf	Massachusetts to Florida	Unknown	N/A / 3,785[16]	Unable to determine	NL	--
Pygmy Sperm Whale *(Kogia breviceps)*	Rare	Deep waters off shelf	Massachusetts to Florida	Unknown	N/A / 3,785[16]	Unable to determine	NL	--
Melon-Headed Whale *(Peponocephala electra)*	Rare	Deep waters off shelf	North Carolina to Florida	Year round	N/A / N/A	Unable to determine	NL	--
Sowerby's Beaked Whale *Mesoplodon bidens)*	Rare	Pelagic, deep slope, canyons	Canada to Florida	Year round	N/A / 7,092[17]	Unable to determine	NL	--
Blainville's Beaked Whale *(Mesoplodon densirostris)*			Canada to Florida	Year round	N/A / 7,092[17]			--
Gervais' Beaked Whale *(Mesoplodon europaeus)*			Canada to Florida	Year round	N/A / 7,092[17]			--
True's Beaked Whale *(Mesoplodon mirus)*			Canada to Bahamas	Year round	N/A / 7,092[17]			--
Cuvier's Beaked Whale *(Ziphius cavirostris)*			Canada to Florida	Year round	N/A / 6,532			--

Table 2 The Habitat, Range, Seasonality, Regional Abundance, and Conservation Status of Marine Mammals that Could Occur In or Near the Study Area

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Northern Bottlenose Whale *(Hyperoodon ampullatus)*	Rare	Pelagic	Arctic to New Jersey	Unknown	N/A / N/A	Unable to determine	NL	--
ORDER CARNIVORA								
Clade Pinnipedia								
Harbor seal (Phoca vitulina)	Rare	Coastal	Canada to North Carolina	Year round in Canada to Massachusetts September – May in Rhode Island to New Jersey (possibly south to North Carolina)	N/A / 70,142	Unable to determine	NL	--
Gray seal *(Halichoerus grypus)*	Rare	Coastal, pelagic	Canada to North Carolina	Year round in Canada to Massachusetts September – May in Rhode Island to New Jersey (possibly south to North Carolina)	N/A / 348,900	Increasing	NL	--
Harp seal *(Phoca groenlandica)*	Rare	Ice whelpers, pelagic	Canada to New Jersey	Winter – Summer in Arctic Fall as far south as New Jersey	8.6–9.6 million[18] / N/A	Unknown	NL	--
Hooded Seal *(Cystophora cristata)*	Rare	Ice whelpers, pelagic	Canada to Caribbean	January – May in New England Summer and Autumn in Caribbean	600,000[19] / N/A	Unable to determine	NL	--

Table 2 The Habitat, Range, Seasonality, Regional Abundance, and Conservation Status of Marine Mammals that Could Occur In or Near the Study Area

Species	Occurrence Near Study Area	Habitat	Range along U.S. East Coast	Seasonality	Regional/SAR abundance estimates[1]	Population Status[1]	ESA[2]	MMPA

Key:
N/A = Not available or not assessed
Sources:
[1] SAR (stock assessment report) abundance estimates are from the Draft Marine Mammal Stock Assessment Reports 2013 for the Western North Atlantic Stock unless otherwise noted.
[2] U.S. Endangered Species Act: EN = Endangered; NL = Not listed (ECOS 2013)
[3] Best estimate for the North Atlantic in 2007 (International Whaling Commission [IWC] 2014)
[4] Best estimate for the western North Atlantic in 1992–1993 (IWC 2014)
[5] Minimum estimate for Gulf of Maine Stock (Waring et al. 2013)
[6] Best estimate for the North Atlantic in 2002–2007 (IWC 2014)
[7] Estimate for the Western North Atlantic Stock (Waring et al. 2013)
[8] Estimate for the central and northeast Atlantic in 2001 (Pike et al. 2009)
[9] Estimate for the Northeast Atlantic in 1989 (Cattanach et al. 1993)
[10] Nova Scotia Stock (Waring et al. 2013)
[11] Tens to low hundreds of thousands in the North Atlantic (Reeves et al. 1999)
[12] Western North Atlantic Offshore Stock (Waring et al. 2013)
[13] Estimate for both long- and short-finned pilot whales in the central and eastern North Atlantic in 1989 (IWC 2014)
[14] Estimate for the North Atlantic (Whitehead 2002)
[15] Estimate for the North Atlantic (Jefferson et al. 2008)
[16] This estimate includes both the dwarf and pygmy sperm whales
[17] Estimate includes all *Mesoplodon* in the Atlantic
[18] Northwest Atlantic (Department of Fisheries and Oceans 2012)
[19] Northwest Atlantic (Andersen et al. 2009)

1.7 Mysticetes

1.7.1 Fin whale (*Balaenoptera physalus*)

Fin whales are one of the more common mysticete species found within the Study Area and in the waters surrounding it. According to Palka (2006), they are the most commonly sighted ESA-listed large whale in the western North Atlantic. Hundreds of OBIS sightings of this species near the Study Area boundaries are recorded and 14 sightings within it are recorded. The three most recent sightings were recorded in 2003 and 2004 and were observed during the NEFSC Right Whale Survey. All other sightings are from the 1970s and 1980s.

The NMFS (2010) reports summer feeding grounds mostly between 41°20’ and 51°00’N latitude (shore to 1,829 meters). The Study Area and proposed project survey dates coincide with this cycle of the fin whale. Fin whale mating and births occur in the winter (November to March), with reproductive activity peaking in December and January. Hain et al. (1992) suggested that calving takes place during October to January in latitudes of the U.S. Mid-Atlantic region. The proposed 2014 survey period of August–September will not interfere with the reproduction cycle.

1.7.2 Humpback whale (*Megaptera novaeangliae*)

Sightings data show that humpback whales traverse coastal waters from the northeastern to the southeastern U.S. They can also be found farther offshore, including the Study Area (Waring et al. 2011). Reports of humpback whale sightings off Delaware Bay and Chesapeake Bay during the winter suggest that the Mid-Atlantic region, including the western portion of the Study Area, may serve as wintering grounds for this species (Swingle et al. 1993; Barco et al. 2002). OBIS logged four sightings of humpback whales within the Study Area. The most recent sighting is from 2006 and was recorded by the NEFSC Right Whale Survey.

1.7.3 Minke whale (*Balaenoptera acutorostrata*)

The minke whale is among the most widely distributed and most abundant of the baleen whales (Carwardine 1998). The OBIS database reports several sightings of the minke whale along the western edge of the Study Area. The sightings increase toward the northwest, in an area identified as the year-round feeding and mating grounds for the North Atlantic right whale located in the waters off New England. In 1980, OBIS reported three sightings of the minke whale within the Study Area.

1.7.4 North Atlantic right whale (*Eubalaena glacialis*)

Research results suggest the existence of six major congregation areas for the North Atlantic right whale: the coastal waters of the southeastern U.S., the Great South Channel, Georges Bank/Gulf of Maine, Cape Cod and Massachusetts Bays, the Bay of Fundy, and the Scotian Shelf (Waring et al. 2011). Movements of individuals within and between these congregation areas are extensive, and data show distant excursions, including into deep water off the continental shelf (Mate, Nieukirk, and Kraus 1997; Baumgartner and Mate 2005). Congregations in U.S. eastern seaboard waters are recorded west of the Study Area; however, movements of the North Atlantic right whale could result in their presence within the Study Area. In addition, year-round feeding and mating grounds exist for the North Atlantic right whale located in the waters off New England. The area overlaps the north section of the Study Area. While the OBIS database makes reference to hundreds of sightings in the vicinity of the Study Area, mainly along the continental shelf, along the western boundary edge of the Study Area, and in the year-round feeding and mating grounds, the OBIS database does not report any sightings within the borders of the Study Area. Overall, the range and seasonal distribution of North Atlantic right whales (particularly males) is not fully understood at this time.

1.7.5 Blue whale (*Balaenoptera musculus*)

Blue whales are only considered “occasional visitors” within U.S. EEZ waters (Waring et al. 2010). However, this species has been acoustically recorded in the deep offshore waters east of the U.S. EEZ (Clark 1995). The OBIS database reports only one blue whale observation within the Study Area boundary, which was recorded in 1969. Blue whales are considered rare within the Study Area due to the lack of observations within the area, their overall sparse existence within the region, and their preference for the colder waters of Canada (Waring et al. 2013).

1.7.6 Bryde’s whale (*Balaenoptera edeni/brydei*)

There is no known U.S. management population of Bryde’s whale in the U.S. western North Atlantic waters. The seasonal distribution of this whale is not well known (Reilly et al. 2008). The species generally prefers sub-tropical to tropical and warm temperate waters. The northern extent of its range is ~40°N (NOAA Fisheries Service, Office of Protected Resources [NOAA Fisheries OPR] 2012a). There are no OBIS sightings reported within the Study Area or its surrounding waters. Bryde’s whales are considered rare within the waters of the Study Area.

1.7.7 Sei whale (*Balaenoptera borealis*)

Sei whales are typically associated with steep bathymetric relief, such as the continental shelf break, canyons, or basins situated between banks and ledges where prey is concentrated (Kenney and Winn 1987; Schiling et al. 1992; Best and Lockyer 2002). The range of this highly migratory species includes the continental shelf waters of the northeastern U.S. and extends to south of Newfoundland (Jefferson et al. 2008). Sei whales are not common in U.S. Atlantic waters (NMFS 2012); however, OBIS reports six sightings of the sei whale within the Study Area. The most recent sightings occurred in June 2001 and October 2006, both of which were recorded during the NEFSC Right Whale Survey.

1.8 Odontocetes

1.8.1 Atlantic White-sided Dolphin (*Lagenorhynchus acutus)*

The Atlantic white-sided dolphin has thousands of recorded sightings in the OBIS database. The sightings occur in coastal, shelf and slope waters, with the majority occurring on the shelf north of the Study Area. Within the Study Area boundaries, ten sightings of this species are recorded in the OBIS database. Nine of those sightings were from the late 1970s and early 1980s, and one sighting was reported in 2002 during the NEFSC Right Whale Survey.

1.8.2 **Atlantic Spotted Dolphin (*Stenella frontalis*)**

Within the Study Area, OBIS records indicate that eight Atlantic spotted dolphins have been sighted. The sightings were divided between mid- and base-slope waters. Four were observed in 1998 during the NEFSC survey. The other four were observed in 2004 during the NEFSC Mid-Atlantic Marine Mammal Abundance Survey.

1.8.3 **Bottlenose Dolphin (*Tursiops truncatus*)**

Within the western North Atlantic stock of bottlenose dolphin, at least six genetically distinct stocks are distributed from southern Long Island, New York, to central Florida (NOAA Fisheries OPR 2013a). These are further divided into two morphotypes: coastal and offshore (Waring et al. 2006). Those bottlenose dolphins expected to occur within the Study Area would primarily be from the offshore morphotype. The offshore morphotype is primarily found along the outer continental shelf and continental slope in the western North Atlantic (Waring et al. 2006). OBIS sightings are in the thousands for the bottlenose dolphin in coastal and shelf, slope and abyssal waters. Approximately 100 sightings of this species (likely consisting of the offshore morphotype) in the Study Area have been recorded.

As a note, the bottlenose dolphin population most recently affected by the 2013 Unusual Mortality Event (UME) along the U.S. Mid-Atlantic states was likely primarily that of the coastal morphotype. Due to the preference of the offshore morphotype for deeper continental shelf and slope waters, it is not expected that this population was affected by the UME.

1.8.4 **Long-Finned Pilot Whale (*Globicephala melas*)**

The long-finned pilot whale is considered uncommon in the mid-Atlantic waters, including the Study Area. While the species prefers deep pelagic waters in temperate and sub-polar climates (NOAA Fisheries OPR 2012b), there are only five OBIS sightings of this species within the Study Area boundary. Three of those five sightings occurred in the 1980s. The OBIS database has hundreds of sightings of this species along the shelf and coastal waters of the U.S. and Canada.

1.8.5 Short-Finned Pilot Whale (*Globicephala macrorhynchus*)

Similar to the long-finned pilot whale, the short-finned pilot whale is considered uncommon in mid-Atlantic waters, including the Study Area. This species also prefers deeper waters; however, it differs from the long-finned pilot whale in that it prefers warmer temperate and tropical waters (NOAA Fisheries OPR 2012c). While no OBIS sightings of this species within the Study Area are recorded, OBIS has records of 18 sightings of this species, all of which occurred since 2004. The sightings primarily occurred along the continental shelf break.

1.8.6 Pantropical Spotted Dolphin (*Stenella attenuata*)

This species is known to occur over deeper waters (Waring et al. 2009). There are six OBIS sightings of the pantropical spotted dolphin within the Study Area. Three occurred in shelf and slope waters, one in slopes waters, one at the base of the slope, and one in abyssal depths of 5000 meters. The latter was observed in 2005 during the Sargasso 2005 cetacean sightings survey.

1.8.7 Risso's Dolphin (*Grampus griseus*)

The Risso's dolphin is considered common within the Study Area. The OBIS database has over 100 sightings of this species within the boundaries, and thousands along adjacent coastal, shelf and slope waters. Many of the sightings occur in the shelf and slope waters, nine sightings occurred in the deeper waters, in isobaths of 4,400 meters.

1.8.8 Shorted-beaked Common Dolphin (*Delphinus delphis*)

The short-beaked common dolphin is considered common within the Study Area and surrounding waters. Within the Study Area, the OBIS database reports 83 sightings. Four studies have reported sightings since the year 2000. The NEFSC Right Whale Survey recorded 14 sightings in 2001 and four sightings in 2002. Also in 2001, the Canada Maritime Regional Cetacean Sightings identified one short-beaked common dolphin. Lastly, in 2004 the NEFSC Mid-Atlantic Marine Mammal Abundance Survey reported observing eight of these species.

1.8.9 Striped Dolphin (*Stenella coeruleoalba*)

The striped dolphin prefers oceanic and deep warm temperate and tropical waters (NOAA Fisheries OPR 2012d). OBIS records indicate approximately 75 sightings of the striped dolphin within the Study Area, nearly all occurring along the shelf and slope waters in the north and west extent.

1.8.10 Sperm Whale (*Physeter macrocephalus*)

The sperm whale is the most commonly occurring odontocete species within the Study Area and in the adjacent waters. The sperm whale spends summer months in the Mid-Atlantic Bight off the Eastern U.S. coast from Virginia to Massachusetts (Reeves et al. 2002; Palka 2006). Hundreds of OBIS sightings of the sperm whale place them primarily in shelf and slope waters of the northeast U.S. and Nova Scotia. Sperm whales can be found in groups that consist of 20 to 40 animals, including adult females, their calves, and juveniles (Waring et al. 2006). The OBIS also recorded several sightings at abyssal depths of 5,000 meters. Within the Study Area, greater than 300 OBIS sightings of the sperm whale have been recorded, with the majority occurring in the slope waters in the northern and western extent. Sperm whales tend to be found in association with frontal systems, canyon, slope, and seamount features within the region. The survey plan minimizes encroachment of such areas.

1.8.11 Killer whale (*Orcinus orca*)

The killer whale is a very rare species within the western North Atlantic Ocean. There are four recorded sightings of this species within the Study Area. All four sightings occurred during the CeTAP survey. One sighting occurred in 1978, one in 1980, and the remaining two occurred in 1981. The species is considered rare within the Study Area.

1.8.12 Clymene Dolphin (*Stenella clymene*)

The Clymene dolphin is a rare species within the western North Atlantic Ocean. The species prefers deep, warm temperate, tropical and sub-tropical waters within the Atlantic Ocean (NOAA Fisheries OPR 2012e). There are only seven sightings in shelf and slope waters in southern

U.S. waters. There are no OBIS sightings for the Clymene dolphin within the Study Area. This species is considered rare within the Study Area.

1.8.13 Spinner Dolphin (*Stenella longirostris*)

The spinner dolphin is a rare species within the western North Atlantic Ocean. The species prefers deep ocean waters within the Atlantic Ocean (NOAA Fisheries OPR 2012f). The OBIS database only has one sighting record of the spinner dolphin within the Study Area. The sighting occurred in 1997, during a CeTAP vessel survey. Other sightings in adjacent waters occurred in the slopes west of the Study Area. The species is considered rare within the Study Area.

1.8.14 Rough-Toothed Dolphin (*Steno bredanensis*)

The rough-toothed dolphin prefers deep ocean warm temperate and tropical waters within the western North Atlantic Ocean. Observations of this species offshore the East Coast of the U.S. are rare (NOAA Fisheries OPR 2012g). Within the Study Area, there are two OBIS sightings of the rough-toothed dolphin. One observation occurred near the shelf edge in slope waters during the 1998 NEFSC Survey. The other observation occurred near the base of the slope in 1979 during the CeTAP vessel survey. The species is considered rare within the Study Area.

1.8.15 Fraser's Dolphin (*Lagenodelphis hosei*)

The Fraser's dolphin prefers deep ocean waters, primarily deeper than 1,000 meters (NOAA Fisheries OPR 2012h). The overall number of sightings of this species in the western North Atlantic Ocean is low. There are no OBIS sightings of the Fraser's dolphin within the Study Area and only one OBIS sighting in the waters adjacent to its boundaries. This dolphin species was observed near the western boundary of the Study Area and is considered rare within the Study Area.

1.8.16 Harbor Porpoise (*Phocoena phocoena*)

The harbor porpoise is primarily a coastal species, preferring waters less than 200 meters deep (NOAA Fisheries OPR 2013b). The OBIS database has records for thousands of sightings of the harbor porpoise in the coastal and shelf waters around the Gulf of Maine. Within the Study Area, only three sightings have been reported. Two observations occurred in the slope waters near the northern extent of the Study Area, and one at abyssal depth of 5,000 meters. The third observation was recorded in 1978 during the Programme Integre de recherches sur les oiseaux pelagiques Northwest Atlantic survey. The species is considered rare within the Study Area.

1.8.17 False Killer Whale (*Pseudorca crassidens*)

The false killer whale does not have a U.S.-managed population in the western North Atlantic Ocean, yet the species can be found sparingly offshore of the Mid-Atlantic states, primarily in waters deeper than 1,000 meters (NOAA Fisheries OPR 2013c). There are only 11 OBIS sightings of this species off the U.S. coast with two occurring within the Study Area; one was recorded in 1971, with the other two occurring in 1997. The false killer whale is considered rare within the Study Area and adjacent waters.

1.8.18 **Pygmy Killer Whale (*Feresa attenuata*)**

The pygmy killer whale is rare within the western North Atlantic Ocean. The species is found primarily in deeper tropical and sub-tropical waters (NOAA Fisheries OPR 2012i). There is only one OBIS sighting of the pygmy killer whale in the Study Area. It was observed in 1981 during the CeTAP aerial survey. Two other OBIS sightings were recorded along the shelf-waters, near the Study Area. The pygmy killer whale is considered rare with the Study Area.

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

Both the dwarf and pygmy sperm whale are most commonly found over the continental shelf edge and slope (NOAA Fisheries OPR 2012j, 2012k). Considered rare in the Mid-Atlantic region, the pygmy sperm whale has no OBIS-recorded sightings within the Study Area. However, three sightings have been recorded in the slope waters near the Study Area. One sighting was recorded in 2004 during the NEFSC Mid-Atlantic Marine Mammal Abundance Survey, and the two other sightings were recorded in 1998 during the NEFSC Survey. Similar to the pygmy sperm whale, the dwarf sperm whale is also considered rare in the Mid-Atlantic region, including in the Study Area. There are only two sightings recorded in the OBIS database. One sighting occurred in 2004 during the NEFSC Mid-Atlantic Marine Mammal Abundance Survey. The other sighting occurred in 1998 during the NEFSC Survey. Both species are considered rare within the Study Area.

1.8.20 Melon-Headed Whale (*Peponocephala electra*)

The melon-headed whale prefers warm, deeper, tropical waters (NOAA Fisheries OPR 2012l). The melon-headed whale is considered rare within the Study Area and in all adjacent waters. While no OBIS sightings within the Study Area have been recorded, one sighting was recorded near the southeastern extent of its boundary. This sighting occurred during the Sargasso 2005 cetacean sightings survey. This species is considered rare within the Study Area

1.8.21 Sowerby's Beaked Whale (*Mesoplodon bidens*)

The Sowerby's beaked whale prefers deep, cold temperate waters within the western North Atlantic (NOAA Fisheries OPR 2012m). During surveys (both aerial and vessel), the various *Mesoplodon* species are difficult to differentiate. OBIS reports eight sightings of the Sowerby's beaked whale within the Study Area. Six have occurred along the shelf with the other two being in the slope waters. The species is considered rare within the Study Area.

1.8.22 Blainville's Beaked Whale (*Mesoplodon densirostris*)

The Blainville's beaked whale is known to occur in deep, offshore waters spanning from tropical to temperate (NOAA Fisheries OPR 2012n). Similar to the Sowerby's beaked whale, the Blainville's beaked whale is difficult to discern from other *Mesoplodon* species during both aerial and vessel surveys. The OBIS data report only one sighting of the Blainville's beaked whale, recorded in 2004 during the NEFSC Mid-Atlantic Marine Mammal Abundance Survey. A second sighting near the northeast extent of the Study Area was logged in 1995 by the NEFSC. The species is considered rare within the Study Area.

1.8.23 Gervais' Beaked Whale (*Mesoplodon europaeus*)

The Gervais' beaked whale can primarily be found in deep warm temperate, tropical, and sub-tropical waters (NOAA Fisheries OPR 2012o). Similar to the Sowerby's beaked whale, the Gervais' beaked whale is difficult to discern from other *Mesoplodon* species during both aerial and vessel surveys. No OBIS sightings of the Gervais' beaked whale within the Study Area or in any adjacent waters have been recorded. This species is considered rare within the Study Area.

1.8.24 True's Beaked Whale (*Mesoplodon mirus*)

The True's beaked whale can primarily be found in deeper, warm temperate waters in the western North Atlantic Ocean (NOAA Fisheries OPR 2012p). Similar to the Sowerby's beaked whale, the True's beaked whale is difficult to discern from other *Mesoplodon* species during both aerial and vessel surveys. The OBIS database does not have any records for sightings of the True's beaked whale within the Study Area. However, of the 20 OBIS sightings for this species, two exist in the waters adjacent to the northwest boundary line of the Study Area. During the NEFSC 1995 survey, one True's beaked whale was spotted along the shelf edge. In 2003, during the Virginia Aquarium Marine Mammal Strandings 1998-2008, the second was reported stranded near approximately 76°N, 37°W. Survey details do not report on the type of stranding. This species is considered rare within the Study Area.

1.8.25 Cuvier's Beaked Whale (*Ziphius cavirostris*)

The Cuvier's beaked whale in can be found in temperate, tropical, and sub-tropical waters. Primarily, this species prefers deeper pelagic waters, being found in water depths greater than 1,000 meters (NOAA Fisheries OPR, 2012q). Of all the beaked whales, the Cuvier's was the most commonly recorded in the OBIS database. The recorded sightings occurred in the shelf and slope waters adjacent to and within the Study Area. The 15 sightings within the Study Area occurred mostly in the slope waters in the northwest portion. While more common than the other beaked whale species, the Cuvier's beaked whale is considered rare within the Study Area.

1.8.26 Northern Bottlenose Whale (*Hyperoodon ampullatus*)

The northern bottlenose whale is considered extremely uncommon/rare within U.S. western North Atlantic Ocean waters. This species prefers cold, deep waters (greater than 2,000 meters), primarily within the temperate to sub-arctic region (NOAA Fisheries OPR 2012r). Only one sighting of this species is in the OBIS database. The observation occurred in 2006 during the NEFSC Right Whale Survey. The northern bottlenose whale is considered rare within the Study Area and adjacent waters.

1.9 **Pinnipeds**

1.9.1 **Harbor seal (*Phoca vitulina*)**

The harbor seal is considered rare outside of their coastal habitat in the U.S. western North Atlantic Ocean waters. This species prefers temperate coastal habitats, using rock, reefs, beach, or drifting ice on which to haul out. During summer months, this species can primarily occur in the nearshore waters of the Gulf of Maine and into Canadian waters (Waring et al. 2013). Two aerial sightings of this species were recorded offshore Cape Cod, Massachusetts around the 100-meter isobath. No sightings of harbor seals within or adjacent to the Study Area are recorded in the OBIS database. The harbor seal is considered rare within the Study Area and adjacent waters.

1.9.2 Gray seal (*Halichoerus grypus*)

The gray seal is considered rare outside of their coastal habitat in the U.S. western North Atlantic Ocean waters. This species prefers cold water coastal habitats, using rocks, sandbars and icebergs to haul out on. During summer months, this species can primarily be found in the nearshore waters of the Gulf of Maine and into Canadian waters (Waring et al. 2013). No sightings of gray seals within or adjacent to the Study Area are recorded in the OBIS database. The gray seal is considered rare within the Study Area and adjacent waters.

1.9.3 Harp Seal (*Pagophilus groenlandicus*)

The harp seal is considered rare outside its cold water habitat in the North Atlantic, and can be found primarily in the pack ice in the North Atlantic Ocean. During summer months, the harp seal can be found at its Arctic summer feeding grounds. No sightings of harp seals within or adjacent to the Study Area are recorded in the OBIS database. The harp seal is considered rare within the Study Area and adjacent waters.

1.9.4 Hooded seal (*Cystophora cristata*)

The hooded seal is considered rare outside its cold weather habitat. While this species can be found in deep waters, they are primarily found among pack ice. The species has been observed as far south as the Florida and the Caribbean; however, this is unusual as the species survives best in cold water habitats (NOAA Fisheries OPR 2012s). No sightings of hooded seals within or adjacent to the Study Area are recorded in the OBIS database. The hooded seal is considered rare within the Study Area and adjacent waters.

V. TYPE OF AUTHORIZATION REQUESTED

The type of incidental taking authorization that is being requested (i.e., takes by harassment only, takes by harassment, injury and/or death), and the method of incidental taking.

The USGS requests an IHA pursuant to Section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA) for incidental take by harassment during its planned seismic surveys in the western North Atlantic Ocean during late August and early September, 2014.

The operations outlined in Section I have the potential to take marine mammals by harassment. Sounds will be generated by the airguns used during the survey, by the echosounder and sub-bottom profiler, and by general vessel operations. “Takes” by harassment potentially could result when marine mammals near the activities are exposed to the pulsed sounds generated by the seismic sources. The effects will depend on the species of cetacean, the behavior of the animals at the time of reception of the stimulus, and received level of the sound (see Section VII). The proposed survey activities may result in disturbance reactions from any marine mammals within proximity to the source vessel. Based on the planned operations and mitigation measures (see Section XI), no serious injury to any marine mammals is expected, and no lethal takes are expected.

VI. NUMBERS OF MARINE MAMMALS THAT COULD BE TAKEN

By age, sex, and reproductive condition (if possible), the number of marine mammals (by species) that may be taken by each type of taking identified in [Section V], and the number of times such takings by each type of taking are likely to occur.

The materials for Sections VI and Section VII are combined and presented in reverse order to minimize duplication among sections.

VII. POTENTIAL IMPACT ON SPECIES OR STOCKS

The anticipated impact of the activity upon the species or stock of marine mammal.

The materials for Section VI and Section VII are combined and presented in reverse order to minimize duplication between sections:

- A summary of potential impacts on marine mammals from airgun operations is presented first, as required for Section VII. A more comprehensive review of the relevant background information is included in the PEIS in Sections 3.6.4.3, 3.7.4.3, and 3.8.4.3, and in Appendix E.
- The estimated numbers of marine mammals that could be affected by the proposed survey in the U.S. ECS region off the Atlantic Seaboard during late August and early September, 2014are presented. This section includes a description of the rationale for the USGS's estimates of the potential numbers of harassment "takes" during the planned survey, as required in Section VI.

1.10 Summary of Potential Effects of Airgun Sounds

Airguns have the potential to affect marine mammals in a number of ways, including tolerance, masking (of natural sounds including inter- and intra-specific calls), behavioral disturbance, and physiological responses such as temporary or permanent hearing impairment or other non-auditory effects (Richardson et al.1995; Nowacek et al. 2007; Southall et al. 2007; Wright et al. 2007; Tyack 2009). Physiological impacts, such as permanent threshold shift (PTS) (which could be considered an injurious event) and temporary threshold shift (TTS) (which is not considered an injurious event) could occur as a result of airgun operations (Southall et al. 2007). However, neither physiological impact is expected to occur during the proposed survey due to use of mitigation measures (described below). While the potential for PTS and TTS cannot be entirely excluded, it is highly unlikely (as summarized in the PEIS in Sections 3.6.7, 3.7.7, and 3.8.7) that this auditory impairment would occur as a result of the proposed 2014 survey. It is also highly unlikely that other non-auditory physiological or physical effects would occur as a result of the proposed survey. It is more likely that, should a marine mammal come within proximity to the proposed survey while the seismic airguns are operating, some behavioral disturbance could occur. However, this disturbance is expected to be short-term and localized. Monitoring and mitigation protocols will reduce any potential impacts to marine mammals. As a result of these protocols, it is anticipated that no marine mammals will be exposed to survey sounds that could cause behavioral disturbance.

1.10.1 Tolerance

Tolerance occurs when animals, often within areas commonly exposed to human-generated noise, do not appear to display a response to these human-generated sounds (Richardson et al. 1995). The pulsed sounds from airguns are known to be detectable in the water up to thousands of kilometers away from the source (Nieukirk et al. 2004). Numerous studies have been conducted on the reaction of marine mammals to seismic airgun pulses. Responses vary as marine mammals have been found to both tolerate the noise and to avoid the noise, indicating that response to noise may be related to individual species. Some studies have reported that marine mammals located a few kilometers from the seismic source have shown no apparent reaction to the noise, while other studies report behavioral reactions such as avoidance in both baleen whales and toothed whales (specifically sperm whales) (Malme et al. 1985; Richardson, Würsig, and Greene 1986; Ljungblad et al. 1988; McCauley et al. 2000a). Although individual baleen and toothed whales, as well as (less frequently) pinnipeds, have shown to exhibit behavioral reactions to airgun pulses at certain times, at other times, all three types of marine mammals have exhibited no obvious response. The relative responses of individual baleen whales, toothed whales, and pinnipeds are expected to be quite variable and depend on factors such as species, age, and previous exposures of the animal to human-generated sound.

1.10.2 Masking

Masking occurs when human-generated sounds interfere or obscure the ability of a marine mammal to detect sound signals they would otherwise receive (Richardson et al. 1995). The number of studies specific to the masking effects of pulsed sounds on marine mammal calls is limited. It is expected that those marine mammal species that could potentially be affected by masking may still be able to receive and emit sounds during the relatively quiet periods between the airgun pulses (Simard 2005; Clark and Gagnon 2006). Some baleen whales have been reported to cease calling due to the presence of pulsed sounds; however, other studies have reported that some baleen have increased the consistency of calls to compensate for presence of pulsed sounds (Clark and Gagnon 2006; Di Iorio and Clark 2010). Other studies have reported that whales have continued calling in the presence of seismic activity (Nieukirk et al. 2004; Richardson et al. 1986; Madsen et al. 2002). Small odontocetes predominantly rely on sounds within the higher frequencies. These frequencies are much higher than the dominant frequencies produced by seismic airguns, thereby limiting the potential for masking related to these species. Due to the intermittent nature of seismic airgun pulses, the relatively short timeframe of the proposed 2014 survey, and the large area to be covered during the proposed 2014 survey (reducing repeated seismic pulses within a small area as is common of seismic surveys), it is expected that masking effect from the seismic pulses will be minor.

1.10.3 Disturbance Reactions

Disturbance effects can be expressed in a variety of ways including both obvious and more subtle reactions. These behavioral disturbance reactions can include (but are not limited to) flight response, changes in diving patters, foraging, and breathing, and avoidance or displacement (Tyack 2009; Nowacek et al. 2007). Temporary exposure and the potential brief reactions to that exposure are not expected to result in any significant disruption to behavioral patterns and will not result in harassment or "taking" (NMFS 2001; National Research Council 2005; Southall et al. 2007). The proposed 2014 survey is not expected to result in any permanent effects to any individuals or populations.

Reactions to sound, if any, depend on the 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). If a marine mammal reacts 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. 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 (Lusseau and Bejder 2007; Weilgart 2007). Currently, the majority of research and information regarding effects of seismic surveys is focused on individual animals and little information exists regarding effects at the population or community level.

Given the many uncertainties in predicting the quantity and types of impacts of sound on marine mammals, it is common practice to estimate how many mammals would be present within a particular distance of human activities and/or exposed to a particular level of anthropogenic sound. In most cases, this approach likely overestimates the numbers of marine mammals that would be affected in some biologically important manner. One of the reasons for this is that the selected distances/isopleths are based on limited studies indicating that some animals exhibited short-term reactions at that specific distance or sound level. The exposure calculations then assume that all animals exposed to this level would react in a biologically significant manner, similar to the few species that were observed exhibiting a reaction at that time.

The sound criteria used to estimate how many marine mammals might be disturbed to some biologically significant degree by seismic survey activities are primarily based on behavioral observations of a few species. Detailed studies have been done on humpback, gray, bowhead, and sperm whales, and on ringed seals. 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 often are 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. Overall, the largest avoidance radii recorded (20 to 30 kilometers) for a reaction to seismic airguns involved migrating bowhead whales (Miller et al. 1999; Richardson et al. 1995). 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, still 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 also has been discussion of effects on the Brazilian wintering grounds. During full-scale seismic surveys off Western Australia, avoidance reactions were reported to begin at 5 to 8 kilometers away from the full airgun array and 2 kilometers away from the single airgun. Traveling pods of humpback whales generally remained approximately 3 to 4 kilometers away from the active survey, and more sensitive resting pods of cow-calf pairs maintained an avoidance distance of 7 to 12 kilometers. However, some individual humpback whales, especially males, approached within distances of 100 to 400 meters (McCauley et al. 1998, 2000b).

On summer feeding grounds in southeast Alaska, humpback whales did not exhibit persistent avoidance when exposed to seismic pulses, although some humpback whales did exhibit a “startle” response (Malme et al. 1985). It has been suggested that South Atlantic humpback whales wintering off Brazil may be displaced or even may strand upon exposure to seismic surveys; however, these data were more circumstantial and subject to other explanations (International Association of Geophysical Contractors 2004). Data from subsequent years indicated that no observable direct correlation between strandings and seismic surveys existed.

Currently, there are no data on reactions of *right whales* to seismic surveys. However, results from studies conducted of the closely related *bowhead whale* indicate that responses of this whale can be variable, depending on their activity (migrating vs. feeding). While at summer feeding grounds, bowhead whales showed no reactions to seismic surveys being conducted between 6 and 99 kilometers away (Richardson et al. 1986). More recent studies also indicate that feeding bowhead whales are more tolerant of higher sound levels. Migrating bowhead whales, on the other hand, appear to be more sensitive and responsive to pulsed seismic sounds. Bowhead whale migrating in the Alaskan Beaufort Sea generally show substantial avoidance of seismic surveys (Miller et al. 1999; Richardson et al. 1995).

Reactions of feeding and migrating (not wintering) *gray whales* to seismic sounds also have been studied. In the Bering Sea (off St. Lawrence Island), 50 percent of feeding gray whales were reported to have stopped feeding at received sound pressure levels of 173 dB re 1 μPa on an (approximate) RMS basis, and that 10 percent of feeding whales interrupted feeding at received levels of 163 dB re 1 μPa_{RMS} (Malme et al. 1986, 1988). These findings were generally consistent with the results of studies conducted on larger numbers of gray whales migrating off California and western Pacific gray whales feeding off Sakhalin, Russia.

Studies have not been conducted on other *Balaenoptera* species (i.e., blue, sei, fin, and minke whales); however, these species occasionally have been observed in ensonified areas during various seismic surveys. Observations made during seismic surveys off the United Kingdom between 1997 and 2000 indicate that mysticetes (mainly fin and sei whales) were sighted at a similar rate while large seismic arrays were operating and while they were silent (Stone 2003;

Stone and Tasker 2006). Localized avoidance also was observed during this time. Fin/sei whales also have been reported to spend less time submerged during periods when seismic arrays were firing compared to times when silent.

Data on short-term reactions by cetaceans to impulsive noises are not necessarily indicative of long-term or biologically significant effects. Whether impulsive sounds affect reproductive rate or distribution and habitat use in subsequent days or years is unknown. 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. Bowhead whales have continued to travel to the eastern Beaufort Sea each summer, and their numbers have increased notably

Toothed whales. Little systematic information is available about reactions of toothed whales to sound pulses. However, there are recent systematic studies on sperm whales (i.e., Gordon et al. 2006; Madsen et al. 2006). There is also an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies (i.e., Stone 2003; Smultea et al. 2004; Stone and Tasker 2006). 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 (Richardson et al. 2009; Barkaszi, Epperson, and Bennett 2009). In most cases, the avoidance radii for delphinids appear to be small, on the order of 1 kilometer or less, and some individuals show no apparent avoidance. Based on observations from active seismic surveys off the United Kingdom, small odontocetes exhibited greater avoidance to operating airguns than previously reported (Stone et al. 2003; Gordon et al. 2004; Stone and Tasker 2006). The observer data also indicated that small odontocetes were feeding less and were interacting with the vessel less during activity seismic surveys. 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 (Finneran et al. 2000, 2002, 2005). However, overall, the animals tolerated high, received levels of sound before exhibiting aversive behaviors. Porpoises, like delphinids, show variable reactions to seismic operations, and reactions apparently depend on species. Harbor porpoises have been reported to show stronger avoidance to seismic operations than Dall's porpoises (Stone 2003; MacLean and Koski 2005; Bain and Williams 2006).

Studies of all three species of sperm whale reported that they show avoidance reactions in general to vessels not operating seismic airguns (Richardson et al. 1995; Würsig et al. 1998; Baird 2005). In studies where sperm whales were exposed to seismic airguns, the species response indicates considerable tolerance to the airgun noise. The whales generally do not show strong avoidance, and they continue to call. Research does indicate; however, that diving and foraging behaviors can be altered upon exposure to airgun sound (Jochens et al. 2008; Miller et al. 2009; Tyack 2009). Specific data on the behavioral reactions of *beaked whales* to seismic surveys is almost non-existent; the majority of information regarding beaked whales is in connection with military sonar events. Most beaked whales are illusive and tend to avoid approaching vessels of other types (Würsig et al. 1998). The species may dive for an extended period when approached by a vessel. However, based on both visual and acoustic observations, 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. Most beaked whales would likely show strong avoidance of an approaching seismic vessel, as they would with any other vessel, although this has not been specifically documented.

Overall, 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. Based on available data, ≥170 dB re 1 μPa_{RMS} disturbance criterion (rather than ≥160 dB re 1 μPa_{RMS}) would be appropriate for delphinids. This is based on reaction distances for delphinids being more consistent with the 170 dB re 1 μPa_{RMS} radius, and delphinids being less responsive than other more responsive cetaceans.

Pinnipeds. Information on the reactions of pinniped species to pulsed seismic airgun sounds is limited. Based on early observations, pinnipeds appear to be quite tolerant of pulsed sounds. Other reports indicate that pinnipeds were tolerant of loud, pulsed sounds when they were strongly attracted to an area for feeding or reproductive purposes (Mate and Harvey 1987; Reeves et al. 1996). In more recent studies, avoidance of pinnipeds during seismic surveys has been reported as being relatively small, within 100 to a few hundred meters. Many seals remained within 100 to 200 meters of the survey track lines while an operating seismic survey passed (Moulton and Lawson 2002). Other observations made during seismic surveys in the Chuckchi and Beaufort Seas reported that pinnipeds were observed less when the seismic airguns were operating than when they were silent (Miller et al. 2005). Overall, behavioral reactions from pinnipeds to pulsed seismic sounds are variable. It is expected that localized avoidance of operating seismic airguns may occur; however, it cannot be guaranteed that these species would fully avoid an operating seismic vessel during active surveys.

1.10.4 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 (Southall et al. 2007). However, neither specific occurrences of TTS nor permanent hearing damage (i.e., PTS, in free-ranging marine mammals exposed to sequences of airgun pulses during realistic field conditions) have been documented. 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 (shutdown) zones planned for the proposed seismic survey. However, those criteria were established before any information about minimum received levels of sounds necessary to cause auditory impairment in marine mammals existed.

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 have not, as of late 2013, been formally adopted by the NMFS for use in regulatory processes and during mitigation programs associated with seismic surveys. However, some aspects of the recommendations have been considered in certain EISs and small take authorizations under the MMPA. The NMFS has indicated that they may soon issue new noise exposure criteria for marine mammals that account for the now-available scientific data on 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 relevant factors.

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 have the potential, to cause hearing impairment (see Sections XI and XIII). Also, many cetaceans and (to a limited degree) pinnipeds show some avoidance of the area where received levels of airgun sounds 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. Appendix E of the PEIS provides a thorough review of the current knowledge available regarding TTS, PTS, and strandings and mortalities for marine mammals and seismic surveys.

Non-auditory physical effects may also occur in marine mammals exposed to strong underwater, pulsed sound. These non-auditory physiological effects or injuries could include stress, neurological effects, gas bubble formation in the blood or tissues, and other types of organ or tissue damage. It is possible that some marine mammal species (i.e., beaked whales) may be especially susceptible to injury and/or stranding when exposed to strong pulsed sounds. This is likely due to the deep-diving behavior of these species, which could result in a situation similar to "the bends" in humans if the animals are disturbed at depth and rise too quickly to the surface. However, no specific evidence exists regarding the potential for non-auditory effects to occur as a result of seismic surveys. Any effects resulting from the proposed seismic survey are expected to be limited to behavioral avoidance of the seismic vessel, as this reaction appears the most common among most baleen whales, some toothed whales, and some pinnipeds. Therefore, those animals avoiding the seismic survey vessel would be even less likely to incur auditory or non-auditory physical effects. The planned monitoring and mitigation, along with the brief duration of exposure expected, and the deep water environment of the Study Area, would all further reduce the potential for marine mammals to be exposed to pulsed sounds strong enough to cause non-auditory physical effects.

1.10.5 Potential Effects of Multibeam Echosounder and Sub-bottom Profiler Signals

The PEIS included a comprehensive review of potential affects from both MBESs and SBPs (see Sections 3.6.4.3; 3.7.4.3; 3.8.4.3; and Appendix E). The PEIS concluded that the operation of MBESs and SBPs is unlikely to impact odontocetes, mysticetes, or pinnipeds because the intermittent and narrow, downward-directed nature of both acoustic sources would result in no more than one or two brief pinging exposures of any individual animal, due to the movement and speed of the survey vessel.

1.11 Number of Marine Mammals that could be Exposed to 160 dB re 1μPA$_{RMS}$

All anticipated takes would be "takes by harassment" of small numbers of marine mammals and are expected to involve only temporary changes in behavior. No injury is expected to result from the proposed 2014 survey due to the proposed mitigation measures discussed below in Section XI. The methods used to estimate the number of marine mammals that could be affected during the proposed survey are described below. In general, the estimates are based on the consideration of the number of marine mammals that could be disturbed by the sounds resulting from the 36-airgun array during the approximately 3,165 kilometers of proposed 2014 survey lines in the U.S. ECS region of the Atlantic seaboard. The sources of data used to determine the “take” estimates are described below.

It is assumed that the airgun array and other sound sources (i.e., MBESs and SBPs) will be operated simultaneously. Therefore, any marine mammal close enough to be affected by an MBES or an SBP would already be affected by the airguns. However, even if the airguns are not operating simultaneously with the other sound sources, as stated earlier, marine mammals are not expected to exhibit anything more than short-term and negligible responses to the MBES and the SBP given the characteristics of the sound (i.e., narrow-downward directed beam) and other considerations as described in Sections 3.6.4.3; 3.7.4.3, 3.8.4.3, and Appendix E of the PEIS. Such reactions, as those expected from an MBES and an SBP alone are not considered to constitute a “taking” (NMFS 2001). Therefore, the “take” estimates described below do not take into account any additional allowance to include any marine mammals that could be affected by sound sources other than airguns.

1.11.1 Basis for Estimating Exposure

Incidental takes were estimated for each species by estimating the likelihood of a marine mammal being present within the expected ensonified area during active 2-D seismic surveys. Expected marine mammal presence in the vicinity of the Study Area during the proposed summer 2014 survey are described in Section IV. Based on the location of the Study Area and the time of year of the proposed 2014 survey, up to 38 marine mammal species have the potential to occur somewhere within the Study Area. Potential exposure is estimated based on the estimated density (animals per unit area) of each species within the Study Area and the amount of area estimated to be within the 160 dB re 1μPa$_{RMS}$ ensonified radius of the 36-airgun array (**Table 1**; **Figure 5**). The estimated 160 dB re 1μPa$_{RMS}$ ensonified zone was determined as described in Section I.

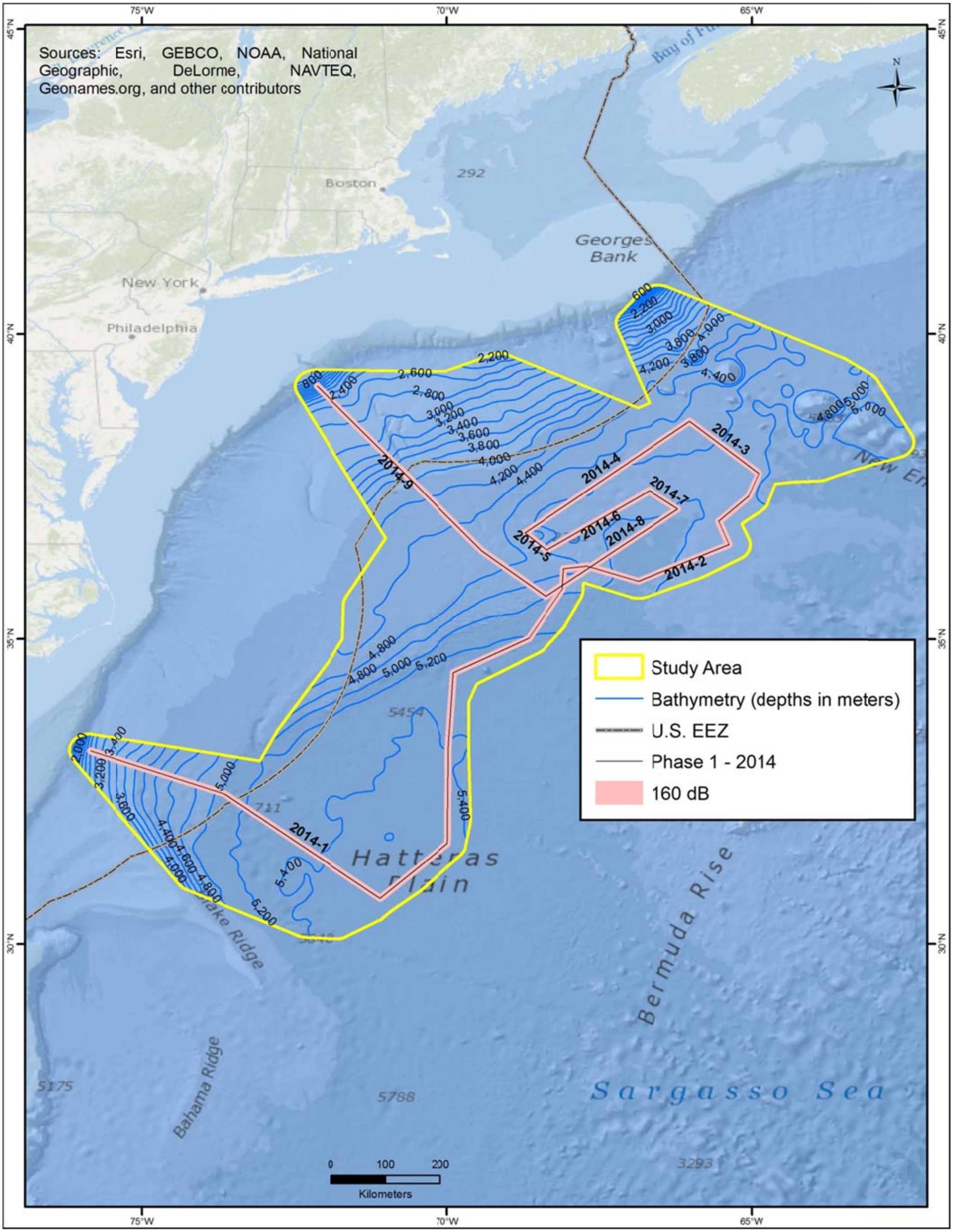

Figure 5 Proposed 2014 Survey – Ensonified Buffer

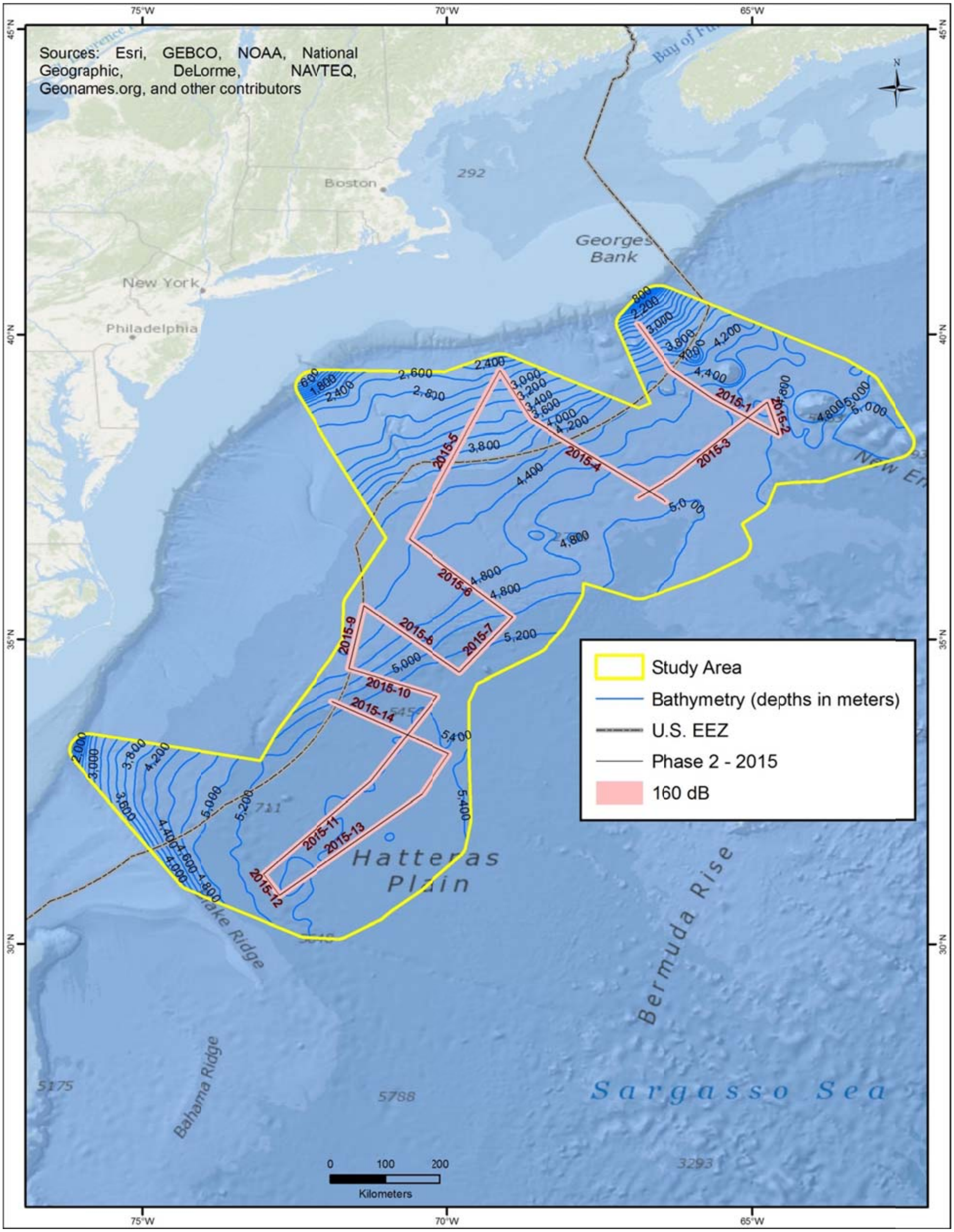

Figure 6 Proposed 2015 Survey – Ensonified Buffer

Density estimates for marine mammals within the vicinity of the Study Area are limited. Density data for species found along the East Coast of the U.S. generally extend slightly outside of the U.S. EEZ. The Study Area, however, extends well beyond the U.S. EEZ, and is well off the continental shelf break. The survey lines for the proposed 2014 survey are located in the far eastern portion of the Study Area, primarily within the area where little to no density data are currently available. It was determined that the best available information for density data (for those species where density data existed) of species located off the U.S. East Coast was housed at the Strategic Environmental and Development Program (SERDP) / National Aeronautics and Space Administration (NASA) / NOAA Marine Animal Model Mapper and OBIS-SEAMAP database. Within this database, the model outputs of all four seasons from the U.S. Department of the Navy Operating Area (OPAREA) Density Estimates (NODE) for the Northeast OPAREA and Southeast OPAREA (Department of the Navy 2007a, 2007b) were used to determine the mean density (animals per square kilometer) for 19 of the 38 marine mammals with the potential to occur within the Study Area. Those species include fin whale, minke whale, Atlantic spotted dolphin, bottlenose dolphin, long-finned and short-finned pilot whale, Pantropical spotted dolphin, Risso's dolphin, Short-beaked common dolphin, striped dolphin, sperm whale, rough-toothed dolphin, dwarf and pygmy sperm whale, and Sowerby's, Blainville's, Gervais', True's, and Cuvier's beaked whales. Model outputs for each season are available in the database. The data from the NODE summer density models, which include the months of June, July, and August, were used as the 2014 survey is proposed to take place between late August and early September. Of the seasonal NODE density models available, it is expected that the summer models are the most accurate and robust as the survey data used to create all of the models were obtained during summer months. The models for the winter, spring, and fall are derived from the data collected during the summer surveys, and therefore are expected to be less representative of actual species density during those seasons.

It should be noted that the mean density for those species was calculated based on the area within the Study Area where density data existed. The outer portion of the Study Area, where the majority of the proposed 2014 survey lines are located, was classified as "no data" in the database. Therefore, the density estimates that were used are based on species density for a portion of the Study Area. Due to the lack of more comprehensive and available data, the NODES data have been determined to be the best available data for that area. The density data likely do not extend out to the eastern portion of the Study Area as marine mammal surveys generally do not occur this far offshore. Therefore, there is a general lack of information in this region.

For those species that did not have density model outputs within the SERDP/NASA/NOAA and OBIS-SEAMAP database, or those species with density outputs that did not extend into the Study Area at all (i.e., all four pinniped species, or the sei whale), but for which OBIS sightings data within or adjacent to the Study Area exists, a *Requested Take Authorization* for the mean group size of the species is included. Mean group sizes were determined based on data reported from the CeTAP surveys (CeTAP 1982).

The estimated numbers of animals potentially exposed to sound during the proposed 2014 survey were determined using the 160 dB re 1μPa$_{RMS}$ threshold criterion for all cetaceans and pinnipeds. It is assumed that any marine mammals that are exposed to airgun sounds within this threshold could change their behavior sufficiently to be considered "taken by harassment." Table 3 shows the density estimates for each species as described above and the estimated numbers of individual marine mammals that could be exposed to ≥160 dB re 1μPa$_{RMS}$ during the active 2-D seismic survey. This estimate assumes that the individual animals do not move away from the seismic survey vessel, therefore, resulting in exposure. As stated earlier, for species for which densities were unavailable, but for which OBIS sightings within or adjacent to the Study Area exist, a *Requested Take Authorization* for the mean group size of the species is included.

It should be noted, that unlike previous USGS, NSF, and L-DEO seismic surveys aboard the *R/V Langseth*, the proposed survey will be conducted as essentially one continuous line. The survey will not be conducted in a pattern of parallel lines and will not include full turns of the vessel. Therefore, the ensonified area for the proposed survey does not include a contingency factor (typically 25%) in line-kilometers. The proposed survey also is not expected to shut down the airguns, only to power-down the airguns, should a marine mammal enter within the 160 dB re 1μPa$_{RMS}$ EZ. Given this, the ensonified area for the single mitigation gun would be much smaller than that of the full array (see Table 1). Therefore, the use of the full 160 dB re 1μPa$_{RMS}$ ensonified area for the entire 3,165 kilometers of survey lines is expected to overestimate of the actual ensonified area should the single mitigation airgun need to be used at any time. It is assumed that the estimates of the numbers of individual marine mammals that could be exposed to sounds at 160 dB re 1μPa$_{RMS}$ are overall precautionary due to the overestimated ensonified area and the estimation of species presence within the large Study Area, and are likely to overestimate the actual number of marine mammals that could be exposed. These estimates assume that there would be no weather, equipment, or mitigation delays, which is highly unlikely.

Note that although the survey track is continuous through the turns and no mitigation gun will be necessary. However, the mitigation airgun may be used in the event of minor, short duration equipment maintenance. Longer maintenance or repair periods (greater than two hours) of the seismic equipment would warrant complete shut-down of the seismic source, including the mitigation gun. The normal ramp-up procedures would be followed at the completion of these longer shut-down periods.

Table 3: Densities and Estimates of Possible Numbers of Individuals That Could be Exposed to 160 dB re 1 µPA$_{RMS}$ During Each of Proposed Summer (June, July, August) 2014 and 2015 2-D Seismic Surveys

Species	Mean Density (#/km^2)[a]	Ensonified Area (km^2)	Calculated Take[b]	% of Regional Population[c]	Requested Level B Take Authorization
Mysticetes					
Fin Whale	0.0000610	36,600	3	0.0113	3
Humpback Whale	N/A	36,600	0	0.0259	3[d]
Minke Whale	0.0000360	36,600	2	0.0014	2
North Atlantic Right Whale	N/A	36,600	0	0.6593	3[d]
Blue Whale	N/A	36,600	0	0.2339	2[d]
Bryde's Whale	N/A	36,600	0	N/A	3[d]
Sei Whale	N/A	36,600	0	0.0291	3[d]
Odontocetes					
Atlantic White-sided Dolphin	N/A	36,600	0	0.1106	54[d]
Atlantic Spotted Dolphin	0.0288400	36,600	1056	2.3616	1056
Bottlenose Dolphin	0.0066470	36,600	244	0.3147	244
Long-Finned Pilot Whale	0.0190400	36,600	697	0.0894	697
Short-Finned Pilot Whale	0.0190400	36,600	697	0.0894	697
Pantropical Spotted Dolphin	0.0197600	36,600	724	21.7222	724
Risso's Dolphin	0.0093180	36,600	342	1.8740	342
Shorted-beaked Common Dolphin	0.0055320	36,600	203	0.1170	203
Striped Dolphin	0.1343000	36,600	4,916	8.9697	4,916
Sperm Whale	0.0022510	36,600	83	0.6293	83
Killer whale	N/A	36,600	0	N/A	7[d]
Clymene Dolphin	0.0093110	36,600	0	N/A	346
Spinner Dolphin	N/A	36,600	0	N/A	65[d]
Rough-Toothed Dolphin	0.0004260	36,600	16	5.5351	16
Fraser's Dolphin	N/A	36,600	0	N/A	100[d]
Harbor Porpoise	N/A	36,600	0	0.0010	5[d]
False Killer Whale	N/A	36,600	0	N/A	15[d]
Pygmy Killer Whale	N/A	36,600	0	N/A	25[d]
Dwarf Sperm Whale	0.0008970	36,600	33	0.8719	33
Pygmy Sperm Whale	0.0008970	36,600	33	0.8719	33
Melon-Headed Whale	N/A	36,600	0	N/A	100[d]
Sowerby's Beaked Whale	0.0022870	36,600	84	1.1844	84
Blainville's Beaked Whale	0.0022870	36,600			
Gervais' Beaked Whale	0.0022870	36,600			
True's Beaked Whale	0.0022870	36,600			
Cuvier's Beaked Whale	0.0022870	36,600		1.2860	
Northern Bottlenose Whale	N/A	36,600	0	N/A	2[d]
Pinnipeds					
Harbor seal	0	36,600	0	N/A	0
Gray seal	0	36,600	0	N/A	0
Harp seal	0	36,600	0	N/A	0
Hooded Seal	0	36,600	0	N/A	0

[a] Source: OBIS-SERDP-Navy NODE 2007a and 2007b (for those species where density data were available).
[b] Calculated take is estimated density multiplied by the 160-db ensonified area. These calculations do not include any contingency as the survey will be conducted as one continuous line.
[c] Requested takes expressed as percentages of the larger regional populations, where available; where not available (most odontocetes–see Table 2), Draft 2013 SAR population estimates were used; N/A means not available
[d] Requested take authorization was increased to average group size for species for which densities were not available but have been sighted near or have the potential to be observed within the Study Area. Average group size from CeTAP 1984.

Table 4: Densities and Estimates of Possible Numbers of Individuals That Could be Exposed to 160 dB re 1 μPa_{RMS} During Spring (March, April, May) 2015 2-D Seismic Surveys

Species	Mean Density $(\#/km^2)$[a]	Ensonified Area (km^2)	Calculated Take[b]	% of Regional Population[c]	Requested Level B Take Authorization
Mysticetes					
Fin Whale	0.0000600	36,600	3	0.113	3
Humpback Whale	0.0010170	36,600	38	0.3276	38
Minke Whale	0.0000350	36,600	2	0.0014	2
North Atlantic Right Whale	N/A	36,600	0	0.6593	3[d]
Blue Whale	N/A	36,600	0	0.2339	2[d]
Bryde's Whale	N/A	36,600	0	N/A	3[d]
Sei Whale	N/A	36,600	0	0.0291	3[d]
Odontocetes					
Atlantic White-sided Dolphin	N/A	36,600	0	0.1106	54[d]
Atlantic Spotted Dolphin	0.0285700	36,600	1046	2.3393	1046
Bottlenose Dolphin	0.0069560	36,600	255	0.3289	255
Long-Finned Pilot Whale	0.0108000	36,600	396	0.0408	396
Short-Finned Pilot Whale	0.0108000	36,600	396	0.0508	396
Pantropical Spotted Dolphin	0.0194900	36,600	714	21.422	714
Risso's Dolphin	0.0092150	36,600	338	1.8520	338
Shorted-beaked Common Dolphin	0.0053940	36,600	198	0.1141	198
Striped Dolphin	0.1330000	36,600	4,868	8.8817	4,868
Sperm Whale	0.0019050	36,600	70	0.5307	70
Killer whale	N/A	36,600	0	N/A	7[d]
Clymene Dolphin	0.0093110	36,600	341	N/A	341
Spinner Dolphin	N/A	36,600	0	N/A	65[d]
Rough-Toothed Dolphin	0.0004200	36,600	16	5.9041	16
Fraser's Dolphin	N/A	36,600	0	N/A	100[d]
Harbor Porpoise	N/A	36,600	0	0.00010	5[d]
False Killer Whale	N/A	36,600	0	N/A	15[d]
Pygmy Killer Whale	N/A	36,600	0	N/A	25[d]
Dwarf Sperm Whale	0.0008850	36,600	33	0.8719	33
Pygmy Sperm Whale	0.0008850	36,600	33	0.8719	33
Melon-Headed Whale	N/A	36,600	0	N/A	100[d]
Sowerby's Beaked Whale		36,600			
Blainville's Beaked Whale		36,600			
Gervais' Beaked Whale	0.0021370	36,600	79	1.1139	79
True's Beaked Whale		36,600			
Cuvier's Beaked Whale		36,600		1.2094	
Northern Bottlenose Whale	N/A	36,600	0	N/A	2[d]
Pinnipeds					
Harbor seal	0	36,600	0	N/A	0
Gray seal	0	36,600	0	N/A	0
Harp seal	0	36,600	0	N/A	0
Hooded Seal	0	36,600	0	N/A	0

[a] Source: OBIS-SERDP-Navy NODE 2007a and 2007b (for those species where density data were available).
[b] Calculated take is estimated density multiplied by the 160-db ensonified area. These calculations do not include any contingency as the survey will be conducted as one continuous line.
[c] Requested takes expressed as percentages of the larger regional populations, where available; where not available (most odontocetes–see Table 2), Draft 2013 SAR population estimates were used; N/A means not available
[d] Requested take authorization was increased to average group size for species for which densities were not available but have been sighted near or have the potential to be observed within the Study Area. Average group size from CeTAP 1984.

It also should be noted that as summarized from the PEIS in the above section, "Summary of Potential Airgun Effects," delphinids appear to be less responsive to airgun sounds than some mysticetes. The 160 dB re 1μPa$_{RMS}$ criterion that the NMFS currently uses to determine potential Level B harassment to all cetaceans was based on recorded reactions of gray and bowhead whales. For delphinids and pinnipeds, a 170 dB re 1μPa$_{RMS}$ disturbance criterion may be more appropriate. Based on this, the estimates of potential "takes by harassment" presented in Table 3 would, therefore, be considered precautionary. Note that the ensonified area (36,600 km^2) shown in Table 3 is calculated for the 2014 survey. The 2015 survey is expected to ensonify an almost identical area (to within 2 %); therefore takes requested are identical for each of the two years. However, the 2015 survey may be scheduled for an earlier time slot. Table 4 indicates the number of takes that would be expected were the survey to be scheduled in the spring rather than summer. The data suggest that spring takes would be higher for only two species: Humpback Whale and Bottlenose Dolphin. Spring takes would be fewer for nine species, and unchanged for the remaining species.

1.11.2 **Potential Number of Marine Mammals Exposed**

The potential number of different individual marine mammals that could be exposed to airguns at or exceeding 160 dB re 1μPa$_{RMS}$ can be determined using the total area that will be located within the 160-dB radius at any one point during the entire survey. In many seismic surveys, this total marine area includes overlap, as seismic surveys are often conducted in parallel survey lines where the ensonified areas of each survey line will overlap. The proposed 2014 survey lines, however, will not have overlap as the individual line segments of the complete 2014 proposed survey line do no run parallel to each other. The entire survey could be considered one continual survey line with slight turns (no more than 90 degrees) between each line segment (see **Figures 5** and **6**). During the proposed 2014 survey, the seismic vessel will continue on the extensive survey line path, not staying within a smaller defined area as most seismic surveys do. Therefore, due to the structure of the proposed 2014 survey, there is a potential for one marine mammal to be exposed to the airgun sounds more than once. It is expected however that, if an individual is exposed at least once at any one point during the survey, that animal is more likely to avoid the survey vessel should it encounter the survey vessel farther down the survey line, reducing the likelihood of a second exposure.

The number of potential individuals exposed to airgun sounds ≥160 dB re 1μPa$_{RMS}$ were determined by multiplying each expected species density (for those species that had density data) by the total ensonified area for the entire 3,165 kilometers of the survey line. The total area expected to be ensonified was determined by creating the 160-dB buffer around the entire survey line (see Table 1). This was done using ESRI ArcGIS. Using this approach, a total of 33,193 square kilometers will fall within the 160-dB isopleth throughout the course of the proposed 2014 survey. This approach does not allow for turnover in the marine mammal populations in the area, therefore, the actual number of marine mammals could be underestimated. However, it is expected that the line kilometers used to calculate the potential exposures and the fact that these calculations assume that no marine mammals would move away from the track line during active surveys before the received sound levels reach 160 dB re 1μPa$_{RMS}$ result in an overestimation of potential individual exposures.

The total number of individual animals that could be exposed to received levels of seismic sounds ≥160 dB re 1µPa$_{RMS}$ during the entire proposed 2014 survey is 9,866 (Table 3). That total includes 97 cetaceans listed as ***Endangered*** under the ESA, including 3 fin whales (0.011 percent of the regional population), 3 humpback whales (0.026 percent of the regional population), 3 North Atlantic right whales (0.66 percent of the regional population), 2 blue whales (0.234 percent of the regional population), 3 sei whales (0.029 percent of the regional population), and 83 sperm whales (0.629 percent of the regional population).

Most of the cetaceans (89.2 percent) potentially exposed are delphinids. The most common species in the area are expected to be the striped dolphin (4,916 estimated individuals [8.97 percent of the regional population]), Atlantic spotted dolphin (1056 estimated individuals [2.36 percent of the regional population]), and Pantropical spotted dolphin (724 estimated individuals [21.72 percent of the regional population]). No “takes” of pinnipeds are expected due to a lack of species observations within the Study Area, the great distance offshore , and the extreme depth of the Study Area, as these species are primarily found in coastal waters. It should be noted that the regional populations for each species are the populations reported in the 2013 NMFS Stock Assessment Report (SAR) for species populations within U.S. waters. Therefore, population percentages may be underestimated for actual population sizes that would include waters outside the U.S. EEZ.

1.11.3 Conclusions

As stated earlier, the proposed 2014 survey will consist of operating a seismic airgun array that will introduce pulsed intermittent noise into the marine environment. During this time, both an MBES and an SBP will be operating simultaneously. During the survey, the R/*V Langseth* will be towing a full 36-airgun array with a total volume discharge of approximately 6,600 in^3. Regular vessel operations also are likely to produce sound within the marine environment; however, continuous noise sources such as this are not commonly known to affect marine mammals to the point of “taking.” In addition, no takes are expected to result from the operation of the echosounder operations given the discussion found in Sections 3.6.4.3, 3.7.4.3, 3.8.4.3, and Appendix E of the PEIS.

Cetaceans. Sections 3.6.7 and 3.7.7 of the PEIS concluded that with the implementation of the proposed monitoring and mitigation measures, unavoidable impacts to mysticetes and odontocetes (in the Northwest Atlantic Detailed Analysis Area and Mid-Atlantic Ridge Qualitative Analysis Area) are expected to be limited to short-term behavioral disturbance and short-term localized avoidance of the area where airguns are operating. These impacts will result in only a small number of Level B behavioral effects. Level A effects are highly unlikely, and seismic operations are unlikely to adversely affect any ESA-listed species.

Pinnipeds. Section 3.8.7 of the PEIS concluded that pinnipeds are absent or rare in most locations where seismic surveys occur. This is true for the proposed 2014 surveys. However, with the implementation of the proposed monitoring and mitigation measures, impacts to pinnipeds are expected to be limited to behavioral disturbance and, in some cases, localized avoidance of the area where airguns are operating. Level A effects are highly unlikely. Due to the lack of species presence data within the Study Area and the species’ preferences for more coastal waters, the proposed survey is not expected to encounter any pinniped species.

This IHA application presents the estimated potential number of marine mammals that could be exposed to pulsed seismic airgun sounds during the proposed 2014 survey. Based on this, "take authorizations" by Level B harassment also have been requested for each species. Overall, the requested take authorizations represent a small percentage of the overall U.S. regional population for each species (see Table 3). Exposure estimates for only one species, the pantropical spotted dolphin, represent greater than 20 percent of the regional population of any species with 656 requested takes. However, it is expected that these, as with the estimates for all of the potential species exposures, are overestimates for the reasons outlined previously. It should also be noted that any bottlenose dolphins potentially encountered during the proposed 2014 survey would primarily be from the offshore morphotype population. This morphotype is genetically distinct from the coastal morphotype populations, which are the populations primarily affected by the recent 2013 UME. Therefore, the potential for Level B harassment of 221 individuals of the offshore bottlenose dolphin morphotype, which represents 0.28 percent of the regional population, would not further affect the potentially vulnerable population of the coastal morphotype.

Overall, the relatively short-term exposures to any marine mammals are unlikely to result in any long-term negative consequences to either individual and animals or populations.

VIII. ANTICIPATED IMPACTS ON SUBSISTENCE USES

The anticipated impact of the activity on the availability of the species or stocks of marine mammals for subsistence uses.

There is no legal subsistence hunting for marine mammals in the western North Atlantic, so the proposed activities will not have any impact on the availability of the species or stocks for subsistence users.

IX. ANTICIPATED IMPACTS ON HABITAT

The anticipated impact of the activity upon the habitat of the marine mammal populations, and the likelihood of restoration of the affected habitat.

The proposed seismic survey would not result in any permanent impact on habitats used by marine mammals or to their food sources. The main impact on marine mammals associated with the proposed 2014 survey activity will be temporarily elevated noise levels and the associated direct effects, as discussed in Section VII, above. Seismic airguns also have the potential to affect fish and invertebrates that serve as prey for marine mammal species. The effects of airguns on fish and invertebrates are reviewed in the PEIS in Sections 3.2.4.3 and 3.3.4.3, and in Appendix D. The PEIS concluded that seismic airguns could have both direct and indirect effects on fish and invertebrate species, including behavioral changes and other non-lethal, temporary impacts, and injury or mortal impacts on individual fish located within direct proximity to an active high-energy acoustic source. However, significant impacts from the proposed 2014 survey to fish or invertebrate populations are not anticipated.

X. ANTICIPATED IMPACT OF LOSS OR MODIFICATION OF HABITAT ON MARINE MAMMALS

The anticipated impact of the loss or modification of the habitat on the marine mammal populations involved.

The proposed 2014 survey is not expected to have any habitat-related effects with the potential to result in significant or long-term impacts on either individual marine mammals or their populations. This is a result of the limited duration of the proposed 2014 survey (approximately 19 days) and the large area the survey will cover. There is a potential that the small number of marine mammals present within the vicinity of the survey vessel while the full airgun array is operating would be temporarily displaced as much as a few kilometers. However, as stated earlier, the proposed 2014 survey is not operating in a small, defined location. The proposed 3,165 kilometers of survey lines are not parallel and the seismic vessel will continuously move along that line. This reduces the potential to create a specific area offshore with repeated seismic activity that marine mammals may avoid.

XI. MITIGATION MEASURES

The availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks, their habitat, and on their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Marine mammals are known to occur within the Study Area. To minimize potential impacts that could occur to species and/or stocks, airgun operations will be conducted in accordance with the MMPA and the ESA. This will include obtaining permission for incidental harassment of incidental “takes” of marine mammals and other federally listed species. The proposed activities will take place both within the U.S. EEZ and in International Waters.

The following subsections outline the proposed mitigation measures that will be followed during the proposed 2014 survey. The procedures described here are based on protocols used during previous L-DEO seismic research cruises as approved by the NMFS.

1.12 Planning Phase

As discussed in the PEIS (Section 2.4.1.1), mitigation of potential impacts from the proposed survey begins during the planning phase. The USGS worked with L-DEO and NSF to identify potential time periods to carry out the survey, taking into consideration key factors such as environmental conditions (i.e., the seasonal presence of marine mammals). As most marine mammal species are expected to occur in the Study Area year-round, altering the timing of the proposed 2014 survey from summer months would result in no net benefits to these species. After consideration of what energy source level was necessary to achieve the research goals, USGS determined that the standard *R/V Langseth* 36-airgun array with a total volume of approximately 6,600 in^3 was appropriate.

1.13 Proposed Exclusion Zones

Based on L-DEO's model (Diebold et al. 2010 and Appendix H of the PEIS), received sound levels have been predicted for the proposed 2014 survey. The predicted received sound levels are a function of distance from the airguns for both the full 36-airgun array and the single 1900LL 40-in^3 airgun (mitigation gun), which would be used during power-downs (see **Figures 3** and **4**). This modeling approach uses ray tracing 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). In addition, propagation measurements of pulses from the 36-airgun array at a tow depth of 6 meters have been reported in approximately 1,600 meters water depth (deep water), 50 meters depth (shallow water) and a slope site (intermediate water depth) in the Gulf of Mexico in 2007–2008 (Tolstoy et al. 2009; Diebold et al. 2010).

For deep water and intermediate water depth cases, these field measurements cannot be used readily to derive mitigation radii. At these sites, the calibration hydrophone was located at a roughly constant depth of 350 to 500 meters, which may not intersect all the SPL isopleths at their widest point from the sea surface down to the maximum relevant water depth for marine mammals of approximately 2,000 meters. Figures 2 and 3 in Appendix H of the PEIS show how the values along the maximum SPL line that connects the points where the isopleths attain their maximum width (providing the maximum distance associated with each sound level) may differ from values obtained along a constant depth line. At short ranges, where the direct arrivals dominate and the effects of seafloor interactions are minimal, the data recorded at the deep and slope sites are suited for comparison with modeled levels at the depth of the calibration hydrophone. At larger ranges, the comparison with the mitigation model—constructed from the maximum SPL through the entire water column at varying distances from the airgun array—is the most relevant. The results are summarized below.

Comparisons at short ranges between sound levels for direct arrivals recorded by the calibration hydrophone and model results for the same array tow depth are consistent (Figures 12 and 14 in Appendix H of the PEIS). Consequently, isopleths falling within this domain can be reliably predicted by the L-DEO model, while they may be imperfectly sampled by measurements recorded at a single depth. At larger distances, the calibration data show that seafloor reflected and sub-seafloor refracted arrivals dominate, while the direct arrivals become weak and/or incoherent (Figures 11, 12 and 16 in Appendix H of the PEIS). Aside from local topography effects, the region around the critical distance (approximately 5 kilometers on Figures 11 and 12, and approximately 4 kilometers in Figure 16 in Appendix H of the PEIS) is where the observed levels rise close to the mitigation model curve. However, the observed sound levels are found to fall almost entirely below the mitigation model curve (Figures 11, 12, and 16 in Appendix H of the PEIS). Thus, analysis of the Gulf of Mexico calibration measurements demonstrates that although simple, the L-DEO model is a robust tool for estimating mitigation radii.

During the proposed 2014 survey, the proposed seismic operations will occur entirely in deep water (i.e., greater than 1,000 meters). Therefore, for the purposes of the proposed 2014 survey, only deep-water radii were predicted. For the full 36-airgun array, the deep-water radii were obtained from 9-meter tow depth L-DEO model results to a maximum water depth of 2,000 meters.

Measurements have not been reported for the single 40-in^3 airgun. The 40-in^3 airgun fits under the PEIS low-energy sources (i.e., any towed acoustic source whose receive level is ≤180 dB re 1 μPa_{RMS} at 100 meters from the source, including any single airgun with a volume ≤ 425 in^3). In the PEIS (Section 2.4.2), Alternative B (the Preferred Alternative) conservatively applies a 100-meter EZ for all low-energy acoustic sources in water depths greater than 100 meters. This approach is adopted here for the single Bolt 1900LL 40-in^3 airgun that would be used during power-downs. In addition, L-DEO model results are used to determine the 160- and 190- dB radii for the 40-in^3 airgun in deep water.

Table 1 shows the modeled distances for both the 36-airgun array and the single mitigation gun at which the 160, 160, and 190 dB re 1 μPa_{RMS} received levels are expected to be reached. The 180-dB re 1 μPa_{RMS} distance is the safety criterion as specified by NMFS (2000) for cetaceans. If marine mammals or sea turtles are detected within, or about to enter, the appropriate exclusion zone, the airguns would be immediately powered down (or shut down if necessary).

New, detailed recommendations for science-based noise exposure criteria have been presented by Southall et al. (2007). The USGS is aware that NOAA is in the process of revising the current guidance for marine mammals regarding acoustic exposure. However, at the time of this IHA application, that guidance has not been finalized. The USGS is prepared to revise its procedures for estimating the number of marine mammals "taken," EZ's, etc., as may be required by any new guidelines that may result.

1.14 Mitigation during Operations

Mitigation measures that will be adopted during the proposed survey include: (1) power-down procedures, (2) ramp-up procedures; and (3) special procedures for situations of species of particular concern.

1.14.1 Power-down Procedures

A power-down involves reducing the number of airguns operating such that the radius of the 180-dB (or 190-dB) zone is decreased to the extent that an observed marine mammal(s) is (are) no longer observed within the EZ. As the proposed survey does not include any full turns (only 90-degree turns maximum), the seismic airgun array will continue to operate at full power between line segments. The survey will be conducted as the segments are one continuous line. During a power-down, only one airgun will be operating. The continued operation of one-airgun is intended to alert any marine mammals of the presence of the seismic vessel.

If a marine mammal is detected within, or is likely to enter the EZ, the airgun array would be powered down immediately. During a power-down situation of the full air-gun array, only a 40-in^3 airgun will be operated. Following a power-down situation, airgun activity will not resume until the marine mammal has cleared the EZ. The animal will be considered clear of the EZ if it:

- is visually observed to have left the EZ; or

- has not been seen within the EZ for 15 minutes in the case of small odontocetes and pinnipeds; or
- has not been seen within the EZ for 30 minutes in the case of mysticetes and large odontocetes including sperm, pygmy sperm, dwarf sperm, and beaked whales; or
- the vessel has moved outside the applicable EZ in which the animal in question was last seen.

Following a power-down and subsequent animal departure from the EZ as described above, the airgun array would resume full operations. Based on previous *R/V Langseth* marine seismic surveys, it has been determined that following a power-down, ramp-up from the single mitigation gun is not necessary as the single mitigation gun serves to warn any marine mammals within the vicinity of the survey of the seismic activities underway. It has also been determined that the ramp-up procedures may unnecessarily extend the length of the survey time needed to collect the seismic data. Previous surveys conducted by L-DEO and NSF in consultation with the NMFS have concluded that undergoing ramp-up procedures following an extended power-down is not necessary. Therefore, this IHA application does not include this practice as part of the monitoring and mitigation plan.

If an animal is observed within the smaller designated EZ for the single airgun (see Table 1), the airguns will be completely shut down. Airgun operation will not be resumed until the above conditions are met, as applicable.

1.14.2 Shutdown Procedures

Operating airgun(s) will be shut down if a marine mammal is observed within or approaching the EZ for the single airgun. During a shutdown, all operating airguns will be turned off immediately. Airgun activity will not resume until the marine mammal(s) has cleared the EZ for the full array, as described above under "Power-down Procedures."

1.14.3 Ramp-up Procedures

A ramp-up procedure will be followed when starting the airguns at the beginning of seismic operations or anytime the entire array has been shut down for a specified period of time. Based on other surveys conducted by L-DEO using the *R/V Langseth* and using an airgun array of similar size as the proposed 2014 survey, a period of approximately 10 minutes is proposed for the 2014 survey. Ramp-up will not occur if an observed marine mammal has not cleared the EZ as described above.

Ramp-up will consist of beginning with the smallest airgun in the array (40 in^3). Airguns will then be added in a sequence such that the source level of the array will increase in steps not exceeding 6 dB per 5-minute period. A 36-airgun array is expected to take approximately 30 minutes to achieve full operations. During the ramp-up, NMFS-approved Protected Species Visual Observers (PSVOs) will monitor the EZ, and if a marine mammal is sighted, a power-down or shutdown will be implemented, as applicable, as though the full array were operating.

Ramp-up may not be initiated unless the full EZ is visible to the PSVOs for no less than 30 minutes, whether conducted in daytime or nighttime. Ramp-up may commence even if the entire EZ is not visible for 30 minutes if at least one airgun (40 in^3 or smaller) has been operating during the interruption of seismic survey operations. Therefore, it is not expected that the full airgun array will be ramped-up from a completion shutdown at night or during poor visibility conditions (i.e., thick fog). However, if one airgun has continued during a power-down period, ramp up to full power will be permissible at night or in poor visibility conditions. This is based on the assumption that marine mammals would be alerted to the presence of the seismic vessel by the continually operating mitigation airgun. Ramp-up of the airguns will not be initiated if a marine mammal is present within the EZ of the airgun array to be operated.

As stated above under “Power-down Procedures,” based on previous *R/V Langseth* marine seismic surveys, it has been determined that following a power-down, ramp-up from the single mitigation gun is not necessary as the single mitigation gun serves to warn any marine mammals within the vicinity of the survey of the seismic activities underway. Therefore, this IHA application does not include this practice as part of the monitoring and mitigation plan.

1.14.4 Special Procedures for Situations or Species of Concern

It is unlikely that a North Atlantic right whale (NARW) will be encountered during the proposed survey. However, if a NARW is visually identified at any distance from the vessel during seismic operations, the airguns will be shut down immediately and remain off for a minimum of 30 minutes after the animal is beyond visual range before resuming with ramp-up. This is due to the species rarity and conservation status. In addition, it is unlikely that concentrations (groups of 6 or more individuals) of humpback, fin, sperm, blue, or sei whales will be encountered, but if so, they will be avoided.

XII. PLAN OF COOPERATION

Where the proposed activity would take place in or near a traditional Arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammal for Arctic subsistence uses, the applicant must submit either a plan of cooperation or information that identifies what measures have been taken and/or will be taken to minimize any adverse effects on the availability of marine mammals for subsistence uses. A plan must include the following:

(i) A statement that the applicant has notified and provided the affected subsistence community with a draft plan of cooperation;

(ii) A schedule for meeting with the affected subsistence communities to discuss proposed activities and to resolve potential conflicts regarding any aspects of either the operation or the plan of cooperation;

(iii) A description of what measures the applicant has taken and/or will take to ensure that proposed activities will not interfere with subsistence whaling or sealing; and

(iv) What plans the applicant has to continue to meet with the affected communities, both prior to and while conducting activity, to resolve conflicts and to notify the communities of any changes in the operation.

Not applicable. The proposed activity will take place in the western North Atlantic, and no activities will take place in or near a traditional Arctic subsistence hunting area.

XIII. MONITORING AND REPORTING PLAN

The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities and suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such activity. Monitoring plans should include a description of the survey techniques that would be used to determine the movement and activity of marine mammals near the activity site(s) including migration and other habitat uses, such as feeding.

The USGS proposes to sponsor marine mammal monitoring during the proposed 2014 survey in order to implement the proposed mitigation measures that require real-time monitoring and to satisfy the anticipated monitoring requirements of the IHA.

The proposed Monitoring and Reporting Plan for the USGS is described below. The USGS understands that this Monitoring and Reporting Plan will be subject to review by the NMFS and that refinements may be required.

The monitoring work described in association with the proposed 2014 survey has been planned as a self-contained project, independent of any other related monitoring projects that may be occurring simultaneously in the same regions. The USGS is prepared to discuss coordination of its monitoring program with any related work that subsequently might be conducted by other groups insofar as it is practicable and desirable.

1.15 Vessel-based Visual Monitoring

Vessel-based PSVO observations will take place during daytime airgun operations and before and during start-ups of airguns during daytime or nighttime. Airgun operations will be suspended when marine mammals are observed within, or about to enter, the designated EZ where there is concern about potential effects on hearing or other physical effects (see Section XI). PSVOs also will be on watch for marine mammals within the EZ for at least 30 minutes prior to the start of seismic operations following an extended shutdown. PSVOs will remain on watch during daytime periods when the seismic airguns are not operating in order to compare animal abundance and behaviors during times of operation and no operation.

In total, five PSVOs will be deployed aboard the *R/V Langset*. Two PSVOs will remain on watch during daytime seismic operations, with at least one PSVO remaining on watch during meal times and restroom breaks. PSVO shifts will last no longer than four hours at a time. The *R/V Langseth* crew will be instructed to assist in observing any marine mammals while they are on watch.

The *R/V* Langseth will serve as the observation platform for marine mammals during the proposed 2014 survey. When the PSVO is stationed on the observation platform, the PSVO eye level will be approximately 21.5 meters above sea level, and each observer will have a good view around the entire vessel. PSVOs will use reticle binoculars (7x50 Fujinon), big-eye binoculars (25x150), and the naked eye during observations. Laser range-finding binoculars (Leica LRF 1200 laser rangefinder or equivalent) will be available to assist with distance estimation. Those are useful in training PSVOs to estimate distances visually, but are generally not useful in measuring distances to animals directly; that is done primarily with the reticles in the binoculars. In addition, both forward-looking infrared camera and night vision monoculars will be available for use in low-light conditions.

1.16 Passive Acoustic Monitoring

Passive acoustic monitoring (PAM) will be conducted to complement the visual monitoring program. Visual monitoring typically is not effective during periods of poor visibility or at night, and even with good visibility, is unable to detect marine mammals when they are below the surface or beyond visual range. Acoustical monitoring can be used in addition to visual monitoring to improve species detection, identification, and localization of cetaceans. However, it should be noted that PAM only works when a marine mammal is actually vocalizing. During the proposed 2014 survey, PAM will be monitored in real-time so that visual observers can be advised when cetaceans are acoustically detected.

The PAM system available on-board the *R/V Langseth* consists of both hardware and software. The deployed part of the system includes a towed hydrophone array stretching approximately 250 meters behind the vessel. The hydrophones are located on the last 10 meters of the towed cable. The cable will typically be towed at 20 meters depth or less. The Pamguard software is used to amplify, digitize, and processed the acoustic signals received by the hydrophones. This particular system can detect marine mammal vocalizations at frequencies up to 250 kHz. The PAM hydrophones respond in the 10 Hz to 200 kHz bandwidth.

One Protected Species Acoustic Observer (PSAO) or one PSVO will monitor the PAM system at all times in shifts no greater than six hours. A PSAO will design and set up the PAM system and be present to operate, oversee, and troubleshoot any technical problems with the PAM system during the proposed survey. When the PAM system detects a vocalization, the PAM operator will alert the PSVOs to the presence of a marine mammal, and a power-down or shutdown can be initiated, if required. The PSAO will enter the vocalization data into a database. The data to be entered includes an acoustic encounter identification number, whether it was linked with a visual sighting, date, time when first and last heard and when 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 the sounds heard (e.g., clicks, continuous, sporadic, whistles, creaks, burst pulses, strength of signal, etc.), and any other notable information.

1.17 PSVO Data and Documentation

PSVOs will record data to estimate the numbers of marine mammals exposed to various received sound levels and to document the behavior of the animal upon sighting. These data will be included in the report submitted to the NMFS and will be used to estimate numbers of marine mammals potentially “taken” by harassment. PSVOs will also provide information needed to order a power-down or a shutdown of airguns when marine mammals are within or near the appropriate EZ.

When a sighting is made, the following information about the sighting will be recorded:

1. 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 behavioral pace.
2. Time, location, heading, speed, activity of the vessel, sea state, visibility, and sun glare.

The data listed under (2) will be recorded at the start and at the end of each observation watch, and during watch whenever there is a change in one or more of the variables.

All observations and power-downs or shutdowns will be recorded in a standardized format. Data will be entered into an electronic database. The accuracy of the data entry will be verified by computerized data validity checks as the data are entered and by subsequent manual checking of the database. These procedures will allow initial summaries of data to be prepared during and shortly after the field program and will facilitate transfer of the data to statistical, graphical, and other programs for further processing and archiving.

Results from the vessel-based observations will provide:

1. The basis for real-time mitigation (airgun power-down or shutdown).
2. Information needed to estimate the number of marine mammals potentially taken by harassment, which must be reported to the NMFS.

3. Data on the occurrence, distribution, and activities of marine mammals in the area where the seismic study is conducted.
4. Information to compare the distance and distribution of marine mammals relative to the source vessel at times with and without seismic activity.
5. Data on the behavior and movement patterns of marine mammals and turtles seen at times with and without seismic activity.

A report will be submitted to the NMFS and the USGS within 90 days of the completion of the proposed 2014 survey cruise. A second report will similarly be filed upon completion of the 2015 survey. The report will describe the seismic operations conducted and sightings of marine mammals within the vicinity of the operations. The report will include full documentation of methods, results, and interpretation pertaining to all monitoring. The report will summarize the dates and locations of seismic operations, and all marine mammal sightings (dates, times, locations, activities, associated seismic survey activities). Finally, the report will include estimates of the number and nature of exposures that could result in "takes" of marine mammals by Level B harassment or in other ways.

XIV. COORDINATING RESEARCH TO REDUCE AND EVALUATE INCIDENTAL TAKE

Suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects.

The USGS will coordinate the planned marine mammal monitoring program associated with the seismic survey (as summarized in Sections XI and XIII) with any parties who express interest in this survey activity. The USGS will coordinate with applicable U.S. agencies (i.e., NMFS) and will comply with their requirements.

XV. LITERATURE CITED

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11 APPENDIX C: DESCRIPTION OF NSF NEW JERSEY AND GEOPRISMS/ENAM SURVEYS

APPENDIX C:
DESCRIPTION OF NSF 2014 SEISMIC SURVEYS UTILIZING
R/V *MARCUS G. LANGSETH*

Two NSF *Langseth* seismic surveys using high-energy sources are planned during 2014, in addition to the proposed USGS survey: (1) NJ Shelf project and (2) the Eastern North American (ENAM) survey. The locations of these surveys are shown in Figure C-1. Table C-1 gives a comparison of the planned survey tracks and source size. This appendix summarizes these surveys.

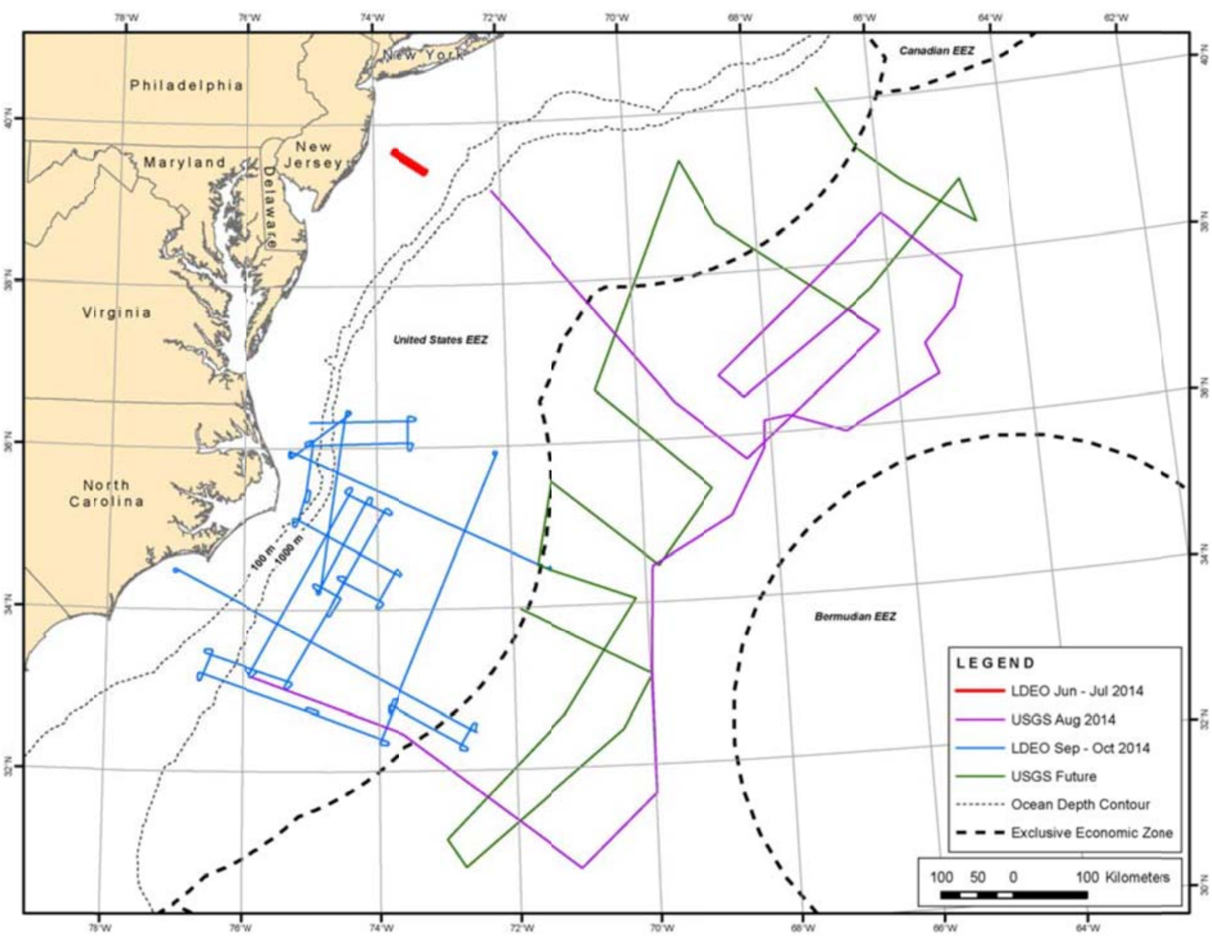

Figure C-1: Map showing the locations of the NJ Shelf (red), USGS (green and purple) and ENAM (blue) tracks. The tracks have been designed to avoid overlap and to complement their respective scientific objectives.

Table C-1: Summary of Survey Information for the NJ Shelf, USGS, and ENAM surveys.

Survey	Time of Year (2014)	Survey Days	Planned Track Length (km)	Planned Source Size (in^3)	Water Depths (m)
NJ Shelf	July	~30	4900	700/1400	30-75
USGS[1]	Aug. – Sep.	21	3150	6600	1450-5400
ENAM	Sep. – Oct.	38	5000	3300/6600	30-4300

[1]The proposed components of the 2015 survey are identical.

(1) NJ Shelf Survey

The NJ Shelf survey occurred in July, 2014, and collected 3-dimensional seismic reflection data between 25 and 75 km offshore from New Jersey (red box in Figure C-1) to study how sea-level rise affected the New Jersey shelf for the past 60 million years. The survey was proposed under a competitive research proposal that underwent merit-review at NSF. The topic of sea-level rise is an NSF program priority to meet NSF's critical need to foster a better understanding of Earth processes. The survey utilized a smaller airgun array than that proposed for the USGS survey (~700 in^3 or 1400 in^3 total volume airgun array).

Finding of No Significant Impact

After receiving all necessary authorizations, including an Incidental Harassment Authorization (MMPA) and Biological Opinion (ESA) allowing for the taking of a small number of marine mammals and endangered species by incidental harassment, NSF issued a FONSI and completed the environmental compliance process for this survey on July 1, 2014 (https://www.nsf.gov/geo/oce/envcomp/index.jsp). This survey was not completed as planned because of mechanical problems with the vessel, but did acquire a subset of multichannel data using specified mitigation and monitoring. The survey may be rescheduled next year at approximately the same time.

The conclusions of the FONSI were consistent with the earlier findings in the NSF/USGS PEIS.

(2) ENAM Survey

The ENAM survey is planned for September – October, 2014 utilizing R/V *Marcus G. Langseth* The proposed research covers a portion of the rifted margin of the eastern U.S., from un-extended continental lithosphere onshore to mature oceanic lithosphere offshore. The data set would therefore allow scientists to investigate how the continental crust stretched and separated during the opening of the Atlantic Ocean, and what the role of magmatism was during continental breakup. The ENAM survey would be coordinated with complementary on-land studies involving the Earth Scope seismometer array along the East Coast. Additional arrays of Ocean Bottom Seismometers would be deployed offshore, and small, passive seismometers are placed along land-based extensions of two of the marine transects as well as limited active source work on land would allow for obtaining critical information on continental crust extension. Additional objectives would be to study features representing the post-rift modification of the margin by slope instability and fluid flow.

The Draft EA for this site specific survey is consistent with the findings of the PEIS. The Draft EA for the ENAM survey provides a summary of relevant bioacoustic studies on marine mammals, sea turtles, fisheries, and habitats since publication of the NSF/USGS PEIS. The information from this more recent literature complements, and does not change the outcome of the effects assessment as presented in the PEIS.

12 APPENDIX D: NMFS CONSULTATION (ESSENTIAL FISH HABITAT)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
55 Great Republic Drive
Gloucester, MA 01930-2276

JUN 20 2014

Deborah R. Hutchinson, Ph.D.
U.S. Geological Survey
Woods Hole Science Center
384 Woods Hole Rd.
Woods Hole, MA 02543

Dear. Dr. Hutchinson:

This responds to your June 3, 2014, electronic mail inquiry regarding essential fish habitat (EFH) consultation requirements for a proposed regional marine two-dimensional seismic reflection scientific research survey in the Atlantic Ocean over the next two years. The U.S. Geological Survey (USGS), in cooperation with the National Science Foundation (NSF), prepared an environmental assessment (EA) dated May 2014 tiered off a 2011 Final Programmatic Environmental Impact Statement (FPEIS)/Overseas Environmental Impact Statement (OEIS) for Marine Seismic Research funded by the NSF. The study area is in the northwest Atlantic Ocean U.S. exclusive economic zone (EEZ) off Delaware and North Carolina and extends into international waters as far as 350 nautical miles from the coast.

In accordance with the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), 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 Magnuson-Stevens Act specifies consultation with NMFS is required for federal actions which may adversely affect EFH. As the federal action agency for this matter, the USGS and NSF have determined the proposed survey activities may result in minor adverse impacts to water column habitats identified and described as EFH. The Habitat Conservation Divisions (HCDs) in the Southeast Regional and Greater Atlantic Regional Fisheries Offices have reviewed the analysis and proposed mitigation measures contained in the FPEIS/OEIS and the EA prepared for this action. Upon considering the design and nature of the survey we have no EFH conservation recommendations to provide pursuant to Section 305(b)(2) of the Magnuson-Stevens Act at this time.

However, much of the research available to date on the adverse effects of seismic survey activities on aquatic resources has been focused on marine mammals. Little information is available on the effects of these activities on fish and benthic organisms. Additional research and monitoring is needed 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 type of 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 by separate correspondence the HCDs have provided similar determinations to the NMFS Office of Protected Resources for their evaluation of an Incidental Harassment Authorization request for this action. Further EFH consultation on this matter by the USGS and NSF is not necessary unless future modifications to the survey are proposed and such actions may result in adverse impacts to EFH.

NMFS comments originate from two regions. The contacts for these offices are:

Mr. David Dale NMFS Southeast Region Habitat Conservation Division 263 13th Avenue South St. Petersburg, Florida 33701-5505	Ms. Karen Greene NMFS Greater Atlantic Region Habitat Conservation Division 74 Magruder Road Highlands, New Jersey 07732
David.Dale@noaa.gov 727-824-5317	Karen.Greene@noaa.gov 727-872-3023

If we can be of further assistance, please advise.

Sincerely,

Louis A. Chiarella
Assistant Regional Administrator
For Habitat Conservation

cc:
F/SER, David.Dale@noaa.gov
F/GAR, Karen.Greene@noaa.gov
F/HC, Terra.Lederhouse@noaa.gov
F/PR, Howard.Goldstein@noaa.gov

13 APPENDIX E: USFWS CONSULTATION (ENDANGERED SPECIES ACT)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington, D.C. 20240

AUG 11 2014

In Reply Refer To:
FWS/AES/DER/BCH/058048
FWS 2014-I-0006

Mr. David Applegate
Pacific Coastal and Marine Geology Science Center
U.S. Geological Survey
Mail Stop 999
345 Middlefield Road
Menlo Park, California 94025

Subject: Informal Consultation on the 2-D Seismic Reflection Scientific Research Surveys During 2014 and 2015 in Support of Mapping the U.S. Atlantic Seaboard Extended Continental Margin and Investigating Tsunami Hazards

Dear Mr. Applegate:

This letter is in response to your April 4, 2014 email, requesting the U.S. Fish and Wildlife Service's (Service) concurrence that the proposed 2-D seismic reflection scientific research surveys during 2014 and 2015 is not likely to adversely affect the endangered roseate tern (*Sterna dougallii*) and Bermuda petrel (*Pterodroma cahow*), 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 submitted document entitled a "Draft Environmental Assessment for Seismic Reflection Scientific Research Surveys During 2014 and 2015 in Support of Mapping the U.S. Atlantic Seaboard Extended Continental Margin and Investigating Tsunami Hazards."

The proposed action is to conduct a seismic survey program that involves using a 36-airgun array with a total discharge volume of 6,600 cubic inches. The survey program is planned to occur over two years, for three weeks or fewer between August and September, 2014, and for a similar amount of time as yet unscheduled between April and August, 2015. The 2014 and 2015 surveys are planned with track lengths of 3,165 and 3,105 kilometers, respectively, and because they are within 1.5 % of each other in length, are considered to have identical impacts on the environment. The proposed action is in water depths greater than 1,000 meters, mostly in international waters outside the U.S. Atlantic continental margin, but partly within the deep-water portions of the U.S. exclusive economic zone. The proposed survey area would be bounded by the following geographic coordinates:

40.5694° N and -66.5324° W
38.5808° N and -61.7105° W

29.2456° N and -72.6766° W
33.1752° N and -75.8697° W
39.1583° N and -72.8697° W

The goal of the proposed research is to: 1) establish the outer limits of the U.S. continental shelf, also referred to as the Extended Continental Shelf, and; 2) study the sudden mass transport of sediments down the continental shelf as submarine landslides that may pose tsunamigenic hazards to the Atlantic and Caribbean coastal areas.

The surveys would involve one source vessel, the R/V *Langseth*. The proposed survey design consists of approximately nine sub-parallel, northwest to southeast lines (perpendicular to the margin) across the study area, with end-line transits and several northeast to southwest tie or strike lines. The airgun array would operate continuously during the survey, except for power/shut downs, equipment repair or weather issues. Data would continue to be acquired between line changes. Seismic airgun sources send sound waves through the water, and formations beneath the seafloor reflect the sound waves back to hydrophone streamers trailing behind the vessel. The components of the 2-D survey would include a seismic vessel, the source towed array (consisting of 36 airguns) and the receiver (hydrophone streamer). The vessel would be at sea during the entire survey operations. There would no crew changes planned and no additional support vessel or helicopter service anticipated.

Although unlikely to be encountered, the listed roseate tern or Bermuda petrel could occur at or near the ocean-based 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 Bermuda petrel is a rare bird with approximately 100 nesting pairs. Currently, all known breeding pairs breed on islets in Castle Harbour, Bermuda. In the non-breeding season (mid-June – mid-October), it is thought that birds move north into the Atlantic and following the warm waters on the western edges of the Gulf Stream.

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 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 these species will be in the action area as well as the precautionary measure of shutting down the airguns if a roseate tern or Bermuda petrel are observed diving, we concur with your determination that this action will not adversely affect these two avian species.

We are pleased that USGS and its contractors are committed to applying proactive protective measures in order to minimize effects on listed species. 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,

Larry Bright

Larry Bright
Acting Chief, Division of Environmental Review,
Ecological Services

14 APPENDIX F: FEDERAL REGISTER NOTICE (NMFS, IHA APPLICATION)

FEDERAL REGISTER

Vol. 79 Monday,

No. 120 June 23, 2014

Part II

Department of Commerce

National Oceanic and Atmospheric Administration

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to a Marine Geophysical Survey in the Atlantic Ocean off the Eastern Seaboard, August to September 2014 and April to August 2015; Notice

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XD214

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to a Marine Geophysical Survey in the Atlantic Ocean off the Eastern Seaboard, August to September 2014 and April to August 2015

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; proposed Incidental Harassment Authorization; request for comments.

SUMMARY: NMFS has received an application from the United States (U.S.) Geological Survey (USGS), Lamont-Doherty Earth Observatory of Columbia University (L–DEO), and National Science Foundation (NSF) for an Incidental Harassment Authorization (IHA) to take marine mammals, by harassment, incidental to conducting a marine geophysical (seismic) survey in the Atlantic Ocean off the Eastern Seaboard, August to September 2014 and April to August 2015. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an IHA to USGS to incidentally harass, by Level B harassment only, 34 species of marine mammals during the specified activity.

DATES: Comments and information must be received no later than July 23, 2014.

ADDRESSES: Comments on the application should be addressed to Jolie Harrison, Supervisor, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910. The mailbox address for providing email comments is *ITP.Goldstein@noaa.gov*. Please include 0648–XD214 in the subject line. Comments sent via email, including all attachments, must not exceed a 25-megabyte file size. NMFS is not responsible for email comments sent to addresses other than the one provided here.

Instructions: All comments received are a part of the public record and will generally be posted to *http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications* without change. All Personal Identifying Information (for example, name, address, etc.) voluntarily submitted by the commenter may be publicly accessible. Do not submit Confidential Business Information or otherwise sensitive or protected information.

An electronic copy of the application may be obtained by writing to the address specified above, telephoning the contact listed below (see **FOR FURTHER INFORMATION CONTACT**) or visiting the Internet at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications*. The following associated documents are also available at the same internet address: ''Draft Environmental Assessment for Seismic Reflection Scientific Research Surveys during 2014 and 2015 in Support of Mapping the U.S. Atlantic Seaboard Extended Continental Margin and Investigating Tsunami Hazards.'' Documents cited in this notice may also be viewed, by appointment, during regular business hours, at the aforementioned address.

The USGS, which is funding the proposed seismic survey, included with its application a ''Draft Environmental Assessment for Seismic Reflection Scientific Research Surveys during 2014 and 2015 in Support of Mapping the U.S. Atlantic Seaboard Extended Continental Margin and Investigating Tsunami Hazards,'' prepared by RPS Evan-Hamilton, Inc. in association with YOLO Environmental, Inc., GeoSpatial Strategy Group, and Ecology and Environment, Inc., on behalf of USGS, which is also available at the same internet address. Documents cited in this notice may be viewed, by appointment, during regular business hours, at the aforementioned address.

FOR FURTHER INFORMATION CONTACT: Howard Goldstein or Jolie Harrison, Office of Protected Resources, NMFS, 301–427–8401.

SUPPLEMENTARY INFORMATION:

Background

Section 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*), directs the Secretary of Commerce (Secretary) to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals, by United States citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review.

An authorization for the incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), and will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth. NMFS has defined ''negligible impact'' in 50 CFR 216.103 as ''. . . an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.''

Except with respect to certain activities not pertinent here, the MMPA defines ''harassment'' as: Any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) 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].

Summary of Request

On March 27, 2014, NMFS received an application from the USGS, L–DEO, and NSF (hereafter referred to as USGS) requesting that NMFS issue an IHA for the take, by Level B harassment only, of small numbers of marine mammals incidental to conducting a marine seismic survey within the Exclusive Economic Zone (EEZ) and on the high seas (i.e., International Waters) to map the U.S. Atlantic Eastern Seaboard Extended Continental Shelf (ECS) region and investigate tsunami hazards during August to September 2014 and April to August 2015. USGS plan to use one source vessel, the R/V *Marcus G. Langseth* (*Langseth*) and a seismic airgun array and a hydrophone streamer to collect seismic data as part of the proposed seismic survey in the Atlantic Ocean off the Eastern Seaboard. In addition to the proposed operation of the seismic airgun array and hydrophone streamer, USGS intends to operate a multi-beam echosounder and a sub-bottom profiler continuously during the seismic operations in order to map the ocean floor. The multi-beam echosounder and sub-bottom profiler would not be operated during transits at the beginning and end of the seismic survey. NMFS determined that the IHA application was adequate and complete on May 14, 2014.

Acoustic stimuli (i.e., increased underwater sound) generated during the operation of the seismic airgun array are likely to result in the take of marine mammals. Take, by Level B harassment only, of individuals of 34 species of marine mammals is anticipated to result from the proposed specified activity. Take is not expected to result from the use of the multi-beam echosounder or sub-bottom profiler, for reasons discussed in this notice; nor is take expected to result from collision with the source vessel because it is a single vessel moving at a relatively slow speed (4.5 knots [kts]; 8.5 kilometers per hour [km/hr]; 5.3 miles per hour [mph]) during seismic acquisition within the survey, for a relatively short period of time (approximately two 17 to 18 day legs), and it is likely that any marine mammal would be able to avoid the vessel.

Description of the Proposed Specified Activity

Overview

USGS plans to conduct a marine seismic survey within the EEZ and on the high seas to map the U.S. Atlantic Eastern Seaboard ECS region and investigate tsunami hazards during August to September 2014 and April to August 2015. USGS proposes to use one source vessel, the *Langseth,* and a 36-airgun array and one 8 kilometer (km) (4.3 nautical mile [nmi]) hydrophone streamer to conduct the conventional seismic survey. In addition to the operations of airguns, the USGS intends to operate a multi-beam echosounder and a sub-bottom profiler on the *Langseth* during the proposed seismic survey to map the ocean floor.

Dates and Duration

The *Langseth* would depart from Newark, New Jersey on August 15, 2014. The seismic survey is expected to take approximately 16 days to complete. Approximately one day transit would be required at the beginning and end of the program. When the 2014 survey is completed, the *Langseth* would then transit to Norfolk, Virginia. The survey schedule is inclusive of weather and other contingency (e.g., equipment failure) time. The proposed activities for 2015 would be virtually identical to the proposed activities for 2014 as geographic area, duration, and trackline coverage are similar. The exact dates for the proposed activities in 2015 are uncertain, but are scheduled to occur within the April to August timeframe. The exact dates of the proposed activities depend on logistics and weather conditions.

Specified Geographic Region

The proposed survey would be bounded by the following geographic coordinates:

40.5694° North, –66.5324° West;
38.5808° North, –61.7105° West;
29.2456° North, –72.6766° West;
33.1752° North, –75.8697° West;
39.1583° North, –72.8697° West;

The proposed activities for 2014 would generally occur towards the periphery of the proposed study area (see Figures 1 and 2 of the IHA application). The proposed activities for 2015 would survey more of the central portions of the study area. The tracklines proposed for both 2014 and 2015 would be in International Waters (approximately 80% in 2014 and 90% in 2015) and in the U.S. EEZ. Water depths range from approximately 1,450 to 5,400 meters (m) (4,593.2 to 17,716.5 feet [ft]) (see Figure 1 and 2 of the IHA application); no survey lines would extend to water depths less than 1,000 m.

Detailed Description of the Proposed Specified Activity

USGS, Coastal and Marine Geology Program, (Primary Investigator [PI], Dr. Deborah Hutchinson) proposes to conduct a regional high-energy, two-dimensional (2D) seismic survey in the northwest Atlantic Ocean within the U.S. EEZ and extending into International Waters as far as 648.2 km (350 nmi) from the U.S. coast (see Figure 1 of the IHA application). Water depths in the survey area range from approximately 1,400 to greater than 5,400 meters (m) (4,593.2 to 17,716.5 feet [ft]). The proposed seismic survey would be scheduled to occur in two phases; the first phase during August to September 2014 (for approximately 17 to 18 days), and the second phase between April and August 2015 (for approximately 17 to 18 days, specific dates to be determined). The proposed activities for both Phase 1 and Phase 2 are included in this IHA application (see Figure 2 of the IHA application). Some minor deviation from these dates is possible, depending on logistics and weather.

USGS proposes to use conventional seismic methodology to: (1) Identify the outer limits of the U.S. continental shelf, also referred to as the ECS as defined by Article 76 of the Convention of the Law of the Sea; and (2) study the sudden mass transport of sediments down the continental shelf as submarine landslides that may pose significant tsunamigenic (i.e., tsunami-related) hazards to the Atlantic and Caribbean coastal communities.

The proposed survey would involve one source vessel, the *Langseth*. The *Langseth* would deploy an array of 36 airguns as an energy source with a total volume of approximately 6,600 in^3. The receiving system would consist of one 8,000 m (26,246.7 ft) hydrophone streamer. As the airgun array is towed along the survey lines, the hydrophone streamer would receive the returning acoustic signals from the towed airgun array and transfer the data to the on-board processing system. The data would be processed on-board the *Langseth* as the survey occurs.

Each proposed leg of the survey (2014 and 2015) would be 17 to 18 days in duration (exclusive of transit and equipment deployment and recovery) and would comprise of approximately 3,165 km (1,709 nmi) of tracklines of 2D seismic reflection coverage. The airgun array would operate continuously during the proposed survey (except for equipment testing, repairs, implemented mitigation measures, etc.). Data would continue to be acquired between line changes, as the successive track segments can be surveyed as almost one continuous line. Line turns of 90 and no greater than 120 degrees would be required to move from one line segment to the next. The 2014 proposed survey design consists primarily of the tracklines that run along the periphery of the overall study area, including several internal tracklines (see Figure 2 of the IHA application). The 2015 proposed survey design consists of additional dip and tie lines (i.e., dip lines are lines that are perpendicular to the north-south trend of the continental margin; strike lines are parallel to the margin; and tie lines are any line that connects other lines). The 2015 proposed survey design may be modified based on the 2014 results.

In addition to the operations of the airgun array, a Kongsberg EM 122 multi-beam echosounder and a Knudsen Model 3260 Chirp sub-bottom profiler would also be operated from the *Langseth* continuously during airgun operations throughout the survey to map the ocean floor. The multi-beam and sub-bottom profiler would not operate during transits at the beginning and end of the survey. All planned geophysical data acquisition activities would be conducted by USGS 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 for the entire cruise.

Vessel Specifications

The *Langseth,* a seismic research vessel owned by the National Science Foundation (NSF) and operated by the Lamont-Doherty Earth Observatory of Columbia University (L–DEO), would tow the 36 airgun array, as well as the hydrophone streamer(s), along predetermined lines (see Figure 2 of the IHA application). When the *Langseth* is towing the airgun array and the hydrophone streamer(s), the turning rate of the vessel is limited to three degrees per minute (2.5 km [1.5 mi]). Thus, the maneuverability of the vessel is limited during operations with the streamer. The vessel would ''fly'' the appropriate U.S. Coast Guard-approved day shapes (mast head signals used to communicate with other vessels) and display the appropriate lighting to designate the vessel has limited maneuverability.

The vessel has a length of 71.5 m (235 ft); a beam of 17.0 m (56 ft); a maximum draft of 5.9 m (19 ft); and a gross tonnage of 3,834. The *Langseth* was designed as a seismic research vessel with a propulsion system designed to be as quiet as possible to avoid interference with the seismic signals emanating from the airgun array. The ship is powered by two 3,550 horsepower (hp) Bergen BRG–6 diesel engines which drive two propellers directly. Each propeller has four blades and the shaft typically rotates at 750 revolutions per minute. The vessel also has an 800 hp bowthruster, which is not used during seismic acquisition. The *Langseth's* operation speed during seismic data acquisition is typically 7.4 to 9.3 km per hour (hr) (km/hr) (4 to 5 knots [kts]). When not towing seismic survey gear, the *Langseth* typically cruises at 18.5 to 24 km/hr (10 to 12 kts). The *Langseth* has a range of 25,000 km (13,499 nmi) (the distance the vessel can travel without refueling).

The vessel also has an observation tower from which Protected Species Visual Observers (PSVO) would watch for marine mammals before and during the proposed airgun operations. When stationed on the observation platform, the PSVO's eye level would be approximately 21.5 m (71 ft) above sea level providing the PSVO an unobstructed view around the entire vessel. More details of the *Langseth* can be found in the IHA application and the ''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'' (2011) and the Record of Decision (2012) (NSF/USGS PEIS).

Acoustic Source Specifications

Seismic Airguns

The *Langseth* would deploy a 36-airgun array, consisting of two 18 airgun (plus 2 spares) sub-arrays. Each sub-array would have a volume of approximately 3,300 cubic inches (in^3) for a total volume of 6,600 in^3 for the 36-airgun array. The airgun array would consist of a mixture of Bolt 1500LL and Bolt 1900LLX airguns ranging in size from 40 to 360 in^3, with a firing pressure of 1,900 pounds per square inch (psi). The 18 airgun sub-arrays would be configured as two identical linear arrays or ''strings'' (see Figure 2.11 of the NSF/USGS PEIS). Each string would have 10 airguns, with the first and last airguns in the strings spaced 16 m (52.5 ft) apart. Of the 10 airguns, nine airguns in each string would be fired simultaneously (1,650 in^3), whereas the tenth would be kept in reserve as a spare, to be turned on in case of failure of another airgun. The sub-arrays would be fired simultaneously during the survey. The two airgun sub-arrays would be distributed across an area of approximately 12 x 16 m (40 x 52.5 ft) behind the *Langseth* and would be towed approximately 140 m (459.3 ft) behind the vessel. Discharge intervals depend on both the ship's speed. The shot interval would be 50 m (164 ft) during the study. The shot interval would be approximately 20 to 24 seconds (s) based on an assumed boat speed of 4.5 knots. During firing, a brief (approximately 0.1 s) pulse sound is emitted; the airguns would be silent during the intervening periods. The dominant frequency components range from 2 to 188 Hertz (Hz). The firing pressure of the airgun array is 2,000 pounds per square inch (psi).

The tow depth of the airgun array would be 9 m (29.5 ft) during the surveys. Because the actual source is a distributed sound source (36 airguns) rather than a single point source, the highest sound measurable at any location in the water would be less than the nominal source level. In addition, the effective source level for sound propagating in near-horizontal directions would be substantially lower than the nominal omni-directional source level applicable to downward propagation because of the directional nature of the sound from the airgun array (i.e., sound is directed downward).

Hydrophone Streamer

Acoustic signals would be recorded using a system array of one hydrophone streamer, which would be towed behind the *Langseth*. The streamer is Thompson-Marconi SENTRY solid cable construction and is approximately 8 km long. Cable-leveling birds would be used to keep the streamer cable and hydrophone at a constant depth. Cable-leveling birds would be spaced every 300 m (984.3 ft) with extra redundancy at the head and tail sections.

Metrics Used in This Document

This section includes a brief explanation of the sound measurements frequently used in the discussions of acoustic effects in this document. Sound pressure is the sound force per unit area, and is usually measured in micropascals (μPa), where 1 pascal (Pa) is the pressure resulting from a force of one newton exerted over an area of one square meter. Sound pressure level (SPL) is expressed as the ratio of a measured sound pressure and a reference level. The commonly used reference pressure level in underwater acoustics is 1 μPa, and the units for SPLs are dB re 1 μPa. SPL (in decibels [dB]) = 20 log (pressure/reference pressure).

SPL is an instantaneous measurement and can be expressed as the peak, the peak-to-peak (p-p), or the root mean square (rms). Root mean square (rms), which is the square root of the arithmetic average of the squared instantaneous pressure values, is typically used in discussions of the effects of sounds on vertebrates and all references to SPL in this document refer to the root mean square unless otherwise noted.

Characteristics of the Airgun Pulses

Airguns function by venting high-pressure air into the water, which creates an air bubble. The pressure signature of an individual airgun consists of a sharp rise and then fall in pressure, followed by several positive and negative pressure excursions caused by the oscillation of the resulting air bubble. The oscillation of the air bubble transmits sounds downward through the seafloor and the amount of sound transmitted in the near horizontal directions is reduced. However, the airgun array also emits sounds that travel horizontally toward non-target areas.

The nominal source levels of the airgun arrays used by L–DEO on the *Langseth* are 236 to 265 dB re 1 μPa (p-p) and the rms value for a given airgun pulse is typically 16 dB re 1 μPa lower than the peak-to-peak value (Greene, 1997; McCauley *et al.,* 1998, 2000a). However, the difference between rms and peak or peak-to-peak values for a given pulse depends on the frequency content and duration of the pulse, among other factors.

Accordingly, L–DEO has predicted the received sound levels in relation to distance and direction from the 36 airgun array and the single Bolt 1900LL 40 in^3 airgun, which would be used during power-downs. A detailed description of L–DEO modeling for this survey's marine seismic source arrays for protected species mitigation is provided in the NSF/USGS PEIS (see Appendix H). NMFS refers the reviewers to the IHA application and NSF/USGS PEIS documents for additional information.

Predicted Sound Levels for the Airguns

Tolstoy *et al.* (2009) and Diebold *et al.* (2010) reported results for propagation measurements of pulses from the *Langseth's* 36 airgun, 6,600 in³ array in shallow water (approximately 50 m [164 ft]), intermediate water (a slope site), and deep water depths (approximately 1,600 m [5,249 ft]) in the Gulf of Mexico in 2007 and 2008. Results of the Gulf of Mexico calibration study (Tolstoy *et al.,* 2009; Diebold *et al.,* 2010) showed that radii around the airguns for various received levels varied with water depth and that sound propagation varied with array tow depth.

The L–DEO used the results from the Gulf of Mexico study to determine the algorithm for its model that calculates the mitigation exclusion zones for the 36-airgun array and the single airgun. L–DEO has used these calculated values to determine buffer (i.e., 160 dB) and exclusion zones for the 36 airgun array and previously modeled measurements by L–DEO for the single airgun, to designate exclusion zones for purposes of mitigation, and to estimate take for marine mammals in the northwest Atlantic Ocean. A detailed description of the modeling effort is provided in the NSF/USGS PEIS.

Comparison of the Tolstoy *et al.* (2009) calibration study with the L–DEO's model for the *Langseth's* 36-airgun array indicates that the model represents the actual received levels, within the first few kilometers and the locations of the predicted exclusion zones. However, the model for deep water (greater than 1,000 m; 3,280 ft) overestimated the received sound levels at a given distance but is still valid for defining exclusion zones at various tow depths. Because the tow depth of the array in the calibration study is less shallow (6 m [19.7 ft]) than the tow depths in the proposed survey (9 m [29.5 ft]), L–DEO used the following correction factors for estimating the received levels during the proposed surveys (see Table 1). The correction factors are the ratios of the 160, 180, and 190 dB distances from the modeled results for the 6,600 in³ airgun arrays towed at 6 m (19.7 ft) versus 9, 12, or 15 m (29.5, 39.4, or 49.2 ft) (LGL, 2008). For a single airgun, the tow depth has minimal effect on the maximum near-field output and the shape of the frequency spectrum for the single airgun; thus, the predicted exclusion zones are essentially the same at different tow depths. The L–DEO's model does not allow for bottom interactions, and thus is most directly applicable to deep water.

Using the model (airgun array and single airgun), Table 1 (below) shows the distances at which three rms sound levels are expected to be received from the 36 airgun array and a single airgun. To avoid the potential for injury or permanent physiological damage (Level A harassment), NMFS's (1995, 2000) current practice is that cetaceans and pinnipeds should not be exposed to pulsed underwater noise at received levels exceeding 180 dB re 1 μPa and 190 dB re 1 μPa, respectively. L–DEO used these levels to establish the proposed exclusion zones. If marine mammals are detected within or about to enter the appropriate exclusion zone, the airguns would be powered-down (or shut-down, if necessary) immediately. NMFS also assumes that marine mammals exposed to levels exceeding 160 dB re 1 μPa may experience Level B harassment. Table 1 summarizes the predicted distances at which sound levels (160, 180, and 190 dB [rms]) are expected to be received from the 36 airgun array and a single airgun operating in deep water depths.

TABLE 1—MEASURED (ARRAY) OR PREDICTED (SINGLE AIRGUN) DISTANCES TO WHICH SOUND LEVELS ≥190, 180, AND 160 dB RE 1 μPA (RMS) COULD BE RECEIVED IN DEEP WATER DURING THE PROPOSED SEISMIC SURVEY IN THE NORTHWEST ATLANTIC OCEAN OFF THE EASTERN SEABOARD, AUGUST TO SEPTEMBER 2014 AND APRIL TO AUGUST 2015

Sound source and volume	Tow depth (m)	Water depth (m)	Predicted RMS radii distances (m)		
			190 dB	180 dB	160 dB
Single Bolt airgun (40 in³)	9	>1,000	13 m (42.7 ft) *100 m would be used for pinnipeds as well as cetaceans.	100 m (328.1 ft)	388 m (1,273 ft).
36 airguns (6,600 in³)	9	>1,000	286 m (938.3 ft)	927 m (3,041.3 ft)	5,780 m (18,963.3 ft).

Along with the airgun operations, two additional acoustical data acquisition systems would be operated from the *Langseth* continuously during seismic operations during the survey. The ocean floor would be mapped with the Kongsberg EM 122 multi-beam echosounder and a Knudsen 320B sub-bottom profiler. These sound sources would be operated continuously from the *Langseth* throughout the cruise, except for during transits at the beginning and end of the proposed survey.

Multi-Beam Echosounder

The *Langseth* would operate a Kongsberg EM 122 multi-beam echosounder concurrently during airgun operations to map characteristics of the ocean floor. The hull-mounted multi-beam echosounder emits brief pulses of sound (also called a ping) (10.5 to 13, usually 12 kHz) in a fan-shaped beam that extends downward and to the sides of the ship. The transmitting beamwidth is 1° or 2° fore-aft and 150° athwartship and the maximum source level is 242 dB re 1 μPa.

Each ping consists of eight (in water greater than 1,000 m) or four (less than 1,000 m) successive, fan-shaped transmissions, each ensonifying a sector that extends 1° fore-aft. Continuous-wave pulses increase from 2 to 15 milliseconds (ms) long in water depths up to 2,600 m (8,350.2 ft), and frequency modulated (FM) chirp pulses up to 100 ms long are used in water greater than 2,600 m. The successive transmissions span an overall cross-track angular extent of about 150°, with 2 ms gaps between the pulses for successive sectors (see Table 1 of the IHA application).

Sub-Bottom Profiler

The *Langseth* would also operate a Knudsen Chirp 3260 sub-bottom profiler continuously throughout the cruise simultaneously with the multi-beam echosounder to map and provide information about the sedimentary features and bottom topography. The beam is transmitted as a 27° cone, which is directed downward by a 3.5 kHz transducer in the hull of the *Langseth.* The nominal power output is 10 kilowatts (kW), but the actual maximum radiated power is 3 kW or 222 dB re 1 μPam. The ping duration is up to 64 milliseconds (ms). The ping interval is three to five seconds, depending on water depth. The sub-bottom profiler is capable of reaching water depths of 10,000 m (32,808.4 ft) and penetrating tens of meters into the sediments.

Both the multi-beam echosounder and sub-bottom profiler are operated continuously during survey operations. The multi-beam echosounder and sub-bottom profiler would not operate during transits at the beginning and end of the proposed seismic survey. Actual operating parameters would be established at the time of the survey.

NMFS expects that acoustic stimuli resulting from the proposed operation of the single airgun or the 36 airgun array has the potential to harass marine mammals. NMFS does not expect that the movement of the *Langseth,* during the conduct of the seismic survey, has the potential to harass marine mammals because of the relatively slow operation speed of the vessel (approximately 4.5 knots [kts]; 8.5 km/hr; 5.3 mph) during seismic acquisition.

Description of the Marine Mammals in the Area of the Proposed Specified Activity

Forty-five species of marine mammal (37 cetaceans [whales, dolphins, and porpoises] including 30 odontocetes and 7 mysticetes, 7 pinnipeds [seals and sea lions], and 1 sirenian [manatees]) are known to occur in the western North Atlantic Ocean study area (Read *et al.,* 2009; Waring *et al.,* 2013). Of those 45 species of marine mammals, 34 cetaceans and 4 pinnipeds could be found or are likely to occur in the proposed study area during the spring/summer/fall months. Several of these species are listed as endangered under the U.S. Endangered Species Act of 1973 (ESA; 16 U.S.C. 1531 *et seq.*), including the North Atlantic right (*Eubalaena glacialis*), humpback (*Megaptera novaeangliae*), sei (*Balaenoptera borealis*), fin (*Balaenoptera physalus*), blue (*Balaenoptera musculus*), and sperm (*Physeter macrocephalus*) whales. Fourteen cetacean species, although present in the wider western North Atlantic Ocean, are considered rare and likely would not be found near the proposed study area. The harbor porpoise (*Phocoena phocoena*) does not occur in deep offshore waters. The four pinniped species (harbor [*Phoca vitulina*], harp [*Phoca groenlandica*], gray [*Halichoerus grypus*], and hooded [*Cystophora cristata*] seals) are also considered coastal species (any sightings would be considered extralimital) and are not known to occur in the deep waters of the proposed survey area. No pinnipeds are expected to be present in the proposed study area. The West Indian manatee (*Trichechus manatus latirostris*) is listed as endangered under the ESA and is managed by the U.S. Fish and Wildlife Service and is not considered further in this proposed IHA notice.

General information on the taxonomy, ecology, distribution, seasonality and movements, and acoustic capabilities of marine mammals are given in sections 3.6.1, 3.7.1, and 3.8.1 of the NSF/USGS PEIS. The general distribution of mysticetes, odontocetes, and pinnipeds in the North Atlantic Ocean is discussed in sections 3.6.3.4, 3.7.3.4, and 3.8.3.4 of the NSF/USGS PEIS, respectively. In addition, Section 3.1 of the ''Atlantic OCS Proposed Geological and Geophysical Activities Mid-Atlantic and South Atlantic Planning Areas Draft Programmatic Environmental Impact Statement'' (Bureau of Ocean Energy Management, 2012) reviews similar information for all marine mammals that may occur within the proposed study area.

Various systematic surveys have been conducted throughout the western North Atlantic Ocean, including within sections of the proposed study area. Records from the Ocean Biogeographic Information System (OBIS) database hosted by Rutgers University and Duke University (Read *et al.,* 2009) were used as the main source of information. The database includes survey data collected during the Cetaceans and Turtle Assessment Program (CeTAP) conducted between 1978 and 1982 that consists of both aerial and vessel-based surveys between Cape Hatteras, North Carolina, and the Gulf of Maine. The database also includes survey data collected during the NMFS Northeast Fisheries Science Center and Southeast Fisheries Science Center stock assessment surveys conducted in 2004 (surveys between Nova Scotia, Canada, and Florida).

No known current regional or stock abundance estimates are available in the proposed study area of the northwest Atlantic Ocean for the Bryde's whale (*Balaenoptera edeni*), Fraser's (*Lagenodelphis hosei*), spinner (*Stenella longirostris*), and Clymene dolphin (*Stenella clymene*), and melon-headed (*Peponocephala electra*), pygmy killer (*Feresa attenuata*), false killer (*Pseudorca crassidens*), and killer whales (*Orcinus orca*). Although NMFS does not have current regional population or stock abundance estimates for these species in the northwest Atlantic Ocean, abundance estimates from other areas such as the northern Gulf of Mexico stock, regional ocean basins (e.g., eastern tropical Pacific Ocean), or global summation are available. These abundance estimates are considered the best available information.

Bryde's whales are distributed worldwide in tropical and sub-tropical waters. In the western North Atlantic Ocean, Bryde's whales are reported from off the southeastern U.S. and the southern West Indies to Cabo Frio, Brazil (Leatherwood and Reeves, 1983). No stock of Bryde's whales has been identified in U.S. waters of the Atlantic coast. The northern Gulf of Mexico population is considered a separate stock and has a best abundance estimate of 33 animals. It has been postulated that the Bryde's whales found in the northern Gulf of Mexico may represent a resident stock (Schmidly, 1981; Leatherwood and Reeves, 1983).

Fraser's dolphins are distributed worldwide in tropical waters and are assumed to be part of the cetacean fauna of the tropical western North Atlantic (Perrin *et al.,* 1994). There are no abundance estimates for either the western North Atlantic or the northern Gulf of Mexico stocks. The western North Atlantic population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock. The numbers of Fraser's dolphins off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock, since it was rarely seen in any surveys. The population size for Fraser's dolphins is unknown; however, about 289,000 animals occur in the eastern tropical Pacific Ocean (Jefferson *et al.,* 2008).

Spinner dolphins are distributed in oceanic and coastal tropical waters (Leatherwood *et al.,* 1976). This is presumably an offshore, deep-water species, and its distribution in the Atlantic is poorly known (Schmidly, 1981; Perrin and Gilpatrick, 1994). The western North Atlantic population of spinner dolphins is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock. The numbers of spinner dolphins off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock since it was rarely seen in any of the surveys. The best abundance estimate available for the northern Gulf of Mexico spinner dolphins is 11,441 animals.

The Clymene dolphin is endemic to tropical and sub-tropical waters of the Atlantic (Jefferson and Curry, 2003). The western North Atlantic population of Clymene dolphins is provisionally considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock. The numbers of Clymene dolphins off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this species since it was rarely seen in any surveys. The best abundance estimate for the Clymene dolphin in the western North Atlantic was 6,086 in 2003 and represents the first and only estimate to date for this species in the U.S. Atlantic EEZ; however this estimate is older than eight years and is deemed unreliable (Wade and Angliss, 1997; Mullin and Fulling, 2003).

The melon-headed whale is distributed worldwide in tropical to sub-tropical waters (Jefferson *et al.,* 1994). The western North Atlantic population is provisionally being considered a separate stock from the northern Gulf of Mexico stock. The numbers of melon-headed whales off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock, since it was rarely seen in any surveys. The best abundance estimate available for northern Gulf of Mexico melon-headed whales is 2,235 animals.

The pygmy killer whale is distributed worldwide in tropical to sub-tropical waters and is assumed to be part of the cetacean fauna of the tropical western North Atlantic (Jefferson *et al.,* 1994). The western North Atlantic population of pygmy killer whales is provisionally being considered one stock for management purposes. The numbers of pygmy killer whales off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock, since it was rarely seen in any surveys. The best abundance estimate available for the northern Gulf of Mexico pygmy killer whale is 152 animals.

The false killer whale is distributed worldwide throughout warm temperate and tropical oceans (Leatherwood and Reeves, 1983). No stock has been identified for false killer whales in U.S. waters off the Atlantic coast. The Gulf of Mexico population is provisionally being considered one stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock. The current population size for the false killer whale in the northern Gulf of Mexico is unknown because the survey data is more than 8 years old; however, the most recent abundance estimate pooled from 2003 to 2004 was 777 animals (Wade and Angliss, 1997; Mullin, 2007).

Killer whales are characterized as uncommon or rare in waters of the U.S. Atlantic EEZ (Katona *et al.,* 1988). Their distribution, however, extends from the Arctic ice-edge to the West Indies, often in offshore and mid-ocean areas. The size of the western North Atlantic stock population off the eastern U.S. coast is unknown. No information on stock differentiation for the Atlantic Ocean population exists, although an analysis of vocalizations of killer whales from Iceland and Norway indicated that whales from these areas may represent different stocks (Moore *et al.,* 1988). The northern Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock. The best abundance estimate available for northern Gulf of Mexico killer whales is 28 animals. There are estimated to be at least approximately 92,500 killer whales worldwide (i.e., 80,000 south of Antarctic Convergence, 445 in Norway, 8,500 in eastern tropical Pacific Ocean, 1,500 in North America coastal waters, and 2,000 in Japanese waters) (Jefferson *et al.,* 2008).Table 2 (below) presents information on the abundance, distribution, population status, and conservation status of the species of marine mammals that may occur in the proposed study area during August to September 2014 and April to August 2015.

TABLE 2—THE HABITAT, OCCURRENCE, RANGE, ABUNDANCE, AND CONSERVATION STATUS OF MARINE MAMMALS THAT MAY OCCUR IN OR NEAR THE PROPOSED SEISMIC SURVEY AREA IN THE NORTHWEST ATLANTIC OCEAN OFF THE EASTERN SEABOARD

[See text and Table 3 in USGS's IHA application for further details]

Species	Habitat	Occurrence	Range in Atlantic Ocean	Population estimate in the North Atlantic region/stock/other [3]	ESA [1]	MMPA [2]
Mysticetes:						
North Atlantic right whale (*Eubalaena glacialis*).	Pelagic, shelf and coastal	Regular	Canada to Florida	455/455 (Western Atlantic stock).	EN	D
Humpback whale (*Megaptera novaeangliae*).	Mainly nearshore, banks	Regular	Canada to Caribbean	11,600 [4]/823 (Gulf of Maine stock).	EN	D
Minke whale (*Balaenoptera acutorostrata*).	Pelagic and coastal	Regular	Arctic to Caribbean	138,000 [5]/20,741 (Canadian East Coast stock).	NL	NC
Bryde's whale (*Balaenoptera edeni*).	Coastal, offshore	Rare	40° North to 40° South	NA/NA/33 (Northern Gulf of Mexico stock)/20,000 to 30,000 [16] (North Pacific Ocean).	NL	NC
Sei whale (*Balaenoptera borealis*).	Primarily offshore, pelagic	Rare	Canada to New Jersey	10,300 [6]/357 (Nova Scotia stock).	EN	D

TABLE 2—THE HABITAT, OCCURRENCE, RANGE, ABUNDANCE, AND CONSERVATION STATUS OF MARINE MAMMALS THAT MAY OCCUR IN OR NEAR THE PROPOSED SEISMIC SURVEY AREA IN THE NORTHWEST ATLANTIC OCEAN OFF THE EASTERN SEABOARD—Continued

[See text and Table 3 in USGS's IHA application for further details]

Species	Habitat	Occurrence	Range in Atlantic Ocean	Population estimate in the North Atlantic region/ stock/other [3]	ESA [1]	MMPA [2]
Fin whale (*Balaenoptera physalus*).	Continental slope, pelagic	Regular	Canada to North Carolina	26,500 [7]/3,522 (Western North Atlantic stock).	EN	D
Blue whale (*Balaenoptera musculus*).	Pelagic, shelf, coastal	Rare	Arctic to Florida	855 [8]/440 (Western North Atlantic stock).	EN	D
Odontocetes:						
Sperm whale (*Physeter macrocephalus*).	Pelagic, slope, canyons, deep sea.	Regular	Canada to Caribbean	13,190 [9]/2,288 (North Atlantic stocks).	EN	D
Pygmy sperm whale (*Kogia breviceps*).	Deep waters off shelf	Rare	Massachusetts to Florida	NA/3,785 (Western North Atlantic stock).	NL	NC
Dwarf sperm whale (*Kogia sima*).	Deep waters off shelf	Rare	Massachusetts to Florida	....	NL	NC
Cuvier's beaked whale (*Ziphius cavirostris*).	Pelagic, slope, canyons	Rare	Canada to Caribbean	NA/6,532 (Western North Atlantic stock).	NL	NC
Northern bottlenose whale (*Hyperoodon ampullatus*).	Pelagic	Rare	Arctic to New Jersey	40,000 [10]/NA (Western North Atlantic stock).	NL	NC
True's beaked whale (*Mesoplodon mirus*).	Pelagic, slope, canyons	Rare	Canada to Bahamas	NA/7,092 (Western North Atlantic stock).	NL	NC
Gervais' beaked whale (*Mesoplodon europaeus*).	Pelagic, slope, canyons	Rare	Canada to Florida	....	NL	NC
Sowerby's beaked whale (*Mesoplodon bidens*).	Pelagic, slope, canyons	Rare	Canada to Florida	....	NL	NC
Blainville's beaked whale (*Mesoplodon densirostris*).	Pelagic, slope, canyons	Rare	Canada to Florida	....	NL	NC
Bottlenose dolphin (*Tursiops truncatus*).	Coastal, oceanic, shelf break.	Regular	Canada to Florida	NA/77,532 (Western North Atlantic Offshore stock).	NL	NC
Atlantic white-sided dolphin (*Lagenorhynchus acutus*).	Shelf and slope	Regular	Greenland to North Carolina.	10,000 to 100,000s [11]/ 48,819 (Western North Atlantic stock).	NL	NC
Fraser's dolphin (*Lagenodelphis hosei*).	Shelf and slope	Rare	North Carolina to Florida	NA/NA (Western North Atlantic stock)/ 289,000 [16] (eastern tropical Pacific Ocean).	NL	NC
Atlantic spotted dolphin (*Stenella frontalis*).	Shelf, offshore	Regular	Massachusetts to Caribbean.	NA/44,715 (Western North Atlantic stock).	NL	NC
Pantropical spotted dolphin (*Stenella attenuata*).	Coastal, shelf, slope	Regular	Massachusetts to Florida	NA/3,333 (Western North Atlantic stock).	NL	NC
Striped dolphin (*Stenella coeruleoalba*).	Off continental shelf, convergence zones, upwelling.	Regular	Canada to Caribbean	NA/54,807 (Western North Atlantic stock).	NL	NC
Spinner dolphin (*Stenella longirostris*).	Mainly nearshore	Rare	Maine to Caribbean	NA/NA (Western North Atlantic stock)/11,441 (Northern Gulf of Mexico stock)/1,250,000 [16] (eastern tropical Pacific Ocean).	NL	NC
Clymene dolphin (*Stenella clymene*).	Coastal, shelf, slope	Rare	North Carolina to Florida	NA/NA (Western North Atlantic stock—6,086 in 2003)/129 (Northern Gulf of Mexico stock).	NL	NC
Short-beaked common dolphin (*Delphinus delphis*).	Shelf, pelagic, seamounts	Regular	Canada to Georgia	NA/173,486 (Western North Atlantic stock).	NL	NC

TABLE 2—THE HABITAT, OCCURRENCE, RANGE, ABUNDANCE, AND CONSERVATION STATUS OF MARINE MAMMALS THAT MAY OCCUR IN OR NEAR THE PROPOSED SEISMIC SURVEY AREA IN THE NORTHWEST ATLANTIC OCEAN OFF THE EASTERN SEABOARD—Continued

[See text and Table 3 in USGS's IHA application for further details]

Species	Habitat	Occurrence	Range in Atlantic Ocean	Population estimate in the North Atlantic region/stock/other[3]	ESA[1]	MMPA[2]
Rough-toothed dolphin (*Steno bredanensis*).	Pelagic	Rare	New Jersey to Florida	NA/271 (Western North Atlantic stock).	NL	NC
Risso's dolphin (*Grampus griseus*).	Shelf, slope, seamounts	Regular	Canada to Florida	NA/18,250 (Western North Atlantic stock).	NL	NC
Melon-headed whale (*Peponocephala electra*).	Deep waters off shelf	Rare	North Carolina to Florida	NA/NA (Western North Atlantic stock)/2,235 (Northern Gulf of Mexico stock)/45,000[16] (eastern tropical Pacific Ocean).	NL	NC
Pygmy killer whale (*Feresa attenuata*).	Pelagic	Rare	NA	NA/NA (Western North Atlantic stock)/152 (Northern Gulf of Mexico stock)/39,000[16] (eastern tropical Pacific Ocean).	NL	NC
False killer whale (*Pseudorca crassidens*).	Pelagic	Rare	NA	NA/NA/777 in 2003–2004 (Northern Gulf of Mexico stock).	NL	NC
Killer whale (*Orcinus orca*).	Pelagic, shelf, coastal	Rare	Arctic to Caribbean	NA/NA (Western North Atlantic stock)/28 (Northern Gulf of Mexico stock)/At least ~92,500[16] Worldwide.	NL	NC
Short-finned pilot whale (*Globicephala macrorhynchus*).	Mostly pelagic, high relief	Regular	Massachusetts to Florida	780,000[12]/21,515 short-finned pilot whale 26,535 long-finned pilot whale (Western North Atlantic stock).	NL	NC
Long-finned pilot whale (*Globicephala melas*).	Mostly pelagic	Regular	Canada to South Carolina	NL	NC	
Harbor porpoise (*Phocoena phocoena*).	Shelf, coastal, pelagic	Rare	Canada to North Carolina	~500,000[13]/79,883 (Gulf of Maine/Bay of Fundy stock).	NL	NC
Pinnipeds:						
Harbor seal (*Phoca vitulina concolor*).	Coastal	Rare	Canada to North Carolina	NA/70,142 (Western North Atlantic stock).	NL	NC
Gray seal (*Halichoerus grypus*).	Coastal, pelagic	Rare	Canada to North Carolina	NA/331,000 (Western North Atlantic stock).	NL	NC
Harp seal (*Phoca groenlandica*).	Ice whelpers, pelagic	Rare	Canada to New Jersey	8.6 to 9.6 million[14]/7.1 million (Western North Atlantic stock).	NL	NC
Hooded seal (*Cystophora cristata*).	Ice whelpers, pelagic	Rare	Canada to Caribbean	600,000/592,100 (Western North Atlantic stock).	NL	NC

NA = Not available or not assessed.
[1] U.S. Endangered Species Act: EN = Endangered, T = Threatened, DL = Delisted, NL = Not listed.
[2] U.S. Marine Mammal Protection Act: D = Depleted, NC = Not Classified.
[3] NMFS Marine Mammal Stock Assessment Reports.
[4] Best estimate for western North Atlantic 1992 to 1993 (IWC, 2014).
[5] Best estimate for North Atlantic 2002 to 2007 (IWC, 2014).
[6] Estimate for the Northeast Atlantic in 1989 (Cattanach *et al.,* 1993).
[7] Best estimate for North Atlantic 2007 (IWC, 2014) .
[8] Central and Northeast Atlantic 2001 (Pike *et al.,* 2009).
[9] North Atlantic (Whitehead, 2002).
[10] Eastern North Atlantic (NAMMCO, 1995).
[11] North Atlantic (Reeves et al., 1999).
[12] *Globicephala* spp. combined, Central and Eastern North Atlantic (IWC, 2014).
[13] North Atlantic (Jefferson *et al.,* 2008).
[14] Northwest Atlantic (DFO, 2012).
[15] Northwest Atlantic (Andersen et al., 2009).
[16] Jefferson *et al.* (2008).

Further detailed information regarding the biology, distribution, seasonality, life history, and occurrence of these marine mammal species in the proposed project area can be found in sections 3 and 4 of USGS's IHA application. NMFS has reviewed these data and determined them to be the best available scientific information for the purposes of the proposed IHA.

Potential Effects of the Specified Activity on Marine Mammals

This section includes a summary and discussion of the ways that the types of stressors associated with the specified activity (e.g., seismic airgun operation, vessel movement, gear deployment) have been observed to impact marine mammals. This discussion may also include reactions that we consider to rise to the level of a take and those that we do not consider to rise to the level of take (for example, with acoustics), we may include a discussion of studies that showed animals not reacting at all to sound or exhibiting barely measureable avoidance). This section is intended as a background of potential effects and does not consider either the specific manner in which this activity would be carried out or the mitigation that would be implemented, and how either of those would shape the anticipated impacts from this specific activity. The ''Estimated Take by Incidental Harassment'' section later in this document will include a quantitative analysis of the number of individuals that are expected to be taken by this activity. The ''Negligible Impact Analysis'' section will include the analysis of how this specific activity would impact marine mammals and will consider the content of this section, the ''Estimated Take by Incidental Harassment'' section, the ''Proposed Mitigation'' section, and the ''Anticipated Effects on Marine Mammal Habitat'' section to draw conclusions regarding the likely impacts of this activity on the reproductive success or survivorship of individuals and from that on the affected marine mammal populations or stocks.

When considering the influence of various kinds of sound on the marine environment, it is necessary to understand that different kinds of marine life are sensitive to different frequencies of sound. Based on available behavioral data, audiograms have been derived using auditory evoked potentials, anatomical modeling, and other data, Southall *et al.* (2007) designate ''functional hearing groups'' for marine mammals and estimate the lower and upper frequencies of functional hearing groups'' for marine mammals and estimate the lower and upper frequencies of functional hearing of the groups. The functional groups and the associated frequencies are indicated below (though animals are less sensitive to sounds at the outer edge of their functional range and most sensitive to sounds of frequencies within a smaller range somewhere in the middle of their functional hearing range):

- Low-frequency cetaceans (13 species of mysticetes): Functional hearing is estimated to occur between approximately 7 Hz and 30 kHz;
- Mid-frequency cetaceans (32 species of dolphins, six species of larger toothed whales, and 19 species of beaked and bottlenose whales): Functional hearing is estimated to occur between approximately 150 Hz and 160 kHz;
- High-frequency cetaceans (eight species of true porpoises, six species of river dolphins, *Kogia* spp., the franciscana [*Pontoporia blainvillei*], and four species of cephalorhynchids): Functional hearing is estimated to occur between approximately 200 Hz and 180 kHz; and
- Phocid pinnipeds in water: Functional hearing is estimated to occur between approximately 75 Hz and 100 kHz;
- Otariid pinnipeds in water: Functional hearing is estimated to occur between approximately 100 Hz and 40 kHz.

As mentioned previously in this document, 38 marine mammal species (34 cetacean and 4 pinniped species) are likely to occur in the proposed seismic survey area. Of the 34 cetacean species likely to occur in USGS's proposed action area, 7 are classified as low-frequency cetaceans (i.e., North Atlantic right, humpback, minke, Bryde's, sei, fin, and blue whale), 24 are classified as mid-frequency cetaceans (i.e., sperm, Cuvier's, True's, Gervais', Sowerby's, Blainville's, Northern bottlenose, melon-headed, pygmy killer, false killer, killer, short-finned, and long-finned whale, bottlenose, Atlantic white-sided, Fraser's, Atlantic spotted, pantropical spotted, striped, spinner, Clymene, short-beaked common, rough-toothed, and Risso's dolphin), and 3 are classified as high-frequency cetaceans (i.e., pygmy sperm and dwarf sperm whale and harbor porpoise) (Southall *et al.,* 2007). A species' functional hearing group is a consideration when we analyze the effects of exposure to sound on marine mammals.

Acoustic stimuli generated by the operation of the airguns, which introduce sound into the marine environment, may have the potential to cause Level B harassment of marine mammals in the proposed survey area. The effects of sounds from airgun operations might include one or more of the following: Tolerance, masking (of natural sounds including inter- and intra-specific calls), behavioral disturbance, 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; Wright *et al.,* 2007; Tyack, 2009). Permanent hearing impairment, in the unlikely event that it occurred, would constitute injury, but temporary threshold shift (TTS) is not an injury (Southall *et al.,* 2007). Although the possibility cannot be entirely excluded, it is unlikely that the proposed project would result in any cases of temporary or permanent hearing impairment, or any significant non-auditory physical or physiological effects. Based on the available data and studies described here, some behavioral disturbance is expected. A more comprehensive review of these issues can be found in the NSF/USGS PEIS (2011) and L–DEO's ''Draft Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Atlantic Ocean off Cape Hatteras, September to October 2014.''

Tolerance

Richardson *et al.* (1995) defines tolerance as the occurrence of marine mammals in areas where they are exposed to human activities or man-made noise. In many cases, tolerance develops by the animal habituating to the stimulus (i.e., the gradual waning of responses to a repeated or ongoing stimulus) (Thorpe, 1963; Richardson, *et al.,* 1995), but because of ecological or physiological requirements, many marine animals may need to remain in areas where they are exposed to chronic stimuli (Richardson, *et al.,* 1995).

Numerous studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers. Several studies have shown that marine mammals at distances more than a few kilometers from operating seismic vessels often show no apparent response (Malme *et al.,* 1985; Richardson *et al.,* 1986; Ljungblad *et al.,* 1988; McCauley *et al.,* 2000a). 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 the marine mammal group. Although various baleen and toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to airgun pulses under some conditions, at other times marine mammals of all three types have shown no overt reactions. The relative responsiveness of baleen and toothed whales and pinnipeds are quite variable and depend on factors such as species, age, and previous exposures of the animal to human-generated sound.

Masking

The term masking refers to the inability of a subject to recognize the occurrence of an acoustic stimulus as a result of the interference of another acoustic stimulus (Clark *et al.,* 2009). Introduced underwater sound may, through masking, reduce the effective communication distance of a marine mammal species if the frequency of the source is close to that used as a signal by the marine mammal, and if the anthropogenic sound is present for a significant fraction of the time (Richardson *et al.,* 1995).

Masking effects of pulsed sounds (even from large arrays of airguns) on marine mammal calls and other natural sounds are expected to be limited. Because of the intermittent nature and low duty cycle of seismic airgun pulses, animals can emit and receive sounds in the relatively quiet intervals between pulses. However, in some situations, reverberation occurs for much or the entire interval between pulses (e.g., Simard *et al.,* 2005; Clark and Gagnon, 2006) which could mask calls. Some baleen and toothed whales are known to continue calling in the presence of seismic pulses, and their calls can usually be heard between the seismic pulses (e.g., Richardson *et al.,* 1986; McDonald *et al.,* 1995; Greene *et al.,* 1999; Nieukirk *et al.,* 2004; Smultea *et al.,* 2004; Holst *et al.,* 2005a,b, 2006; and Dunn and Hernandez, 2009). However, Clark and Gagnon (2006) reported that fin whales in the North Atlantic Ocean went silent for an extended period starting soon after the onset of a seismic survey in the area. Similarly, there has been one report that sperm whales ceased calling when exposed to pulses from a very distant seismic ship (Bowles *et al.,* 1994). However, more recent studies found that they continued calling in the presence of seismic pulses (Madsen *et al.,* 2002; Tyack *et al.,* 2003; Smultea *et al.,* 2004; Holst *et al.,* 2006; and Jochens *et al.,* 2008). Dilorio and Clark (2009) found evidence of increased calling by blue whales during operations by a lower-energy seismic source (i.e., sparker). Dolphins and porpoises commonly are heard calling while airguns are operating (e.g., Gordon *et al.,* 2004; Smultea *et al.,* 2004; Holst *et al.,* 2005a, b; and Potter *et al.,* 2007). 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.

Marine mammals are thought to be able to compensate for masking by adjusting their acoustic behavior through shifting call frequencies, increasing call volume, and increasing vocalization rates. For example, blue whales are found to increase call rates when exposed to noise from seismic surveys in the St. Lawrence Estuary (Dilorio and Clark, 2009). The 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). In general, NMFS expects the masking effects of seismic pulses to be minor, given the normally intermittent nature of seismic pulses.

Behavioral Disturbance

Marine mammals may behaviorally react to sound when exposed to anthropogenic noise. Disturbance includes a variety of effects, including (but not limited to) subtle to conspicuous changes in behavior, movement, and displacement (Nowacek *et al.,* 2007; Tyack, 2009). 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). 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/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 the water from haul-outs or rookeries). 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. 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).

The biological significance of many of these behavioral disturbances is difficult to predict, especially if the detected disturbances appear minor. However, the consequences of behavioral modification could be expected to be biologically significant if the change affects growth, survival, and/or reproduction. Some of these significant behavioral modifications include:

- Change in diving/surfacing patterns (such as those thought to be causing beaked whale stranding due to exposure to military mid-frequency tactical sonar);
- Habitat abandonment due to loss of desirable acoustic environment; and
- Cessation of feeding or social interaction.

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). 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 mammals would be present within a particular distance of industrial activities and/or exposed to a particular level of sound. In most cases, this approach likely overestimates the numbers of marine mammals that would be affected in some biologically-important manner.

Baleen Whales—Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable (reviewed in Richardson *et al.,* 1995; Gordon *et al.,* 2004). 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 (*Eschrichtius robustus*) and bowhead (*Balaena mysticetus*) whales, the observed changes in behavior appeared to be of little or no biological consequence to the animals (Richardson, *et al.,* 1995). 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).

Studies of gray, bowhead, and humpback whales have shown that seismic pulses with received levels of 160 to 170 dB re 1 μPa (rms) seem to cause obvious avoidance behavior in a substantial fraction of the animals exposed (Malme *et al.,* 1986, 1988; Richardson *et al.,* 1995). In many areas, seismic pulses from large arrays of airguns diminish to those levels at distances ranging from 4 to 15 km (2.2 to 8.1 nmi) from the source. A substantial proportion of the baleen whales within those distances may show avoidance or other strong behavioral reactions to the airgun array. Subtle behavioral changes sometimes become evident at somewhat lower received levels, and studies have shown that some species of baleen whales, notably bowhead, gray, and humpback whales, at times, show strong avoidance at received levels lower than 160 to 170 dB re 1 μPa (rms).

Researchers have studied the responses of humpback whales to seismic surveys during migration, feeding during the summer months, breeding while offshore from Angola, and wintering offshore from Brazil. McCauley *et al.* (1998, 2000a) studied the responses of humpback whales off western Australia to a full-scale seismic survey with a 16-airgun array (2,678 in^3) and to a single airgun (20 in^3) with source level of 227 dB re 1 μPa (p-p). In the 1998 study, they documented that avoidance reactions began at 5 to 8 km (2.7 to 4.3 nmi) from the array, and that those reactions kept most pods approximately 3 to 4 km (1.6 to 2.2 nmi) from the operating seismic boat. In the 2000 study, they noted localized displacement during migration of 4 to 5 km (2.2 to 2.7 nmi) by traveling pods and 7 to 12 km (3.8 to 6.5 nmi) by more sensitive resting pods of cow-calf pairs. Avoidance distances with respect to the single airgun were smaller but consistent with the results from the full array in terms of the received sound levels. The mean received level for initial avoidance of an approaching airgun was 140 dB re 1 μPa (rms) for humpback pods containing females, and at the mean closest point of approach distance from the received level was 143 dB re 1 μPa (rms). The initial avoidance response generally occurred at distances of 5 to 8 km (2.7 to 4.3 nmi) from the airgun array and 2 km (1.1 nmi) from the single airgun. However, some individual humpback whales, especially males, approached within distances of 100 to 400 m (328 to 1,312 ft), where the maximum received level was 179 dB re 1 μPa (rms) (McCauley *et al.,* 1998, 2000b).

Data collected by observers during several seismic surveys in the Northwest Atlantic showed that sighting rates of humpback whales were significantly greater during non-seismic periods compared with periods when a full array was operating (Moulton and Holst, 2010). In addition, 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).

Humpback whales on their summer feeding grounds in southeast Alaska did not exhibit persistent avoidance when exposed to seismic pulses from a 1.64–L (100 in^3) airgun (Malme *et al.,* 1985). Some humpbacks seemed ''startled'' at received levels of 150 to 169 dB re 1 μPa. Malme *et al.* (1985) concluded that there was no clear evidence of avoidance, despite the possibility of subtle effects, at received levels up to 172 dB re 1 μPa (rms). However, Moulton and Holst (2010) reported that humpback whales monitored during seismic surveys in the Northwest Atlantic had lower sighting rates and were most often seen swimming away from the vessel during seismic periods compared with periods when airguns were silent.

Studies have suggested that South Atlantic humpback whales in the South Atlantic Ocean wintering off Brazil may be displaced or even strand upon exposure to seismic surveys (Engel *et al.,* 2004). The evidence for this was circumstantial and subject to alternative explanations (IAGC, 2004). Also, the evidence was not consistent with subsequent results from the same area of Brazil (Parente *et al.,* 2006), or with direct studies of humpbacks exposed to seismic surveys in other areas and seasons. After allowance for data from subsequent years, there was ''no observable direct correlation'' between strandings and seismic surveys (IWC, 2007: 236).

Reactions of migrating and feeding (but not wintering) gray whales to seismic surveys have been studied. Malme *et al.* (1986, 1988) studied the responses of feeding Eastern North Pacific gray whales to pulses from a single 100 in^3 airgun off St. Lawrence Island in the northern Bering Sea. They estimated, based on small sample sizes, that 50 percent 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 percent of feeding whales interrupted feeding at received levels of 163 dB re 1 μPa (rms). 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 North Pacific gray whales feeding off Sakhalin Island, Russia (Wursig *et al.,* 1999; Gailey *et al.,* 2007; Johnson *et al.,* 2007; Yazvenko *et al.,* 2007a, b), along with data on gray whales off British Columbia (Bain and Williams, 2006).

Various species of *Balaenoptera* (blue, sei, fin, and minke whales) have occasionally been seen in areas ensonified by airgun pulses (Stone, 2003; MacLean and Haley, 2004; Stone and Tasker, 2006), and calls from blue and fin whales have been localized in areas with airgun operations (e.g., McDonald *et al.,* 1995; Dunn and Hernandez, 2009; Castellote *et al.,* 2010). Sightings by observers on seismic vessels off the United Kingdom 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 (Stone, 2003; Stone and Tasker, 2006). However, these whales tended to exhibit localized avoidance, remaining significantly further (on average) from the airgun array during seismic operations compared with non-seismic periods (Stone and Tasker, 2006). Castellote *et al.* (2010) reported that singing fin whales in the Mediterranean moved away from an operating airgun array.

Ship-based monitoring studies of baleen whales (including blue, fin, sei, minke, and humpback whales) in the Northwest Atlantic found that overall, this group had lower sighting rates during seismic vs. non-seismic periods (Moulton and Holst, 2010). Baleen whales as a group were also seen significantly farther from the vessel during seismic compared with non-seismic periods, and they were more often seen to be swimming away from the operating seismic vessel (Moulton and Holst, 2010). Blue and minke whales were initially sighted significantly farther from the vessel during seismic operations compared to non-seismic periods; the same trend was observed for fin whales (Moulton and Holst, 2010). Minke whales were most often observed to be swimming away from the vessel when seismic operations were underway (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 (Appendix A in

Malme *et al.,* 1984; Richardson *et al.,* 1995; Allen and Angliss, 2010). The Western North Pacific gray whale population did not seem affected by a seismic survey in its feeding ground during a previous year (Johnson *et al.,* 2007). Similarly, 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 (Richardson *et al.,* 1987; Allen and Angliss, 2010). The history of coexistence between seismic surveys and baleen whales suggests that brief exposures to sound pulses from any single seismic survey are unlikely to result in prolonged effects.

Toothed Whales—There is little systematic information available about reactions of toothed whales to noise pulses. Few studies similar to the more extensive baleen whale/seismic pulse work summarized above have been reported for toothed whales. However, there are recent systematic studies on sperm whales (e.g., Gordon *et al.,* 2006; Madsen *et al.,* 2006; Winsor and Mate, 2006; Jochens *et al.,* 2008; Miller *et al.,* 2009). There is an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies (e.g., Stone, 2003; Smultea *et al.,* 2004; Moulton and Miller, 2005; Bain and Williams, 2006; Holst *et al.,* 2006; Stone and Tasker, 2006; Potter *et al.,* 2007; Hauser *et al.,* 2008; Holst and Smultea, 2008; Weir, 2008; Barkaszi *et al.,* 2009; Richardson *et al.,* 2009; Moulton and Holst, 2010).

Seismic operators and Protected Species Observers (PSOs) 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., Goold, 1996a,b,c; Calambokidis and Osmek, 1998; Stone, 2003; Moulton and Miller, 2005; Holst *et al.,* 2006; Stone and Tasker, 2006; Weir, 2008; Richardson *et al.,* 2009; Barkaszi *et al.,* 2009; Moulton and Holst, 2010). Some dolphins seem to be attracted to the seismic vessel and floats, and some ride the bow wave of the seismic vessel even when large arrays of airguns are firing (e.g., Moulton and Miller, 2005). Nonetheless, small toothed whales more often tend to head away, or to maintain a somewhat greater distance from the vessel, when a large array of airguns is operating than when it is silent (e.g., Stone and Tasker, 2006; Weir, 2008; Barry *et al.,* 2010; Moulton and Holst, 2010). In most cases, the avoidance radii for delphinids appear to be small, on the order of one km (0.5 nmi) or less, and some individuals show no apparent avoidance. Based on observations from seismic surveys off the United Kingdom, small odontocetes exhibited greater avoidance to operating airguns than previously reported (Stone *et al.,* 2003; Gordon *et al.,* 2004; Stone and Tasker, 2006). The observer data also indicated that small odontocetes were feeding less and were interacting with the vessel less during active seismic surveys. Captive bottlenose dolphins and beluga whales (*Delphinapterus leucas*) exhibited changes in behavior when exposed to strong pulsed sounds similar in duration to those typically used in seismic surveys (Finneran *et al.,* 2000, 2002, 2005). However, the animals tolerated high, received levels of sound before exhibiting aversive behaviors.

Results of reactions to seismic operations for porpoises depend on species. The limited available data suggest that harbor porpoises show stronger avoidance of seismic operations than do Dall's porpoises (*Phocoenoides dalli*) (Stone, 2003; MacLean and Koski, 2005; Bain and Williams, 2006; Stone and Tasker, 2006). Dall's porpoises seem relatively tolerant of airgun operations (MacLean and Koski, 2005; Bain and Williams, 2006), although they too have been observed to avoid large arrays of operating airguns (Calambokidis and Osmek, 1998; Bain and Williams, 2006). This apparent difference in responsiveness of these two porpoise species is consistent with their relative responsiveness to boat traffic and some other acoustic sources (Richardson *et al.,* 1995; Southall *et al.,* 2007).

Most studies of sperm whales exposed to airgun sounds indicate that the sperm whale shows considerable tolerance of airgun pulses (e.g., Stone, 2003; Moulton *et al.,* 2005, 2006a; Stone and Tasker, 2006; Weir, 2008). In most cases the whales do not show strong avoidance, and they continue to call. However, controlled exposure experiments in the Gulf of Mexico indicate that foraging behavior was altered upon exposure to airgun sound (Jochens *et al.,* 2008; Miller *et al.,* 2009; Tyack, 2009).

There are almost no specific data on the behavioral reactions of beaked whales to seismic surveys. 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 (Gosselin and Lawson, 2004; Laurinolli and Cochrane, 2005; Simard *et al.,* 2005). Most beaked whales are illusive and tend to avoid approaching vessels of other types (e.g., Wursig *et al.,* 1998). They may also dive for an extended period when approached by a vessel (e.g., Kasuya, 1986), although it is uncertain how much longer such dives may be as compared to dives by undisturbed beaked whales, which also are often quite long (Baird *et al.,* 2006; Tyack *et al.,* 2006). Based on a single observation, Aguilar-Soto *et al.* (2006) suggested that foraging efficiency of Cuvier's beaked whales may be reduced by close approach of vessels. 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 definitively. In fact, Moulton and Holst (2010) reported 15 sightings of beaked whales during seismic studies in the Northwest Atlantic; seven of those sightings were made at times when at least one airgun was operating. There was little evidence to indicate that beaked whale behavior was affected by airgun operations; sighting rates and distances were similar during seismic and non-seismic periods (Moulton and Holst, 2010).

There are indications that some beaked whales may strand when naval exercises involving mid-frequency sonar operation are ongoing nearby (e.g., Simmonds and Lopez-Jurado, 1991; Frantzis, 1998; NOAA and USN, 2001; Jepson *et al.,* 2003; Hildebrand, 2005; Barlow and Gisiner, 2006; see also the ''Stranding and Mortality'' section in this notice). These strandings are apparently a disturbance response, although auditory or other injuries or other physiological effects may also be involved. Whether beaked whales would ever react similarly to seismic surveys is unknown. Seismic survey sounds are quite different from those of the sonar in operation during the above-cited incidents.

Odontocete reactions to large arrays of airguns are variable and, at least for delphinids and Dall's porpoises, seem to be confined to a smaller radius than has been observed for the more responsive of some mysticetes. However, other data suggest that some odontocete species, including harbor porpoises, may be more responsive than might be expected given their poor low-frequency hearing. Reactions at longer distances may be particularly likely when sound propagation conditions are conducive to transmission of the higher frequency components of airgun sound to the animals' location (DeRuiter *et al.,* 2006; Goold and Coates, 2006; Tyack *et al.,* 2006; Potter *et al.,* 2007).

Pinnipeds—Information on the reaction of pinniped species to pulsed seismic airgun sounds is limited. Based on early observations, pinnipeds appear to be quite tolerant of pulsed sounds. Other reports indicate that pinnipeds were tolerant of loud, pulsed sounds when they were strongly attracted to an area for feeding or reproductive purposes (Mate and Harvey, 1987; Reeves *et al.,* 1996). In most recent studies, avoidance of pinnipeds during seismic surveys has been reported as being relatively small, within 100 to few hundred meters. Many seals remained within 100 to 200 m (328.1 to 656.2 ft) of the survey tracklines while an operating seismic survey passed (Harris *et al.,* 2001; Moulton and Lawson, 2002). Other observations made during seismic surveys in the Chukchi and Beaufort Seas reported that pinnipeds (i.e., ringed seals [*Phoca hispida*]) were observed less when seismic airguns were operating than when they were silent (Miller *et al.,* 2005). In Puget Sound, sighting distances for harbor seals and California sea lions (Zalophus californianus) tended to be larger when airguns were operating (Calambokidis and Osmek, 1998). Previous telemetry work suggests that avoidance and other behavioral reactions may be stronger than evident to date from visual studies (Thompson *et al.,* 1998). Overall, behavioral reactions from pinnipeds to pulsed seismic sounds are variable. It is expected that localized avoidance of operating seismic airguns may occur; however, it cannot be guaranteed that these species would fully avoid an operating seismic vessel during active surveys.

Hearing Impairment and Other Physical Effects

Exposure to high intensity sound for a sufficient duration may result in auditory effects such as a noise-induced threshold shift—an increase in the auditory threshold after exposure to noise (Finneran, Carder, Schlundt, and Ridgway, 2005). Factors that influence the amount of threshold shift include the amplitude, duration, frequency content, temporal pattern, and energy distribution of noise exposure. The magnitude of hearing threshold shift normally decreases over time following cessation of the noise exposure. The amount of threshold shift just after exposure is called the initial threshold shift. If the threshold shift eventually returns to zero (i.e., the threshold returns to the pre-exposure value), it is called temporary threshold shift (TTS) (Southall *et al.,* 2007).

Researchers have studied TTS in certain captive odontocetes and pinnipeds exposed to strong sounds (reviewed in Southall *et al.,* 2007). However, there has been no specific documentation of TTS let alone permanent hearing damage, i.e., permanent threshold shift (PTS), in free-ranging marine mammals exposed to sequences of airgun pulses during realistic field conditions.

Temporary Threshold Shift—TTS is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter, 1985). While experiencing TTS, the hearing threshold rises and a sound must be stronger in order to be heard. At least in terrestrial mammals, TTS can last from minutes or hours to (in cases of strong TTS) days. For sound exposures at or somewhat above the TTS threshold, hearing sensitivity in both terrestrial and marine mammals recovers rapidly after exposure to the noise ends. Few data on sound levels and durations necessary to elicit mild TTS have been obtained for marine mammals, and none of the published data concern TTS elicited by exposure to multiple pulses of sound. Available data on TTS in marine mammals are summarized in Southall *et al.* (2007). Table 1 (above) presents the estimated distances from the *Langseth's* airguns at which the received energy level (per pulse, flat-weighted) would be expected to be greater than or equal to 180 or 190 dB re 1 μPa (rms).

To avoid the potential for injury (i.e., Level A harassment), NMFS (1995, 2000) concluded that cetaceans and pinnipeds should not be exposed to pulsed underwater noise at received levels exceeding 180 and 190 dB re 1 μPa (rms), respectively. The established 180 and 190 dB (rms) criteria are not considered to be the levels above which TTS might occur. Rather, they are the received levels above which, in the view of a panel of bioacoustics specialists convened by NMFS before TTS measurements for marine mammals started to become available, one could not be certain that there would be no injurious effects, auditory or otherwise, to marine mammals. NMFS also assumes that cetaceans and pinnipeds exposed to levels exceeding 160 dB re 1 μPa (rms) may experience Level B harassment.

For toothed whales, researchers have derived TTS information for odontocetes from studies on the bottlenose dolphin and beluga. The experiments show that exposure to a single impulse at a received level of 207 kPa (or 30 psi, p-p), which is equivalent to 228 dB re 1 Pa (p-p), resulted in a 7 and 6 dB TTS in the beluga whale at 0.4 and 30 kHz, respectively. Thresholds returned to within 2 dB of the pre-exposure level within 4 minutes of the exposure (Finneran *et al.,* 2002). For the one harbor porpoise tested, the received level of airgun sound that elicited onset of TTS was lower (Lucke *et al.,* 2009). If these results from a single animal are representative, it is inappropriate to assume that onset of TTS occurs at similar received levels in all odontocetes (*cf.* Southall *et al.,* 2007). Some cetaceans apparently can incur TTS at considerably lower sound exposures than are necessary to elicit TTS in the beluga or bottlenose dolphin.

For baleen whales, there are no data, direct or indirect, on levels or properties of sound that are required to induce TTS. The frequencies to which baleen whales are most sensitive are assumed to be lower than those to which odontocetes are most sensitive, and natural background noise levels at those low frequencies tend to be higher. As a result, auditory thresholds of baleen whales within their frequency band of best hearing are believed to be higher (less sensitive) than are those of odontocetes at their best frequencies (Clark and Ellison, 2004). From this, it is suspected that received levels causing TTS onset may also be higher in baleen whales than those of odontocetes (Southall *et al.,* 2007).

Permanent Threshold Shift—When PTS occurs, there is physical damage to the sound receptors in the ear. In severe cases, there can be total or partial deafness, whereas in other cases, the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter, 1985). 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 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.,* 2008). 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.

Relationships between TTS and PTS thresholds have not been studied in marine mammals, but are assumed to be similar to those in humans and other terrestrial mammals (Southall *et al.,* 2007). PTS might occur at a received sound level at least several dBs above that inducing mild TTS if the animal were exposed to strong sound pulses with rapid rise times. Based on data from terrestrial mammals, a precautionary assumption is that the PTS threshold for impulse sounds (such as airgun pulses as received close to the source) is at least 6 dB higher than the

TTS threshold on a peak-pressure basis, and probably greater than 6 dB (Southall *et al.,* 2007).

Given the higher level of sound necessary to cause PTS as compared with TTS, it is considerably less likely that PTS would occur. Baleen whales generally avoid the immediate area around operating seismic vessels, as do some other marine mammals. Some pinnipeds show avoidance reactions to airguns, but their avoidance reactions are generally not as strong or consistent as those of cetaceans, and occasionally they seem to be attracted to operating seismic vessels (NMFS, 2010).

Non-auditory Physiological Effects—Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to strong underwater sound include stress, neurological effects, bubble formation, resonance, and other types of organ or tissue damage (Cox *et al.,* 2006; Southall *et al.,* 2007). Studies examining such effects are limited. However, resonance effects (Gentry, 2002) and direct noise-induced bubble formations (Crum *et al.,* 2005) are implausible in the case of exposure to an impulsive broadband source like an airgun array. If seismic surveys disrupt diving patterns of deep-diving species, this might perhaps result in bubble formation and a form of the bends, as speculated to occur in beaked whales exposed to sonar. However, there is no specific evidence of this upon exposure to airgun pulses.

In general, very little is known about the potential for seismic survey sounds (or other types of strong underwater sounds) to cause non-auditory physical effects in marine mammals. Such effects, if they occur at all, would presumably be limited to short distances and to activities that extend over a prolonged period. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall *et al.,* 2007), or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. 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.

Stranding and Mortality—When a living or dead marine mammal swims or floats onto shore and becomes ‘‘beached’’ or incapable of returning to sea, the event is termed a ‘‘stranding’’ (Geraci *et al.,* 1999; Perrin and Geraci, 2002; Geraci and Lounsbury, 2005; NMFS, 2007). The legal definition for a stranding under the MMPA is that ‘‘(A) a marine mammal is dead and is (i) on a beach or shore of the United States; or (ii) in waters under the jurisdiction of the United States (including any navigable waters); or (B) a marine mammal is alive and is (i) on a beach or shore of the United States and is unable to return to the water; (ii) on a beach or shore of the United States and, although able to return to the water is in need of apparent medical attention; or (iii) in the waters under the jurisdiction of the United States (including any navigable waters), but is unable to return to its natural habitat under its own power or without assistance.’’

Marine mammals are known to strand for a variety of reasons, such as infectious agents, biotoxicosis, starvation, fishery interaction, ship strike, unusual oceanographic or weather events, sound exposure, or combinations of these stressors sustained concurrently or in series. However, the cause or causes of most strandings are unknown (Geraci *et al.,* 1976; Eaton, 1979; Odell *et al.,* 1980; Best, 1982). Numerous studies suggest that the physiology, behavior, habitat relationships, age, or condition of cetaceans may cause them to strand or might pre-dispose them to strand when exposed to another phenomenon. These suggestions are consistent with the conclusions of numerous other studies that have demonstrated that combinations of dissimilar stressors commonly combine to kill an animal or dramatically reduce its fitness, even though one exposure without the other does not produce the same result (Chroussos, 2000; Creel, 2005; DeVries *et al.,* 2003; Fair and Becker, 2000; Foley *et al.,* 2001; Moberg, 2000; Relyea, 2005a, 2005b; Romero, 2004; Sih *et al.,* 2004).

Strandings Associated with Military Active Sonar—Several sources have published lists of mass stranding events of cetaceans in an attempt to identify relationships between those stranding events and military active sonar (Hildebrand, 2004; IWC, 2005; Taylor et al., 2004). For example, based on a review of stranding records between 1960 and 1995, the International Whaling Commission (2005) identified ten mass stranding events and concluded that, out of eight stranding events reported from the mid-1980s to the summer of 2003, seven had been coincident with the use of mid-frequency active sonar and most involved beaked whales.

Over the past 12 years, there have been five stranding events coincident with military mid-frequency active sonar use in which exposure to sonar is believed to have been a contributing factor to strandings: Greece (1996); the Bahamas (2000); Madeira (2000); Canary Islands (2002); and Spain (2006). Refer to Cox *et al.* (2006) for a summary of common features shared by the strandings events in Greece (1996), Bahamas (2000), Madeira (2000), and Canary Islands (2002); and Fernandez *et al.,* (2005) for an additional summary of the Canary Islands 2002 stranding event. USGS would not be using military sonars; therefore, NMFS does not expect these potential effects to marine mammals.

Potential for Stranding from Seismic Surveys—Marine mammals close to underwater detonations of high explosives can be killed or severely injured, and the auditory organs are especially susceptible to injury (Ketten *et al.,* 1993; Ketten, 1995). However, explosives are no longer used in marine waters for commercial seismic surveys or (with rare exceptions) for seismic research. These methods have been replaced entirely by airguns or related non-explosive pulse generators. Airgun pulses are less energetic and have slower rise times, and there is no specific evidence that they can cause serious injury, death, or stranding even in the case of large airgun arrays. However, the association of strandings of beaked whales with naval exercises involving mid-frequency active sonar (non-pulse sound) and, in one case, the co-occurrence of an L–DEO seismic survey (Malakoff, 2002; Cox *et al.,* 2006), has raised the possibility that beaked whales exposed to strong ‘‘pulsed’’ sounds could also be susceptible to injury and/or behavioral reactions that can lead to stranding (e.g., Hildebrand, 2005; Southall *et al.,* 2007).

Specific sound-related processes that lead to strandings and mortality are not well documented, but may include:

(1) Swimming in avoidance of a sound into shallow water;

(2) A change in behavior (such as a change in diving behavior) that might contribute to tissue damage, gas bubble formation, hypoxia, cardiac arrhythmia, hypertensive hemorrhage or other forms of trauma;

(3) A physiological change such as a vestibular response leading to a behavioral change or stress-induced hemorrhagic diathesis, leading in turn to tissue damage; and

(4) Tissue damage directly from sound exposure, such as through acoustically-mediated bubble formation and growth or acoustic resonance of tissues.

Some of these mechanisms are unlikely to apply in the case of impulse sounds. However, there are indications that gas-bubble disease (analogous to ''the bends''), induced in supersaturated tissue by a behavioral response to acoustic exposure, could be a pathologic mechanism for the strandings and mortality of some deep-diving cetaceans exposed to sonar. The evidence for this remains circumstantial and associated with exposure to naval mid-frequency sonar, not seismic surveys (Cox *et al.,* 2006; Southall *et al.,* 2007).

Seismic pulses and mid-frequency sonar signals are quite different, and some mechanisms by which sonar sounds have been hypothesized to affect beaked whales are unlikely to apply to airgun pulses. Sounds produced by airgun arrays are broadband impulses with most of the energy below one kHz. Typical military mid-frequency sonar emits non-impulse sounds at frequencies of 2 to 10 kHz, generally with a relatively narrow bandwidth at any one time. A further difference between seismic surveys and naval exercises is that naval exercises can involve sound sources on more than one vessel. Thus, it is not appropriate to expect that the same effects to marine mammals would result from military sonar and seismic surveys. However, evidence that sonar signals can, in special circumstances, lead (at least indirectly) to physical damage and mortality (e.g., Balcomb and Claridge, 2001; NOAA and USN, 2001; Jepson *et al.,* 2003; Fernández *et al.,* 2004, 2005; Hildebrand 2005; Cox *et al.,* 2006) suggests that caution is warranted when dealing with exposure of marine mammals to any high-intensity sound.

There is no conclusive evidence of cetacean strandings or deaths at sea as a result of exposure to seismic surveys, but 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. 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, there was a stranding of two Cuvier's beaked whales in the Gulf of California, Mexico, when the L–DEO vessel R/V *Maurice Ewing* was operating a 20 airgun (8,490 in^3) array in the general area. The link between the stranding and the seismic surveys was inconclusive and not based on any physical evidence (Hogarth, 2002; Yoder, 2002). Nonetheless, the Gulf of California incident plus the beaked whale strandings near naval exercises involving use of mid-frequency sonar suggests a need for caution in conducting seismic surveys in areas occupied by beaked whales until more is known about effects of seismic surveys on those species (Hildebrand, 2005). No injuries of beaked whales are anticipated during the proposed study because of:

(1) The high likelihood that any beaked whales nearby would avoid the approaching vessel before being exposed to high sound levels, and

(2) Differences between the sound sources operated by L–DEO and those involved in the naval exercises associated with strandings.

Potential Effects of Other Acoustic Devices

Multi-Beam Echosounder

USGS would operate the Kongsberg EM 122 multi-beam echosounder from the source vessel during the planned study. Sounds from the multi-beam echosounder are very short pulses, occurring for 2 to 15 ms once every 5 to 20 s, depending on water depth. Most of the energy in the sound pulses emitted by this multi-beam echosounder is at frequencies near 12 kHz, and the maximum source level is 242 dB re 1 μPa (rms). The beam is narrow (1 to 2°) in fore-aft extent and wide (150°) in the cross-track extent. Each ping consists of eight (in water greater than 1,000 m deep) or four (in water less than 1,000 m deep) successive fan-shaped transmissions (segments) at different cross-track angles. Any given mammal at depth near the trackline would be in the main beam for only one or two of the nine segments. Also, marine mammals that encounter the Kongsberg EM 122 are unlikely to be subjected to repeated pulses because of the narrow fore–aft width of the beam and would receive only limited amounts of pulse energy because of the short pulses. Animals close to the ship (where the beam is narrowest) are especially unlikely to be ensonified for more than one 2 to 15 ms pulse (or two pulses if in the overlap area). Similarly, Kremser *et al.* (2005) noted that the probability of a cetacean swimming through the area of exposure when a multi-beam echosounder emits a pulse is small. The animal would have to pass the transducer at close range and be swimming at speeds similar to the vessel in order to receive the multiple pulses that might result in sufficient exposure to cause TTS.

Navy sonars that have been linked to avoidance reactions and stranding of cetaceans: (1) Generally have longer pulse duration than the Kongsberg EM 122; and (2) are often directed close to horizontally versus more downward for the multi-beam echosounder. The area of possible influence of the multi-beam echosounder is much smaller—a narrow band below the source vessel. Also, the duration of exposure for a given marine mammal can be much longer for naval sonar. During USGS's operations, the individual pulses would be very short, and a given mammal would not receive many of the downward-directed pulses as the vessel passes by. Possible effects of a multi-beam echosounder on marine mammals are described below.

Stranding—In 2013, an International Scientific Review Panel 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 multi-beam 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 has 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 to 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).

Masking—Marine mammal communications would not be masked appreciably by the multi-beam echosounder signals given the low duty cycle of the multi-beam echosounder and the brief period when an individual mammal is likely to be within its beam. Furthermore, in the case of baleen whales, the multi-beam echosounder signals (12 kHz) do not overlap with the predominant frequencies in the calls, which would avoid any significant masking.

Behavioral Responses—Behavioral reactions of free-ranging marine mammals to sonars, echosounders, and other sound sources appear to vary by species and circumstance. Observed reactions have included silencing and dispersal by sperm whales (Watkins *et al.,* 1985), increased vocalizations and no dispersal by pilot whales (Rendell and Gordon, 1999), and the previously-mentioned beachings by beaked whales. During exposure to a 21 to 25 kHz ''whale-finding'' sonar with a source level of 215 dB re 1 µPa, gray whales reacted by orienting slightly away from the source and being deflected from their course by approximately 200 m (656.2 ft) (Frankel, 2005). When a 38 kHz echosounder and a 150 kHz acoustic Doppler current profiler were transmitting during studies in the eastern tropical Pacific, baleen whales showed no significant responses, while spotted and spinner dolphins were detected slightly more often and beaked whales less often during visual surveys (Gerrodette and Pettis, 2005).

Captive bottlenose dolphins and a beluga whale exhibited changes in behavior when exposed to 1 s tonal signals at frequencies similar to those that would be emitted by the multi-beam echosounder used by USGS, and to shorter broadband pulsed signals. Behavioral changes typically involved what appeared to be deliberate attempts to avoid the sound exposure (Schlundt *et al.,* 2000; Finneran *et al.,* 2002; Finneran and Schlundt, 2004). The relevance of those data to free-ranging odontocetes is uncertain, and in any case, the test sounds were quite different in duration as compared with those from a multi-beam echosounder.

Hearing Impairment and Other Physical Effects—Given recent stranding events that have been associated with the operation of naval sonar, there is concern that mid-frequency sonar sounds can cause serious impacts to marine mammals (see above). However, the multi-beam echosounder proposed for use by USGS is quite different than sonar used for Navy operations. Pulse duration of the multi-beam echosounder is very short relative to the naval sonar. Also, at any given location, an individual marine mammal would be in the beam of the multi-beam echosounder for much less time given the generally downward orientation of the beam and its narrow fore-aft beamwidth; Navy sonar often uses near-horizontally-directed sound. Those factors would all reduce the sound energy received from the multi-beam echosounder rather drastically relative to that from naval sonar. NMFS believes that the brief exposure of marine mammals to one pulse, or small numbers of signals, from the multi-beam echosounder is not likely to result in the harassment of marine mammals.

Sub-Bottom Profiler

USGS would also operate a sub-bottom profiler from the source vessel during the proposed survey. Sounds from the sub-bottom profiler are very short pulses, occurring for 1 to 4 ms once every few (3 to 6) seconds. Most of the energy in the sound pulses emitted by the sub-bottom profiler is at 3.5 kHz, and the beam is directed downward. The sub-bottom profiler on the *Langseth* has a maximum source level of 204 dB re 1 µPa. Kremser *et al.* (2005) noted that the probability of a cetacean swimming through the area of exposure when a bottom profiler emits a pulse is small—even for a sub-bottom profiler more powerful than that on the *Langseth.* If the animal was in the area, it would have to pass the transducer at close range in order to be subjected to sound levels that could cause TTS.

Masking—Marine mammal communications would not be masked appreciably by the sub-bottom profiler signals given the directionality of the signal and the brief period when an individual mammal is likely to be within its beam. Furthermore, in the case of most baleen whales, the sub-bottom profiler signals do not overlap with the predominant frequencies in the calls, which would avoid significant masking.

Behavioral Responses—Marine mammal behavioral reactions to other pulsed sound sources are discussed above, and responses to the sub-bottom profiler are likely to be similar to those for other pulsed sources if received at the same levels. However, the pulsed signals from the sub-bottom profiler are considerably weaker than those from the multi-beam echosounder. Therefore, behavioral responses are not expected unless marine mammals are very close to the source.

Hearing Impairment and Other Physical Effects—It is unlikely that the sub-bottom profiler produces pulse levels strong enough to cause hearing impairment or other physical injuries even in an animal that is (briefly) in a position near the source. The sub-bottom profiler is usually operated simultaneously with other higher-power acoustic sources, including airguns. Many marine mammals would move away in response to the approaching higher-power sources or the vessel itself before the mammals would be close enough for there to be any possibility of effects from the less intense sounds from the sub-bottom profiler.

Potential Effects of Vessel Movement and Collisions

Vessel movement in the vicinity of marine mammals has the potential to result in either a behavioral response or a direct physical interaction. Both scenarios are discussed below in this section.

Behavioral Responses to Vessel Movement—There are limited data concerning marine mammal behavioral responses to vessel traffic and vessel noise, and a lack of consensus among scientists with respect to what these responses mean or whether they result in short-term or long-term adverse effects. In those cases where there is a busy shipping lane or where there is a large amount of vessel traffic, marine mammals (especially low frequency specialists) may experience acoustic masking (Hildebrand, 2005) if they are present in the area (e.g., killer whales in Puget Sound; Foote *et al.,* 2004; Holt *et al.,* 2008). In cases where vessels actively approach marine mammals (e.g., whale watching or dolphin watching boats), scientists have documented that animals exhibit altered behavior such as increased swimming speed, erratic movement, and active avoidance behavior (Bursk, 1983; Acevedo, 1991; Baker and MacGibbon, 1991; Trites and Bain, 2000; Williams *et al.,* 2002; Constantine *et al.,* 2003), reduced blow interval (Ritcher *et al.,* 2003), disruption of normal social behaviors (Lusseau, 2003, 2006), and the shift of behavioral activities which may increase energetic costs (Constantine *et al.*, 2003, 2004). A detailed review of marine mammal reactions to ships and boats is available in Richardson *et al.,* (1995). For each of the marine mammal taxonomy groups, Richardson *et al.,* (1995) provides the following assessment regarding reactions to vessel traffic:

Toothed whales—''In summary, toothed whales sometimes show no avoidance reaction to vessels, or even approach them. However, avoidance can occur, especially in response to vessels of types used to chase or hunt the animals. This may cause temporary displacement, but we know of no clear evidence that toothed whales have abandoned significant parts of their range because of vessel traffic.''

Baleen whales—''When baleen whales receive low-level sounds from distant or stationary vessels, the sounds often seem to be ignored. Some whales approach the sources of these sounds. When vessels approach whales slowly and non-aggressively, whales often exhibit slow and inconspicuous avoidance maneuvers. In response to strong or rapidly changing vessel noise, baleen whales often interrupt their normal behavior and swim rapidly away. Avoidance is especially strong when a boat heads directly toward the whale.''

Behavioral responses to stimuli are complex and influenced to varying degrees by a number of factors, such as species, behavioral contexts, geographical regions, source characteristics (moving or stationary, speed, direction, etc.), prior experience of the animal and physical status of the animal. For example, studies have shown that beluga whales' reaction varied when exposed to vessel noise and traffic. In some cases, beluga whales exhibited rapid swimming from ice-breaking vessels up to 80 km (43.2 nmi) away, and showed changes in surfacing, breathing, diving, and group composition in the Canadian high Arctic where vessel traffic is rare (Finley *et al.,* 1990). In other cases, beluga whales were more tolerant of vessels, but responded differentially to certain vessels and operating characteristics by reducing their calling rates (especially older animals) in the St. Lawrence River where vessel traffic is common (Blane and Jaakson, 1994). In Bristol Bay, Alaska, beluga whales continued to feed when surrounded by fishing vessels and resisted dispersal even when purposefully harassed (Fish and Vania, 1971).

In reviewing more than 25 years of whale observation data, Watkins (1986) concluded that whale reactions to vessel traffic were ''modified by their previous experience and current activity: Habituation often occurred rapidly, attention to other stimuli or preoccupation with other activities sometimes overcame their interest or wariness of stimuli.'' Watkins noticed that over the years of exposure to ships in the Cape Cod area, minke whales changed from frequent positive interest (e.g., approaching vessels) to generally uninterested reactions; fin whales changed from mostly negative (e.g., avoidance) to uninterested reactions; fin whales changed from mostly negative (e.g., avoidance) to uninterested reactions; right whales apparently continued the same variety of responses (negative, uninterested, and positive responses) with little change; and humpbacks dramatically changed from mixed responses that were often negative to reactions that were often strongly positive. Watkins (1986) summarized that ''whales near shore, even in regions with low vessel traffic, generally have become less wary of boats and their noises, and they have appeared to be less easily disturbed than previously. In particular locations with intense shipping and repeated approaches by boats (such as the whale-watching areas of Stellwagen Bank), more and more whales had positive reactions to familiar vessels, and they also occasionally approached other boats and yachts in the same ways.''

Although the radiated sound from the *Langseth* would be audible to marine mammals over a large distance, it is unlikely that marine mammals would respond behaviorally (in a manner that NMFS would consider harassment under the MMPA) to low-level distant shipping noise as the animals in the area are likely to be habituated to such noises (Nowacek *et al.,* 2004). In light of these facts, NMFS does not expect the *Langseth's* movements to result in Level B harassment.

Vessel Strike—Ship strikes of cetaceans can cause major wounds, which may lead to the death of the animal. An animal at the surface could be struck directly by a vessel, a surfacing animal could hit the bottom of a vessel, or an animal just below the surface could be cut by a vessel's propeller. The severity of injuries typically depends on the size and speed of the vessel (Knowlton and Kraus, 2001; Laist *et al.,* 2001; Vanderlaan and Taggart, 2007).

The most vulnerable marine mammals are those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (e.g., the sperm whale). In addition, some baleen whales, such as the North Atlantic right whale, seem generally unresponsive to vessel sound, making them more susceptible to vessel collisions (Nowacek *et al.,* 2004). These species are primarily large, slow moving whales. Smaller marine mammals (e.g., bottlenose dolphin) move quickly through the water column and are often seen riding the bow wave of large ships. Marine mammal responses to vessels may include avoidance and changes in dive pattern (NRC, 2003).

An examination of all known ship strikes from all shipping sources (civilian and military) indicates vessel speed is a principal factor in whether a vessel strike results in death (Knowlton and Kraus, 2001; Laist *et al.,* 2001; Jensen and Silber, 2003; Vanderlaan and Taggart, 2007). In assessing records in which vessel speed was known, Laist *et al.* (2001) found a direct relationship between the occurrence of a whale strike and the speed of the vessel involved in the collision. The authors concluded that most deaths occurred when a vessel was traveling in excess of 13 kts (24.1 km/hr, 14.9 mph).

USGS's proposed operation of one source vessel for the proposed survey is relatively small in scale compared to the number of commercial ships transiting at higher speeds in the same area on an annual basis. The probability of vessel and marine mammal interactions occurring during the proposed survey is unlikely due to the *Langseth's* slow operational speed, which is typically 4.5 kts (8.5 km/hr, 5.3 mph). Outside of seismic operations, the *Langseth's* cruising speed would be approximately 10 kts (18.5 km/hr, 11.5 mph), which is generally below the speed at which studies have noted reported increases of marine mammal injury or death (Laist *et al.,* 2001).

As a final point, the *Langseth* has a number of other advantages for avoiding ship strikes as compared to most commercial merchant vessels, including the following: The *Langseth's* bridge offers good visibility to visually monitor for marine mammal presence; Protected Species Visual Observers (PSVO) posted during operations would scan the ocean for marine mammals and would be required to report visual sightings of marine mammal presence to crew; and the PSVOs receive extensive training that covers the fundamentals of visual observing for marine mammals and information about marine mammals and their identification at sea. In addition, during airgun operations, a passive acoustic monitoring (PAM) system would be deployed from the *Langseth* that may alert the vessel of the presence of marine mammals in the vicinity of the vessel.

Entanglement

Entanglement can occur if wildlife becomes immobilized in survey lines, cables, nets, or other equipment that is moving through the water column. The proposed seismic survey would require towing of seismic equipment and cables. The large airgun array and hydrophone streamer carries the risk of entanglement for marine mammals. Wildlife, especially slow moving individuals, such as large whales, have a low probability of becoming entangled due to the slow speed of the survey vessel and onboard monitoring efforts. There are no recorded cases of entanglement of marine mammals during the conduct of over 8 years of seismic surveys on the *Langseth.* In May 2011, there was one recorded entanglement of an olive ridley sea turtle (*Lepidochelys olivacea*) in the *Langseth's* barovanes after the conclusion of a seismic survey off Costa Rica. However, the barovanes would not be deployed from the *Langseth* during USGS's proposed seismic survey. There have been cases of baleen whales, mostly gray whales (Heyning, 1990), becoming entangled in fishing lines. The probability for entanglement of marine mammals is considered not significant because of the vessel speed and the monitoring efforts onboard the survey vessel.

The potential effects to marine mammals described in this section of the document do not take into consideration the proposed monitoring and mitigation measures described later in this document (see the ''Proposed Mitigation'' and ''Proposed Monitoring and Reporting'' sections) which, as noted, are designed to effect the least practicable impact on affected marine mammal species and stocks.

Anticipated Effects on Marine Mammal Habitat

The proposed seismic survey is not anticipated to have any permanent impact on habitats used by the marine mammals in the proposed survey area, including the food sources they use (i.e., fish and invertebrates). Additionally, no physical damage to any habitat is anticipated as a result of conducting the proposed seismic survey. While it is anticipated that the specified activity may result in marine mammals avoiding certain areas due to temporary ensonification, this impact to habitat is temporary and was considered in further detail earlier in this document, as behavioral modification. The main impact associated with the proposed activity would be temporarily elevated noise levels and the associated direct effects on marine mammals in any particular area of the proposed project area, previously discussed in this notice. The proposed 2014 and 2015 seismic survey is not operating in a small, defined location. During the proposed 3,165 km (1,709 nmi) and 3,115 km (1,682 nmi) of tracklines in 2014 and 2015, respectively, the vessel would continuously move along the tracklines during the survey. The next section discusses the potential impacts of anthropogenic sound sources on common marine mammal prey in the proposed survey area (i.e., fish and invertebrates).

Anticipated Effects on Fish

One reason for the adoption of airguns as the standard energy source for marine seismic surveys is that, unlike explosives, they have not been associated with large-scale fish kills. However, existing information on the impacts of seismic surveys on marine fish and invertebrate populations is limited. There are three types of potential effects of exposure to seismic surveys: (1) Pathological, (2) physiological, and (3) behavioral. Pathological effects involve lethal and temporary or permanent sub-lethal injury. Physiological effects involve temporary and permanent primary and secondary stress responses, such as changes in levels of enzymes and proteins. Behavioral effects refer to temporary and (if they occur) permanent changes in exhibited behavior (e.g., startle and avoidance behavior). The three categories are interrelated in complex ways. For example, it is possible that certain physiological and behavioral changes could potentially lead to an ultimate pathological effect on individuals (i.e., mortality).

The specific received sound levels at which permanent adverse effects to fish potentially could occur are little studied and largely unknown. Furthermore, the available information on the impacts of seismic surveys on marine fish is from studies of individuals or portions of a population; there have been no studies at the population scale. The studies of individual fish have often been on caged fish that were exposed to airgun pulses in situations not representative of an actual seismic survey. Thus, available information provides limited insight on possible real-world effects at the ocean or population scale. This makes drawing conclusions about impacts on fish problematic because, ultimately, the most important issues concern effects on marine fish populations, their viability, and their availability to fisheries.

Hastings and Popper (2005), Popper (2009), and Popper and Hastings (2009a,b) provided recent critical reviews of the known effects of sound on fish. The following sections provide a general synopsis of the available information on the effects of exposure to seismic and other anthropogenic sound as relevant to fish. The information comprises results from scientific studies of varying degrees of rigor plus some anecdotal information. Some of the data sources may have serious shortcomings in methods, analysis, interpretation, and reproducibility that must be considered when interpreting their results (see Hastings and Popper, 2005). Potential adverse effects of the program's sound sources on marine fish are noted.

Pathological Effects—The potential for pathological damage to hearing structures in fish depends on the energy level of the received sound and the physiology and hearing capability of the species in question. For a given sound to result in hearing loss, the sound must exceed, by some substantial amount, the hearing threshold of the fish for that sound (Popper, 2005). The consequences of temporary or permanent hearing loss in individual fish on a fish population are unknown; however, they likely depend on the number of individuals affected and whether critical behaviors involving sound (e.g., predator avoidance, prey capture, orientation and navigation, reproduction, etc.) are adversely affected.

Little is known about the mechanisms and characteristics of damage to fish that may be inflicted by exposure to seismic survey sounds. Few data have been presented in the peer-reviewed scientific literature. As far as USGS and NMFS know, there are only two papers with proper experimental methods, controls, and careful pathological investigation implicating sounds produced by actual seismic survey airguns in causing adverse anatomical effects. One such study indicated anatomical damage, and the second indicated TTS in fish hearing. The anatomical case is McCauley *et al.* (2003), who found that exposure to airgun sound caused observable anatomical damage to the auditory maculae of pink snapper (*Pagrus auratus*). This damage in the ears had not been repaired in fish sacrificed and examined almost two months after exposure. On the other hand, Popper *et al.* (2005) documented only TTS (as determined by auditory brainstem response) in two of three fish species from the Mackenzie River Delta. This study found that broad whitefish (*Coregonus nasus*) exposed to five airgun shots were not significantly different from those of controls. During both studies, the repetitive exposure to sound was greater than would have occurred during a typical seismic survey. However, the substantial low-frequency energy produced by the airguns (less than 400 Hz in the study by McCauley *et al.* [2003] and less than approximately 200 Hz in Popper *et al.* [2005]) likely did not propagate to the fish because the water in the study areas was very shallow (approximately nine m in the former case and less than two m in the latter). Water depth sets a lower limit on the lowest sound frequency that would propagate (the ''cutoff frequency'') at about one-quarter wavelength (Urick, 1983; Rogers and Cox, 1988).

Wardle *et al.* (2001) suggested that in water, acute injury and death of organisms exposed to seismic energy depends primarily on two features of the sound source: (1) The received peak pressure, and (2) the time required for the pressure to rise and decay. Generally, as received pressure increases, the period for the pressure to rise and decay decreases, and the chance of acute pathological effects increases. According to Buchanan *et al.* (2004), for the types of seismic airguns and arrays involved with the proposed program, the pathological (mortality) zone for fish would be expected to be within a few meters of the seismic source. Numerous other studies provide examples of no fish mortality upon exposure to seismic sources (Falk and Lawrence, 1973; Holliday *et al.,* 1987; La Bella *et al.,* 1996; Santulli *et al.,* 1999; McCauley *et al.,* 2000a,b, 2003; Bjarti, 2002; Thomsen, 2002; Hassel *et al.,* 2003; Popper *et al.,* 2005; Boeger *et al.,* 2006).

An experiment of the effects of a single 700 in^3 airgun was conducted in Lake Meade, Nevada (USGS, 1999). The data were used in an Environmental Assessment of the effects of a marine reflection survey of the Lake Meade fault system by the National Park Service (Paulson *et al.,* 1993, in USGS, 1999). The airgun was suspended 3.5 m (11.5 ft) above a school of threadfin shad in Lake Meade and was fired three successive times at a 30 second interval. Neither surface inspection nor diver observations of the water column and bottom found any dead fish.

Some studies have reported, some equivocally, that mortality of fish, fish eggs, or larvae can occur close to seismic sources (Kostyuchenko, 1973; Dalen and Knutsen, 1986; Booman *et al.,* 1996; Dalen *et al.,* 1996). Some of the reports claimed seismic effects from treatments quite different from actual seismic survey sounds or even reasonable surrogates. However, Payne *et al.* (2009) reported no statistical differences in mortality/morbidity between control and exposed groups of capelin eggs or monkfish larvae. Saetre and Ona (1996) applied a 'worst-case scenario' mathematical model to investigate the effects of seismic energy on fish eggs and larvae. They concluded that mortality rates caused by exposure to seismic surveys are so low, as compared to natural mortality rates, that the impact of seismic surveying on recruitment to a fish stock must be regarded as insignificant.

Physiological Effects—Physiological effects refer to cellular and/or biochemical responses of fish to acoustic stress. Such stress potentially could affect fish populations by increasing mortality or reducing reproductive success. Primary and secondary stress responses of fish after exposure to seismic survey sound appear to be temporary in all studies done to date (Sverdrup *et al.,* 1994; Santulli *et al.,* 1999; McCauley *et al.,* 2000a,b). The periods necessary for the biochemical changes to return to normal are variable and depend on numerous aspects of the biology of the species and of the sound stimulus.

Behavioral Effects—Behavioral effects include changes in the distribution, migration, mating, and catchability of fish populations. Studies investigating the possible effects of sound (including seismic survey sound) on fish behavior have been conducted on both uncaged and caged individuals (e.g., Chapman and Hawkins, 1969; Pearson *et al.,* 1992; Santulli *et al.,* 1999; Wardle *et al.,* 2001; Hassel *et al.,* 2003). Typically, in these studies fish exhibited a sharp startle response at the onset of a sound followed by habituation and a return to normal behavior after the sound ceased.

The Minerals Management Service (MMS, 2005) assessed the effects of a proposed seismic survey in Cook Inlet. The seismic survey proposed using three vessels, each towing two, four-airgun arrays ranging from 1,500 to 2,500 in^3. MMS noted that the impact to fish populations in the survey area and adjacent waters would likely be very low and temporary. MMS also concluded that seismic surveys may displace the pelagic fishes from the area temporarily when airguns are in use. However, fishes displaced and avoiding the airgun noise are likely to backfill the survey area in minutes to hours after cessation of seismic survey. Fishes not dispersing from the airgun noise (e.g., demersal species) may startle and move short distances to avoid airgun emissions.

In general, any adverse effects on fish behavior or fisheries attributable to seismic surveys may depend on the species in question and the nature of the fishery (season, duration, fishing method). They may also depend on the age of the fish, its motivational state, its size, and numerous other factors that are difficult, if not impossible, to quantify at this point, given such limited data on effects of airguns on fish, particularly under realistic at-sea conditions.

Anticipated Effects on Invertebrates

The existing body of information on the impacts of seismic survey sound on marine invertebrates is very limited. However, there is some unpublished and very limited evidence of the potential for adverse effects on invertebrates, thereby justifying further discussion and analysis of this issue. The three types of potential effects of exposure to seismic surveys on marine invertebrates are pathological, physiological, and behavioral. Based on the physical structure of their sensory organs, marine invertebrates appear to be specialized to respond to particle displacement components of an impinging sound field and not to the pressure component (Popper *et al.,* 2001).

The only information available on the impacts of seismic surveys on marine invertebrates involves studies of individuals; there have been no studies at the population scale. Thus, available information provides limited insight on possible real-world effects at the regional or ocean scale. The most important aspect of potential impacts concerns how exposure to seismic survey sound ultimately affects invertebrate populations and their viability, including availability to fisheries.

Literature reviews of the effects of seismic and other underwater sound on invertebrates were provided by Moriyasu *et al.* (2004) and Payne *et al.* (2008). The following sections provide a synopsis of available information on the effects of exposure to seismic survey sound on species of decapod crustaceans and cephalopods, the two taxonomic groups of invertebrates on which most such studies have been conducted. The available information is from studies with variable degrees of scientific soundness and from anecdotal information. A more detailed review of the literature on the effects of seismic survey sound on invertebrates is provided in Appendix D of the NSF/USGS PEIS.

Pathological Effects—In water, lethal and sub-lethal injury to organisms exposed to seismic survey sound appears to depend on at least two features of the sound source: (1) The received peak pressure; and (2) the time required for the pressure to rise and decay. Generally, as received pressure increases, the period for the pressure to rise and decay decreases, and the chance of acute pathological effects increases. For the type of airgun array planned for the proposed program, the pathological (mortality) zone for crustaceans and cephalopods is expected to be within a few meters of the seismic source, at most; however, very few specific data are available on levels of seismic signals that might damage these animals. This premise is based on the peak pressure and rise/decay time characteristics of seismic airgun arrays currently in use around the world.

Some studies have suggested that seismic survey sound has a limited pathological impact on early developmental stages of crustaceans (Pearson *et al.,* 1994; Christian *et al.,* 2003; DFO, 2004). However, the impacts appear to be either temporary or insignificant compared to what occurs under natural conditions. Controlled field experiments on adult crustaceans (Christian *et al.,* 2003, 2004; DFO, 2004) and adult cephalopods (McCauley *et al.,* 2000a,b) exposed to seismic survey sound have not resulted in any significant pathological impacts on the animals. It has been suggested that exposure to commercial seismic survey activities has injured giant squid (Guerra *et al.,* 2004), but the article provides little evidence to support this claim. Tenera Environmental (2011b) reported that Norris and Mohl (1983, summarized in Mariyasu *et al.,* 2004) observed lethal effects in squid (*Loligo vulgaris*) at levels of 246 to 252 dB after 3 to 11 minutes.

Andre *et al.* (2011) exposed four species of cephalopods (*Loligo vulgaris, Sepia officinalis, Octopus vulgaris,* and *Ilex coindetii*), primarily cuttlefish, to two hours of continuous 50 to 400 Hz sinusoidal wave sweeps at 157+/−5 dB re 1 μPa while captive in relatively small tanks. They reported morphological and ultrastructural evidence of massive acoustic trauma (i.e., permanent and substantial alterations [lesions] of statocyst sensory hair cells) to the exposed animals that increased in severity with time, suggesting that cephalopods are particularly sensitive to low frequency sound. The received SPL was reported as 157+/−5 dB re 1 μPa, with peak levels at 175 dB re 1 μPa. As in the McCauley *et al.* (2003) paper on sensory hair cell damage in pink snapper as a result of exposure to seismic sound, the cephalopods were subjected to higher sound levels than they would be under natural conditions, and they were unable to swim away from the sound source.

Physiological Effects—Physiological effects refer mainly to biochemical responses by marine invertebrates to acoustic stress. Such stress potentially could affect invertebrate populations by increasing mortality or reducing reproductive success. Primary and secondary stress responses (i.e., changes in haemolymph levels of enzymes, proteins, etc.) of crustaceans have been noted several days or months after exposure to seismic survey sounds (Payne *et al.,* 2007). It was noted however, that no behavioral impacts were exhibited by crustaceans (Christian *et al.,* 2003, 2004; DFO, 2004). The periods necessary for these biochemical changes to return to normal are variable and depend on numerous aspects of the biology of the species and of the sound stimulus.

Behavioral Effects—There is increasing interest in assessing the possible direct and indirect effects of seismic and other sounds on invertebrate behavior, particularly in relation to the consequences for fisheries. Changes in behavior could potentially affect such aspects as reproductive success, distribution, susceptibility to predation, and catchability by fisheries. Studies investigating the possible behavioral effects of exposure to seismic survey sound on crustaceans and cephalopods have been conducted on both uncaged and caged animals. In some cases, invertebrates exhibited startle responses (e.g., squid in McCauley *et al.,* 2000a,b). In other cases, no behavioral impacts were noted (e.g., crustaceans in Christian *et al.,* 2003, 2004; DFO 2004). There have been anecdotal reports of reduced catch rates of shrimp shortly after exposure to seismic surveys; however, other studies have not observed any significant changes in shrimp catch rate (Andriguetto-Filho *et al.,* 2005). Similarly, Parry and Gason (2006) did not find any evidence that lobster catch rates were affected by seismic surveys. Any adverse effects on crustacean and cephalopod behavior or fisheries attributable to seismic survey sound depend on the species in question and the nature of the fishery (season, duration, fishing method).

Proposed Mitigation

In order to issue an Incidental Take Authorization (ITA) under section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and the availability of such species or stock for taking for certain subsistence uses (where relevant).

USGS has reviewed the following source documents and has incorporated a suite of appropriate mitigation measures into their project description.

(1) Protocols used during previous NSF and USGS-funded seismic research cruises as approved by NMFS and detailed in the NSF/USGS PEIS;

(2) Previous IHA applications and IHAs approved and authorized by NMFS; and

(3) Recommended best practices in Richardson *et al.* (1995), Pierson *et al.* (1998), and Weir and Dolman (2007).

To reduce the potential for disturbance from acoustic stimuli associated with the proposed activities, USGS and/or its designees have proposed to implement the following mitigation measures for marine mammals:

(1) Planning Phase;

(2) Proposed exclusion zones around the airgun(s);

(3) Power-down procedures;

(4) Shut-down procedures;

(5) Ramp-up procedures; and

(6) Special procedures for situations or species of concern.

Planning Phase—Mitigation of potential impacts from the proposed activities began during the planning phases of the proposed activities. USGS considered whether the research objectives could be met with a smaller source than the full, 36-airgun array (6,600 in^3) used on the *Langseth,* and determined that the standard 36-airgun array with a total volume of approximately 6,600 in^3 was appropriate. USGS also worked with L–DEO and NSF to identify potential time periods to carry out the survey taking into consideration key factors such as environmental conditions (i.e., the seasonal presence of marine mammals and other protected species), weather conditions, equipment, and optimal timing for other proposed seismic surveys using the *Langseth.* Most marine mammal species are expected to occur in the study area year-round, so altering the timing of the proposed project from spring and summer months likely would result in no net benefits for those species.

Proposed Exclusion Zones—USGS use radii to designate exclusion and buffer zones and to estimate take for marine mammals. Table 1 (presented earlier in this document) shows the distances at which one would expect marine mammal exposures to received sound levels (160 and 180/190 dB) from the 36 airgun array and a single airgun. (The 180 dB and 190 dB level shut-down criteria are applicable to cetaceans and pinnipeds, respectively, as specified by NMFS [2000].) USGS used these levels to establish the exclusion and buffer zones.

If the PSVO detects marine mammal(s) within or about to enter the appropriate exclusion zone, the *Langseth* crew would immediately power-down the airgun array, or perform a shut-down if necessary (see ''Shut-down Procedures''). Table 1 summarizes the calculated distances at which sound levels (160, 180 and 190 dB [rms]) are expected to be received from the 36 airgun array and the single airgun operating in deep water depths. Received sound levels have been calculated by USGS, in relation to distance and direction from the airguns, for the 36 airgun array and for the single 1900LL 40 in^3 airgun, which would be used during power-downs.

Power-down Procedures—A power-down involves decreasing the number of airguns in use to one airgun, such that the radius of the 180 dB or 190 dB zone is decreased to the extent that the observed marine mammal(s) are no longer in or about to enter the exclusion zone for the full airgun array. During a power-down for mitigation, L–DEO would operate one small airgun. The continued operation of one airgun is intended to (a) alert marine mammals to the presence of the seismic vessel in the area; and (b) retain the option of initiating a ramp-up to full operations under poor visibility conditions. In contrast, a shut-down occurs when all airgun activity is suspended.

If the PSVO detects a marine mammal outside the exclusion zone that is likely to enter the exclusion zone, USGS would power-down the airguns to reduce the size of the 180 dB or 190 dB exclusion zone before the animal is within the exclusion zone. Likewise, if a mammal is already within the exclusion zone, when first detected USGS would power-down the airguns immediately. During a power-down of the airgun array, USGS would operate the single 40 in^3 airgun, which has a smaller exclusion zone. If the PSVO detects a marine mammal within or near the smaller exclusion zone around that single airgun (see Table 1), USGS would shut-down the airgun (see next section).

Resuming Airgun Operations After a Power-down—Following a power-down, the *Langseth* will not resume full airgun activity until the marine mammal has cleared the 180 or 190 dB exclusion zone (see Table 1). The PSVO would consider the animal to have cleared the exclusion zone if:

- The PSVO has visually observed the animal leave the exclusion zone, or
- A PSVO 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); or
- The vessel has transited outside the original 180 dB or 190 dB exclusion zone after a 10 minute wait period.

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).

Because the vessel would have transited away from the vicinity of the original sighting during the 10 minute period, implementing ramp-up procedures for the full array after an extended power-down (i.e., transiting for an additional 35 minutes from the location of initial sighting) would not meaningfully increase the effectiveness of observing marine mammals approaching or entering the exclusion zone for the full source level and would not further minimize the potential for take. The *Langseth's* PSVOs would continually monitoring the exclusion zone for the full source level while the mitigation airgun is firing. On average, PSVOs can observe to the horizon (10 km or 5.4 nmi) from the height of the *Langseth's* observation deck and should be able to state with a reasonable degree of confidence whether a marine mammal would be encountered within this distance before resuming airgun operations at full-power.

Shut-down Procedures—USGS would shut-down the operating airgun(s) if a marine mammal is seen within or approaching the exclusion zone for the single airgun. USGS would implement a shut-down:

(1) If an animal enters the exclusion zone of the single airgun after USGS has initiated a power-down; or

(2) If an animal is initially seen within the exclusion zone of the single airgun when more than one airgun (typically the full airgun array) is operating (and it is not practical or adequate to reduce exposure to less than 180 dB [rms] or 190 dB [rms]).

Considering the conservation status for the North Atlantic right whale, the airguns would be shut-down immediately in the unlikely event that this species is observed, regardless of the distance from the *Langseth*. Ramp-up would only begin if the North Atlantic right whale has not been seen for 30 minutes.

Resuming Airgun Operations After a Shut-down—Following a shut-down in excess of 10 minutes, the *Langseth* crew would initiate a ramp-up with the smallest airgun in the array (40 in^3). The crew would turn on additional airguns in a sequence such that the source level of the array would increase in steps not exceeding 6 dB per five-minute period over a total duration of approximately 30 minutes. During ramp-up, the PSVOs would monitor the exclusion zone, and if they sight a marine mammal, the *Langseth* crew would implement a power-down or shut-down as though the full airgun array were operational.

During periods of active seismic operations, there are occasions when the *Langseth* crew would need to temporarily shut-down the airguns due to equipment failure or for maintenance. In this case, if the airguns are inactive longer than eight minutes, the crew would follow ramp-up procedures for a shut-down described earlier and the PSVOs would monitor the full exclusion zone and would implement a power-down or shut-down if necessary.

If the full exclusion zone is not visible to the PSVO for at least 30 minutes prior to the start of operations in either daylight or nighttime, the *Langseth* crew would not commence ramp-up 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 shut-down at night or during poor visibility conditions (i.e., in thick fog), because the outer part of the zone for that array would not be visible during those conditions.

If one airgun has operated during a power-down period, ramp-up to full power would be permissible at night or in poor visibility, on the assumption that marine mammals would be alerted to the approaching seismic vessel by the sounds from the single airgun and could move away. The vessel's crew would not initiate ramp-up of the airguns if a marine mammal is sighted within or near the applicable exclusion zones.

Ramp-up Procedures—Ramp-up of an airgun array provides a gradual increase in sound levels, and involves a step-wise increase in the number and total volume of airguns firing until the full volume of the airgun array is achieved. The purpose of a ramp-up is to ''warn'' marine mammals in the vicinity of the airguns, and to provide the time for them to leave the area and thus avoid any potential injury or impairment of their hearing abilities. USGS would follow a ramp-up procedure when the airgun array begins operating after a 10 minute period without airgun operations or when a power-down or shut-down has exceeded that period. USGS and L–DEO have used similar periods (approximately 8 to 10 minutes) during previous USGS and L–DEO seismic surveys.

Ramp-up would begin with the smallest airgun in the array (40 in^3). Airguns would be added in a sequence such that the source level of the array would increase in steps not exceeding six dB per five minute period over a total duration of approximately 30 to 35 minutes (i.e., the time it takes to achieve full operation of the airgun array). During ramp-up, the PSVOs would monitor the exclusion zone, and if marine mammals are sighted, USGS would implement a power-down or shut-down as though the full airgun array were operational.

If the complete exclusion zone has not been visible for at least 30 minutes prior to the start of operations in either daylight or nighttime, USGS would not commence the ramp-up 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 airgun array would not be ramped-up from a complete shut-down at night or during poor visibility conditions (i.e., in thick fog), because the outer part of the exclusion zone for that array would not be visible during those conditions. If one airgun has operated during a power-down period, ramp-up to full power would be permissible at night or in poor visibility, on the assumption that marine mammals would be alerted to the approaching seismic vessel by the sounds from the single airgun and could move away. USGS would not initiate a ramp-up of the airguns if a marine mammal is sighted within or near the applicable exclusion zones.

Use of a Small-Volume Airgun During Turns and Maintenance

For short-duration equipment maintenance activities, USGS would employ the use of a small-volume airgun (i.e., 40 in^3 ''mitigation airgun'') to deter marine mammals from being within the immediate area of the seismic operations. The mitigation airgun would be operated at approximately one shot per minute and would not be operated for longer than three hours in duration. The seismic survey's tracklines are continuous around turns and no mitigation airgun would be necessary. For longer-duration equipment maintenance or repair activities (greater than three hours), USGS would shut-down the seismic equipment and not involve using the mitigation airgun.

During brief transits (e.g., less than three hours), one mitigation airgun would continue operating. The ramp-up procedure would still be followed when increasing the source levels from one airgun to the full airgun array. However, keeping one airgun firing would avoid the prohibition of a ''cold start'' during darkness or other periods of poor visibility. Through use of this approach, seismic operations may resume without the 30 minute observation period of the full exclusion zone required for a ''cold start,'' and without ramp-up if operating with the mitigation airgun for under 10 minutes, or with ramp-up if operating with the mitigation airgun over 10 minutes. PSOs would be on duty whenever the airguns are firing during daylight, during the 30 minute periods prior to ramp-ups.

Special Procedures for Situations or Species of Concern—It is unlikely that a North Atlantic right whale would be encountered during the proposed seismic survey, but if so, the airguns would be shut-down immediately if one is visually sighted at any distance from the vessel because of its rarity and conservation status. The airgun array shall not resume firing (with ramp-up) until 30 minutes after the last documented North Atlantic right whale visual sighting. Concentrations of humpback, sei, fin, blue, and/or sperm whales would be avoided if possible (i.e., exposing concentrations of animals to 160 dB), and the array would be powered-down if necessary. For purposes of this proposed survey, a concentration or group of whales would consist of six or more individuals visually sighted that do not appear to be traveling (e.g., feeding, socializing, etc.).

Mitigation Conclusions

NMFS has carefully evaluated the applicant's proposed mitigation measures and has considered a range of other measures in the context of ensuring that NMFS prescribes the means of effecting the least practicable impact on the affected marine mammal species and stocks and their habitat. NMFS's evaluation of potential measures included consideration of the following factors in relation to one another:

(1) The manner in which, and the degree to which, the successful implementation of the measure is expected 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 mitigation measure(s) prescribed by NMFS should be able to accomplish, have a reasonable likelihood of accomplishing (based on current science), or contribute to the accomplishment of one or more of the general goals listed below:

(1) Avoidance or minimization of injury or death of marine mammal wherever possible (goals 2, 3, and 4 may contribute to this goal).

(2) A reduction in the numbers of marine mammals (total number of number at biologically important time or location) exposed to received levels of airgun operations, or other activities expected to result in the take of marine mammals (this goal may contribute to 1, above, or to reducing harassment takes only).

(3) A reduction in the number of times (total number or number at biologically important time or location) individuals would be exposed to received levels of airgun operations, or other activities expected to result in the take of marine mammals (this goal may contribute to 1, above, or to reducing harassment takes only).

(4) A reduction in the intensity of exposures (either total number or number at biologically important time or location) to received levels of airgun operations, or other activities expected to result in the take of marine mammals (this goal may contribute to a, above, or to reducing the severity of harassment takes only).

(5) Avoidance of 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.

(6) For monitoring directly related to mitigation—an increase in the probability of detecting marine mammals, thus allowing for more effective implementation of the mitigation.

Based on NMFS's evaluation of the applicant's proposed measures, as well as other measures considered by NMFS or recommended by the public, NMFS has preliminarily determined that the proposed mitigation measures provide the means of effecting the least practicable impact on marine mammal species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Proposed Monitoring and Reporting

In order to issue an ITA for an activity, section 101(a)(5)(D) of the MMPA states that NMFS must set forth ''requirements pertaining to the monitoring and reporting of such taking.'' The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for ITAs must include the suggested means of accomplishing the necessary monitoring and reporting that would result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed action area. USGS submitted a marine mammal monitoring plan as part of the IHA application. It can be found in Section 13 of the IHA application. The plan may be modified or supplemented based on comments or new information received from the public during the public comment period or from the peer review panel.

Monitoring measures prescribed by NMFS should accomplish one or more of the following general goals:

(1) An increase in the probability of detecting marine mammals, both within the mitigation zone (thus allowing for more effective implementation of the mitigation) and in general to generate more data to contribute to the analyses mentioned below;

(2) An increase in our understanding of how many marine mammals are likely to be exposed to levels of seismic airguns that we associate with specific adverse effects, such as behavioral harassment, TTS or PTS;

(3) An increase in our understanding of how marine mammals respond to stimuli expected to result in take and how anticipated adverse effects on individuals (in different ways and to varying degrees) may impact the population, species, or stock (specifically through effects on annual rates of recruitment or survival) through any of the following methods:

- Behavioral observations in the presence of stimuli compared to observations in the absence of stimuli (need to be able to accurately predict received level, distance from source, and other pertinent information);
- Physiological measurements in the presence of stimuli compared to observations in the absence of stimuli (need to be able to accurately predict receive level, distance from the source, and other pertinent information);
- Distribution and/or abundance comparisons in times or areas with concentrated stimuli versus times or areas without stimuli;

(4) An increased knowledge of the affected species; and

(5) An increase in our understanding of the effectiveness of certain mitigation and monitoring measures.

Proposed Monitoring

USGS proposes to sponsor marine mammal monitoring during the proposed project, in order to implement the proposed mitigation measures that require real-time monitoring, and to satisfy the anticipated monitoring requirements of the IHA. USGS's proposed ''Monitoring Plan'' is described below this section. The monitoring work described here has been planned as a self-contained project independent of any other related monitoring projects that may be occurring simultaneously in the same region. USGS is prepared to discuss coordination of its monitoring program with any related work that might be done by other groups insofar as this is practical and desirable.

Vessel-Based Visual Monitoring

PSVOs would be based aboard the seismic source vessel and would watch for marine mammals near the vessel during daytime airgun operations and during any ramp-ups of the airguns at night. PSVOs would also watch for marine mammals near the seismic vessel for at least 30 minutes prior to the start of airgun operations after an extended shut-down (i.e., greater than approximately 10 minutes for this proposed cruise). When feasible, PSVOs would conduct observations during daytime periods when the seismic system is not operating (such as during transits) for comparison of sighting rates and behavior with and without airgun operations and between acquisition periods. Based on PSVO observations, the airguns would be powered-down or shut-down when marine mammals are observed within or about to enter a designated exclusion zone.

During seismic operations in the northwest Atlantic Ocean off the Eastern Seaboard, at least five PSOs (four PSVOs and one Protected Species Acoustic Observer [PSAO]) would be based aboard the *Langseth.* USGS would appoint the PSOs with NMFS's concurrence. Observations would take place during ongoing daytime operations and nighttime ramp-ups of the airguns. During the majority of seismic operations, two PSVOs would be on duty from the observation tower (i.e., the best available vantage point on the source vessel) to monitor marine mammals near the seismic vessel. Use of two simultaneous PSVOs would increase the effectiveness of detecting animals near the source vessel. However, during meal times and bathroom breaks, it is sometimes difficult to have two PSVOs on effort, but at least one PSVO would be on duty. PSVO(s) would be on duty in shifts no longer than 4 hours in duration.

Two PSVOs would also be on visual watch during all daytime ramp-ups of the seismic airguns. A third PSAO would monitor the PAM equipment 24 hours a day to detect vocalizing marine mammals present in the action area. In summary, a typical daytime cruise would have scheduled two PSVOs on duty from the observation tower, and a third PSAO on PAM. Other ship's crew would also be instructed to assist in detecting marine mammals and implementing mitigation requirements (if practical). Before the start of the seismic survey, the crew would be given additional instruction on how to do so.

The *Langseth* is a suitable platform for marine mammal observations. When stationed on the observation platform, the eye level would be approximately 21.5 m (70.5 ft) above sea level, and the PSVO would have a good view around the entire vessel. During daytime, the PSVO(s) would scan the area around the vessel systematically with reticle binoculars (e.g., 7 x 50 Fujinon), Big-eye binoculars (25 x 150), and with the naked eye. During darkness or low-light conditions, night vision devices (monoculars) and a forward looking infrared (FLIR) camera would be available, when required. Laser range-finding binoculars (Leica LRF 1200 laser rangefinder or equivalent) would be available to assist with distance estimation. Those are useful in training observers to estimate distances visually, but are generally not useful in measuring distances to animals directly; that is done primarily with the reticles in the binoculars.

When marine mammals are detected within or about to enter the designated exclusion zone, the airguns would immediately be powered-down or shut-down if necessary. The PSVO(s) would continue to maintain watch to determine when the animal(s) are outside the exclusion zone by visual confirmation. Airgun operations would not resume until the animal is confirmed to have left the exclusion zone, or if not observed after 15 minutes for species with shorter dive durations (small odontocetes and pinnipeds) or 30 minutes for species with longer dive durations (mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, killer, and beaked whales).

Vessel-Based Passive Acoustic Monitoring

Vessel-based, towed PAM would complement the visual monitoring program, when practicable. Visual monitoring typically is not effective during periods of poor visibility or at night, and even with good visibility, is unable to detect marine mammals when they are below the surface or beyond visual range. PAM can be used in addition to visual observations to improve detection, identification, and localization of cetaceans. The PAM system would serve to alert visual observers (if on duty) when vocalizing cetaceans are detected. It is only useful when marine mammals call, but it does not depend on good visibility. It would be monitored in real-time so that the PSVOs can be advised when cetaceans are acoustically detected.

The PAM system consists of both hardware (i.e., hydrophones) and software (i.e., Pamguard). The ''wet end'' of the system consists of a towed hydrophone array that is connected to the vessel by a tow cable. The tow cable is 250 m (820.2 ft) long, and the hydrophones are fitted in the last 10 m (32.8 ft) of cable. A depth gauge is attached to the free end of the cable, and the cable is typically towed at depths 20 m (65.6 ft) or less. The array would be deployed from a winch located on the back deck. A deck cable would connect from the winch to the main computer laboratory where the acoustic station, signal conditioning, and processing system would be located. The acoustic signals received by the hydrophones are amplified, digitized, and then processed by the Pamguard software. The PAM system, which has a configuration of 4 hydrophones, can detect a frequency bandwidth of 10 Hz to 200 kHz.

One PSAO, an expert bioacoustician (in addition to the four PSVOs) with primary responsibility for PAM, would be onboard the *Langseth*. The expert bioacoustician would design and set up the PAM system and be present to operate, oversee, and troubleshoot any technical problems with the PAM system during the proposed survey. The towed hydrophones would ideally be monitored by the PSAO 24 hours per day while within the proposed seismic survey area during airgun operations, and during most periods when the *Langseth* is underway while the airguns are not operating. However, PAM may not be possible if damage occurs to the array or back-up systems during operations. The primary PAM streamer on the *Langseth* is a digital hydrophone streamer. Should the digital streamer fail, back-up systems should include an analog spare streamer and a hull-mounted hydrophone. One PSAO would monitor the acoustic detection system by listening to the signals from two channels via headphones and/or speakers and watching the real-time spectrographic display for frequency ranges produced by cetaceans. The PSAO monitoring the acoustical data would be on shift for no greater than six hours at a time. All PSOs are expected to rotate through the PAM position, although the expert PSAO (most experienced) would be on PAM duty more frequently.

When a vocalization is detected while visual observations (during daylight) are in progress, the PSAO would contact the PSVO immediately, to alert him/her to the presence of cetaceans (if they have not already been seen), and to allow a power-down or shut-down to be initiated, if required. When bearings (primary and mirror-image) to calling cetacean(s) are determined, the bearings would be relayed to the PSVO(s) to help him/her sight the calling animal. During non-daylight hours, when a cetacean is detected by acoustic monitoring and may be close to the source vessel, the *Langseth* crew would be notified immediately so that the proper mitigation measure may be implemented.

The information regarding the call would be entered into a database. Data entry would 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. The acoustic detection can also be recorded for further analysis.

PSO Data and Documentation

PSVOs would record data to estimate the numbers of marine mammals exposed to various received sound levels and to document apparent disturbance reactions or lack thereof. Data would be used to estimate numbers of animals potentially 'taken' by harassment. They would also provide information needed to order a power-down or shut-down of the airguns when a marine mammal is within or near the appropriate exclusion zone. Observations would also be made during daytime periods when the *Langseth* is underway without seismic operations. There would also be opportunities to collect baseline biological data during the transits to, from, and through the study area.

When a sighting is made, the following information about the sighting would be recorded:

1. 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 behavioral pace.

2. Time, location, heading, speed, activity of the vessel, Beaufort sea state and wind force, visibility, and sun glare.

The data listed under (2) 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.

All observations and ramp-ups, power-downs, or shut-downs would be recorded in a standardized format. The PSVOs would record this information onto datasheets. During periods between watches and periods when operations are suspended, those data would be entered into a laptop computer running a custom electronic database. The accuracy of the data entry would be verified by computerized data validity checks as the data are entered and by subsequent manual checking of the database. These procedures would allow initial summaries of data to be prepared during and shortly after the field program, and would facilitate transfer of the data to statistical, graphical, and other programs for further processing and archiving.

Results from the vessel-based observations would provide:

1. The basis for real-time mitigation (airgun power-down or shut-down).

2. Information needed to estimate the number of marine mammals potentially taken by harassment, which must be reported to NMFS.

3. Data on the occurrence, distribution, and activities of marine mammals in the area where the seismic study is conducted.

4. Information to compare the distance and distribution of marine mammals relative to the source vessel at times with and without seismic activity.

5. Data on the behavior and movement patterns of marine mammals seen at times with and without seismic activity.

Proposed Reporting

USGS would submit a comprehensive report to NMFS and NSF within 90 days after the end of phase 1 in 2014 and another comprehensive report to NMFS and NSF within 90 days after the end of phase 2 in 2015 for the proposed cruise. The report would describe the proposed operations that were conducted and sightings of marine mammals within the vicinity of the operations. The report would provide full documentation of methods, results, and interpretation pertaining to all monitoring. The 90-day report would summarize the dates and locations of seismic operations, and all marine mammal sightings (i.e., dates, times, locations, activities, associated seismic survey activities, and associated PAM detections). The report would minimally include:

- Summaries of monitoring effort—total hours, total distances, and distribution of marine mammals through the study period accounting for Beaufort sea state and wind force, and other factors affecting visibility and detectability of marine mammals;
- Analyses of the effects of various factors influencing detectability of

marine mammals including Beaufort sea state and wind force, number of PSOs, and fog/glare;

- Species composition, occurrence, and distribution of marine mammals sightings including date, water depth, numbers, age/size/gender, and group sizes; and analyses of the effects of seismic operations;
- Sighting rates of marine mammals during periods with and without airgun activities (and other variables that could affect detectability);
- Initial sighting distances versus airgun activity state;
- Closest point of approach versus airgun activity state;
- Observed behaviors and types of movements versus airgun activity state;
- Numbers of sightings/individuals seen versus airgun activity state; and
- Distribution around the source vessel versus airgun activity state.

The report would also include estimates of the number and nature of exposures that could result in ''takes'' of marine mammals by harassment or in other ways. After the report is considered final, it would be publicly available on the NMFS, USGS and NSF Web sites at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm#iha, http://woodshole.er.usgs.gov/project-pages/environmental_compliance/index.html,* and *http://www.nsf.gov/geo/oce/encomp/index.jsp.*

Notification of Injured or Dead Marine Mammals—In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner not permitted by the authorization (if issued), such as an injury, serious injury, or mortality (e.g., ship-strike, gear interaction, and/or entanglement), the USGS shall immediately cease the specified activities and immediately report the incident to the Incidental Take Program Supervisor, Permits and Conservation Division, Office of Protected Resources, NMFS, at 301–427–8401 and/or by email to *Jolie.Harrison@noaa.gov* and *Howard.Goldstein@noaa.gov*, the NMFS Greater Atlantic Region Marine Mammal Stranding Network at 866–755–6622 (*Mendy.Garron@noaa.gov*), and the NMFS Southeast Region Marine Mammal Stranding Network at 877–433–8299 (*Blair.Mase@noaa.gov* and *Erin.Fougeres@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 source 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 animal(s) involved;
- Fate of the animal(s); and
- Photographs or video footage of the animal(s) (if equipment is available).

USGS shall not resume its activities until NMFS is able to review the circumstances of the prohibited take. NMFS shall work with USGS to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. The USGS may not resume their activities until notified by NMFS via letter, email, or telephone.

In the event that USGS discovers an injured or dead marine mammal, and the lead 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 NMFS describes in the next paragraph), the USGS would immediately report the incident to the Incidental Take Program Supervisor, Permits and Conservation Division, Office of Protected Resources, at 301–427–8401 and/or by email to *Jolie.Harrison@noaa.gov* and *Howard.Goldstein@noaa.gov,* the NMFS Greater Atlantic Region Marine Mammal Stranding Network (866–755–6622) and/or by email to the Greater Atlantic Regional Stranding Coordinator (*Mendy.Garron@noaa.gov*), and the NMFS Southeast Region Marine Mammal Stranding Network (877–433–8299) and/or by email to the Southeast Regional Stranding Coordinator (*Blair.Mase@noaa.gov*) and Southeast Regional Stranding Program Administrator (*Erin.Fougeres@noaa.gov*). The report must include the same information identified in the paragraph above this section. Activities may continue while NMFS reviews the circumstances of the incident. NMFS would work with the USGS to determine whether modifications in the activities are appropriate.

In the event that USGS 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), the USGS would report the incident to the Incidental Take Program Supervisor, Permits and Conservation Division, Office or Protected Resources, at 301–427–8401 and/or by email to *Jolie.Harrison@noaa.gov* and *Howard.Goldstein@noaa.gov,* the NMFS Greater Atlantic Region Marine Mammal Stranding Network (866–755–6622), and/or by email to the Greater Atlantic Regional Stranding Coordinator (*Mendy.Garron@ noaa.gov*), and the NMFS Southeast Region Marine Mammal Stranding Network (877–433–8299), and/or by email to the Southeast Regional Stranding Coordinator (*Blair.Mase@noaa.gov*) and Southeast Regional Stranding Program Administrator (*Erin.Fougeres@noaa.gov*), within 24 hours of the discovery. The USGS would provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS and the Marine Mammal Stranding Network. Activities may continue while NMFS reviews the circumstances of the incident.

Estimated Take by Incidental Harassment

Except with respect to certain activities not pertinent here, the MMPA defines ''harassment'' as: Any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) 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].

TABLE 3—NMFS'S CURRENT UNDERWATER ACOUSTIC EXPOSURE CRITERIA

Impulsive (non-explosive) sound		
Criterion	Criterion definition	Threshold
Level A harassment (injury)	Permanent threshold shift (PTS) (Any level above that which is known to cause TTS).	180 dB re 1 μPa-m (root means square [rms]) (cetaceans). 190 dB re 1 μPa-m (rms) (pinnipeds).
Level B harassment	Behavioral disruption (for impulsive noise)	160 dB re 1 μPa-m (rms).
Level B harassment	Behavioral disruption (for continuous noise)	120 dB re 1 μPa-m (rms).

Level B harassment is anticipated and proposed to be authorized as a result of the proposed marine seismic survey in the northwest Atlantic Ocean off the Eastern Seaboard. Acoustic stimuli (i.e., increased underwater sound) generated during the operation of the seismic airgun array are expected to result in the behavioral disturbance of some marine mammals. There is no evidence that the planned activities for which USGS seeks the IHA could result in injury, serious injury, or mortality. The required mitigation and monitoring measures would minimize any potential risk for injury, serious injury, or mortality.

The following sections describe USGS's methods to estimate take by incidental harassment and present the applicant's and NMFS's estimates of the numbers of marine mammals that could be affected during the proposed seismic program in the northwest Atlantic Ocean. The estimates are based on a consideration of the number of marine mammals that could be harassed by seismic operations with the 36 airgun array to be used. The length of the proposed 2D seismic survey area in 2014 is approximately 3,165 km (1,704 nmi) and in 2015 is approximately 3,115 km (1,682 nmi) in the U.S. ECS region of the Eastern Seaboard in the Atlantic Ocean, as depicted in Figure 1 of the IHA application. For estimating take and other calculations, the 2015 tracklines are assumed to be identical in length to the 2014 tracklines (even though they are slightly shorter).

USGS assumes that, during simultaneous operations of the airgun array and the other sources, any marine mammals close enough to be affected by the multi-beam echosounder and sub-bottom profiler would already be affected by the airguns. However, whether or not the airguns are operating simultaneously with the other sources, marine mammals are expected to exhibit no more than short-term and inconsequential responses to the multi-beam echosounder and sub-bottom profiler given their characteristics (e.g., narrow, downward-directed beam) and other considerations described previously. Such reactions are not considered to constitute ''taking'' (NMFS, 2001). Therefore, USGS provided no additional allowance for animals that could be affected by sound sources other than airguns.

Density estimates for marine mammals within the vicinity of the proposed study area are limited. Density data for species found along the East Coast of the U.S. generally extend slightly outside of the U.S. EEZ. The proposed study area, however, is well beyond the U.S. EEZ, and is well off the continental shelf break. The proposed survey lines for the proposed 2014 survey are located in the far eastern portion of the proposed study area, primarily within the area where little to no density data are currently available. It was determined that the best available information for density data (for those species where density data existed) of species located off the U.S. East Coast was housed at the Strategic Environmental and Development Program (SERDP)/National Aeronautics and Space Administration (NASA)/NOAA Marine Animal Model Mapper and OBIS–SEAMAP database. Within this database, the model outputs for all four seasons from the U.S. Department of the Navy Operating Area (OPAREA) Density Estimates (NODE) for the Northeast OPAREA and Southeast OPAREA (Department of the Navy 2007a, 2007b) were used to determine the mean density (animals per square kilometer) for 19 of the 38 marine mammals with the potential to occur in the proposed study area. Those species include fin, minke, Atlantic spotted, bottlenose, long-finned and short-finned pilot, pantropical spotted, Risso's, short-beaked common, striped, sperm, rough-toothed, dwarf and pygmy sperm, Sowerby's, Blainville's, Gervais', True's, and Cuvier's beaked whales. Within the NODE document, the density calculations and models both took into account detection probability ($f[0]$) and availability ($g[0]$) biases. Model outputs for each season are available in the database. The data from the NODE summer density models, which include the months of June, July, and August, were used as the 2014 survey is proposed to take place between late August and early September. Of the seasonal NODE density models available, it is expected that the summer models are the most accurate and robust as the survey data used to create all of the models were obtained during summer months. The models for the winter, spring, and fall are derived from the data collected during the summer surveys, and therefore are expected to be less representative of actual species density during those seasons.

For those species of marine mammals that did not have density model outputs within the SERDP/NASA/NOAA and OBIS–SEAMAP database, or for those species with density outputs that did not extend into the proposed study area at all (i.e., all four pinniped species and sei whale), but for which OBIS sightings data within or adjacent to the proposed study area exist, the requested take authorization for the mean group size of the species of marine mammal is included. The mean group sizes were determined based on data reported from the Cetacean and Turtle Assessment Program (CeTAP) surveys (CeTAP, 1982).

The estimated numbers of individuals potentially exposed to sound during the proposed 2014 to 2015 survey are presented below and are based on the 160 dB (rms) criterion currently used for all cetaceans and pinnipeds. It is assumed that marine mammals exposed to airgun sounds that strong could change their behavior sufficiently to be considered ''taken by harassment.'' Table 4 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 greater than or equal to 160 dB (rms) during the seismic survey if no animals moved away from the survey vessel. The requested take authorization is given in the middle (fourth from the left) column of Table 4. For species for which densities were unavailable as described above, but for which there were Ocean Biogeographic Information System (OBIS) sightings within or adjacent to the proposed study area, USGS has included a requested take authorization for the mean group size for the species.

It should be noted that unlike previous USGS, NSF, and L–DEO seismic surveys aboard the *Langseth,* the proposed survey would be conducted as almost one continuous line. Therefore, the ensonified area for the proposed seismic survey does not include a contingency factor (typically increased 25% to accommodate turns, lines that may need to be repeated, equipment testing, etc.) in line-kilometers. As 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 exclusion zones would result in a power-down and/or shut-down of seismic operations as a mitigation measure. Thus, the following estimates of the numbers of marine mammals potentially exposed to 160 dB (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.

The number of different individuals that could be exposed to airgun sounds with received levels greater than or equal to 160 dB (rms) on one or more occasions can be estimated by considering the total marine area that would be within the 160 dB (rms) 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. In many seismic surveys, this total marine area includes overlap, as seismic surveys are often conducted in parallel survey lines where the ensonified areas of each survey line would overlap. The proposed tracklines in 2014 and 2015 would not have overlap as the individual line segments do not run parallel to each other. The entire survey could be considered one continual survey line with slight turns (no more than 120 degrees) between each line segment. During the proposed seismic survey, the vessel would continue on the extensive survey line path, not staying within a smaller defined area as most seismic surveys often do. The numbers of different individuals potentially exposed to greater than or equal to 160 dB (rms) were calculated by multiplying the expected species density (for those marine mammal species that had density data available) times the total anticipated area to be ensonified to that level during airgun operations (3,165 km of survey lines). The total area expected to be ensonified was determined by multiplying the total trackline distance (3,165 km times the width of the swath of the 160 dB buffer zone (2 times 5.78 km). Using this approach, a total of 36,600 km² (10,671 nmi²) would fall within the 160 dB isopleth throughout the proposed survey in 2014. The proposed survey in 2015 is expected to ensonify an almost identical area (to within 2%); therefore, the same ensonified area of 36,600 km² (10,671 nmi²) was used for calculation purposes since the number of estimated takes would be very similar for each of the two years. The number of estimated takes for the proposed survey in 2015 may need to be seasonally adjusted if the activity takes place in the late spring or early summer. Because it is uncertain at this time whether the 2015 survey would be scheduled in the spring (March, April, and May) or summer (June, July, and August) months, estimated takes were calculated for both seasons. For purposes of conservatively estimating the number of takes, the higher density (for spring or summer) was used for each species since it is not known at this time which season the 2015 proposed survey would take place in the April to August 2015 timeframe. If the 2015 survey occurred in the spring rather than summer, the density data suggests that takes would likely be higher for only the humpback whale, beaked whales, and bottlenose dolphin, and takes would likely be fewer for nine species (i.e., sperm whale, short-finned and long-finned pilot whales, Atlantic spotted, pantropical spotted, striped, Clymene, short-beaked common, and Risso's dolphin), and unchanged for the remaining species.

TABLE 4—ESTIMATED DENSITIES OF MARINE MAMMAL SPECIES AND ESTIMATES OF POSSIBLE NUMBERS OF MARINE MAMMALS EXPOSED TO SOUND LEVELS ≥160 dB DURING USGS'S PROPOSED SEISMIC SURVEY IN THE NORTHWEST ATLANTIC OCEAN OFF THE EASTERN SEABOARD, AUGUST TO SEPTEMBER 2014 AND APRIL TO AUGUST 2015

Species	Density spring/ summer (#/km²) [1]	Calculated take authorization 2014/2015 [i.e., estimated number of individuals exposed to sound levels ≥160 dB re 1 μPa] [2]	Requested take authorization (includes increase to average group size) [3]	Abundance (regional population/ stock) [4]	Approximate percentage of estimated of regional population/stock (for requested take) [5]	Population trend [6]
Mysticetes:						
North Atlantic right whale.	NA	0/0	3 + 3 = 6	455/455	1.32/1.32	Increasing.
Humpback whale	0.0010170/0	0/38	38 + 3 = 41	11,600/823	0.35/4.98	Increasing.
Minke whale	0.0000350/ 0.0000360	2/2	2 + 2 = 4	138,000/20,741	0.0014/0.0096	NA.
Bryde's whale	NA	0/0	3 + 3 = 6	NA/NA	NA/NA	NA.
Sei whale	NA	0/0	3 + 3 = 6	10,300/357	0.06/1.68	NA.
Fin whale	0.000060/ 0.000610	3/3	3 + 3 = 6	26,500/3,522	0.02/0.17	NA.
Blue whale	NA	0/0	2 + 2 = 4	855/440	0.47/0.91	NA.
Odontocetes:						
Sperm whale	0.0019050/ 0.0022510	83/83	83 + 83 = 166	13,190/2,288	1.26/7.26	NA.
Pygmy sperm whale.	0.0008850/ 0.008970	33/33	33 + 33 = 66	NA/3,785	NA/1.74	NA.

TABLE 4—ESTIMATED DENSITIES OF MARINE MAMMAL SPECIES AND ESTIMATES OF POSSIBLE NUMBERS OF MARINE MAMMALS EXPOSED TO SOUND LEVELS ≥160 dB DURING USGS'S PROPOSED SEISMIC SURVEY IN THE NORTHWEST ATLANTIC OCEAN OFF THE EASTERN SEABOARD, AUGUST TO SEPTEMBER 2014 AND APRIL TO AUGUST 2015—Continued

Species	Density spring/summer (#/km²)[1]	Calculated take authorization 2014/2015 [i.e., estimated number of individuals exposed to sound levels ≥160 dB re 1 μPa][2]	Requested take authorization (includes increase to average group size)[3]	Abundance (regional population/stock)[4]	Approximate percentage of estimated of regional population/stock (for requested take)[5]	Population trend[6]
Dwarf sperm whale	0.0008850/0.0008970	33/33	33 + 33 = 66	NA/3,785	NA/1.74	NA.
Northern bottlenose whale.	NA	0/0	2 + 2 = 4	40,000/NA	0.01/NA	NA.
Cuvier's beaked whale.	0.0021370/0.0022870	84/84	84 + 84 = 168	NA/6,532	NA/1.29	NA.
Mesoplodon spp. (i.e., True's, Gervais', Sowerby's, and Blainville's beaked whale.				NA/7,092	NA/2.37	NA.
Bottlenose dolphin	0.0069560/0.0066470	244/255	244 + 255 = 499	NA/77,532	NA/0.64	NA.
Atlantic white-sided dolphin.	NA	0/0	54 + 54 = 108	10,000 to 100,000s/48,819.	1.08/0.22	NA.
Fraser's dolphin	NA	0/0	100 + 100 = 200	NA/NA	NA/NA	NA.
Atlantic spotted dolphin.	0.0285700/0.0288400	1,056/1,056	1,056 + 1,056 = 2,112.	NA/44,715	NA/4.72	NA.
Pantropical spotted dolphin.	0.0194900/0.0197600	724/724	724 + 724 = 1,448	NA/3,333	NA/43.44	NA.
Striped dolphin	0.1330000/0.1343000	4,916/4,916	4,916 + 4,916 = 9,832.	NA/54,807	NA/17.94	NA.
Spinner dolphin	NA	0/0	65 + 65 = 130	NA/NA	NA/NA	NA.
Clymene dolphin	0.0093110/0	0/341	70 + 341 = 411	NA/NA	NA/NA	NA.
Short-beaked common dolphin.	0.0053940/0.0055320	203/203	203 + 203 = 406	NA/173,486	NA/0.23	NA.
Rough-toothed dolphin.	0.004200/0.0004260	16/16	16 + 16 = 32	NA/271	NA/11.81	NA.
Risso's dolphin	0.0092150/0.0093180	342/342	342 + 342 = 684	NA/18,250	NA/3.75	NA.
Melon-headed whale.	NA	0/0	100 + 100 = 200	NA/NA	NA/NA	NA.
Pygmy killer whale	NA	0/0	25 + 25 = 50	NA/NA	NA/NA	NA.
False killer whale	NA	0/0	15 + 15 = 30	NA/NA	NA/NA	NA.
Killer whale	NA	0/0	7 + 7 = 14	NA/NA	NA/NA	NA.
Short-finned pilot whale.	0.0108000/0.0190400	697/697	697 + 697 = 1,394	780,000/21,515	0.18/6.48	NA.
Long-finned pilot whale.	0.0108000/0.0190400	697/697	697 + 697 = 1,394	780,000/26,535	0.18/5.25	NA.
Harbor porpoise	NA	0/0	5 + 5 = 10	500,000/79,883	0.002/0.01	NA.
Pinnipeds:						
Harbor seal	NA	0/0	0 + 0 = 0	NA/70,142	NA/NA	NA.
Gray seal	NA	0/0	0 + 0 = 0	NA/331,000	NA/NA	Increasing.
Harp seal	NA	0/0	0 + 0 = 0	8.6 to 9.6 million/7.1 million.	NA/NA	NA.
Hooded seal	NA	0/0	0 + 0 = 0	600,000/592,100	NA/NA	NA.

NA = Not available or not assessed.
[1] OBIS–SERDP–Navy NODE 2007a and 2007b (for those species where density data is available).
[2] Calculated take is estimated density multiplied by the 160 dB ensonified area.
[3] Requested take authorization was increased to group size for species for which densities were not available but that have been sighted near the proposed survey area (CeTAP, 1984).
[4] Stock sizes are best populations from NMFS Stock Assessment Reports where available (see Table 2 in above).
[5] Requested takes expressed as percentages of the larger regional population and NMFS Stock Assessment Reports, where available.
[6] Based on NMFS Stock Assessment Reports.

Applying the approach described above, approximately 36,600 km² would be within the 160 dB isopleth on one or more occasions during the proposed survey in 2014. The proposed survey in 2015 is expected to ensonify an almost identical area (to within 2%); therefore an ensonified area of 36,600 km² was used for the proposed surveys in 2014 and 2015. Because this approach does not allow for turnover in the marine 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 and pinnipeds would move away or toward the trackline as the *Langseth* approaches in response to increasing sound levels before the levels reach 160 dB (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 greater than or equal to 160 dB (rms).

Encouraging and Coordinating Research

USGS would coordinate the planned marine mammal monitoring program associated with the seismic survey with other parties that may have interest in this area and specified activity. USGS would coordinate with applicable U.S. agencies (e.g., NMFS), and would comply with their requirements.

Impact on Availability of Affected Species or Stock for Taking for Subsistence Uses

Section 101(a)(5)(D) of the MMPA also requires NMFS to determine that the authorization would not have an unmitigable adverse effect on the availability of marine mammal species or stocks for subsistence use. There are no relevant subsistence uses of marine mammals implicated by this action. Therefore, NMFS has determined that the total taking of affected species or stocks would not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

Analyses and Preliminary Determinations

Negligible Impact

Negligible impact is ''an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival'' (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (i.e., population-level effects). An estimate of the number of Level B harassment takes alone is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be ''taken'' through behavioral harassment, NMFS must consider other factors, such as the likely nature of any responses (their intensity, duration, etc.), the context of any responses (critical reproductive time or location, migration, etc.), as well as the number and nature of estimated Level A harassment takes, the number of estimated mortalities, and effects on habitat.

In making a negligible impact determination, NMFS evaluated factors such as:

(1) The number of anticipated injuries, serious injuries, or mortalities;

(2) The number, nature, and intensity, and duration of Level B harassment (all relatively limited); and

(3) The context in which the takes occur (i.e., impacts to areas of significance, impacts to local populations, and cumulative impacts when taking into account successive/contemporaneous actions when added to baseline data);

(4) The status of stock or species of marine mammals (i.e., depleted, not depleted, decreasing, increasing, stable, impact relative to the size of the population);

(5) Impacts on habitat affecting rates of recruitment/survival; and

(6) The effectiveness of monitoring and mitigation measures.

As described above and based on the following factors, the specified activities associated with the marine seismic survey are not likely to cause PTS, or other non-auditory injury, serious injury, or death. The factors include:

(1) The likelihood that, given sufficient notice through relatively slow ship speed, marine mammals are expected to move away from a noise source that is annoying prior to its becoming potentially injurious;

(2) The availability of alternate areas of similar habitat value for marine mammals to temporarily vacate the survey area during the operation of the airgun(s) to avoid acoustic harassment;

(3) The potential for temporary or permanent hearing impairment is relatively low and would likely be avoided through the implementation of the required monitoring and mitigation measures (including power-down and shut-down measures); and

(4) The likelihood that marine mammal detection ability by trained PSOs is high at close proximity to the vessel.

Table 4 of this document outlines the number of requested Level B harassment takes that are anticipated as a result of these activities. The type of Level B (behavioral) harassment that could result from the proposed action are described in the ''Potential Effects of the Specified Activity on Marine Mammals'' section above, and include tolerance, masking, behavioral disturbance, TTS, PTS, and non-auditory or physiological effects.

For the marine mammal species that may occur within the proposed action area, there are no known designated or important feeding and/or reproductive areas. Many animals perform vital functions, such as feeding, resting, traveling, and socializing, on a diel cycle (i.e., 24 hr cycle). Behavioral reactions to noise exposure (such as disruption of critical life functions, displacement, or avoidance of important habitat) are more likely to be significant if they last more than one diel cycle or recur on subsequent days (Southall *et al.,* 2007). While seismic operations are anticipated to occur on consecutive days, the estimated duration of the survey would last no more than a total of 36 days (a 17 to 18 day leg in August to September 2014 and a 17 to 18 day leg in April to August 2015). Additionally, the seismic survey would be increasing sound levels in the marine environment in a relatively small area surrounding the vessel (compared to the range of the animals). The seismic surveys would not take place in areas of significance for marine mammal feeding, resting, breeding, or calving and would not adversely impact marine mammal habitat. Furthermore, the vessel would be constantly travelling over distances, and some animals may only be exposed to and harassed by sound for less than a day.

NMFS's practice has been to apply the 160 dB re 1 μPa (rms) received level threshold for underwater impulse sound levels to determine whether take by Level B harassment occurs. Southall *et al.* (2007) provide a severity scale for ranking observed behavioral responses of both free-ranging marine mammals and laboratory subjects to various types of anthropogenic sound (see Table 4 in Southall *et al.* [2007]). NMFS has preliminarily determined, provided that the aforementioned mitigation and monitoring measures are implemented, the impact of conducting a marine seismic survey in the northwest Atlantic Ocean off of the Eastern Seaboard, August to September 2014 and April to August 2015, may result, at worst, in a modification in behavior and/or low-level physiological effects (Level B harassment) of certain species of marine mammals. No injuries, serious injuries, or mortalities are anticipated to occur as a result of USGS's planned marine seismic survey, and none are proposed to be authorized by NMFS.

While behavioral modifications, including temporarily vacating the area during the operation of the airgun(s), may be made by these species to avoid the resultant acoustic disturbance, the availability of alternate areas within these areas for species and the short and sporadic duration of the research activities, have led NMFS to preliminary determine that the taking by Level B harassment from the specified activity would have a negligible impact on the affected species in the specified geographic region. Due to the nature, degree, and context of Level B (behavioral) harassment anticipated and described (see ''Potential Effects on Marine Mammals'' section above) in this notice, the activity is not expected to impact rates of annual recruitment or survival for any affected species or stock, particularly given the NMFS and the applicant's proposal to implement mitigation and monitoring measures that would minimize impacts to marine mammals. Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, NMFS preliminarily finds that the total marine mammal take from USGS's proposed marine seismic survey would have a negligible impact on the affected marine mammal species or stocks.

Small Numbers

As mentioned previously, NMFS estimates that 34 species of marine mammals under its jurisdiction could be potentially affected by Level B harassment over the course of the IHA. The population estimates for the marine mammal species that may be taken by Level B harassment are provided in Table 4 of this document. No takes of pinnipeds are expected due to a lack of species observations within the proposed study area, the great distance offshore, and the deep water depths of the proposed study area. It should be noted that the stock populations for each marine mammal species in the NMFS Stock Assessment Reports are generally for species populations in U.S. waters, which may underestimate actual population sizes for species that have ranges that would include waters outside the U.S. EEZ.

NMFS has regional population and/or stock abundance estimates for the northwest Atlantic Ocean for 26 of the species under its jurisdiction that could potentially be affected by Level B harassment over the course of the IHA. The estimate of the number of individual cetaceans by species for which NMFS has such data that could be exposed to seismic sounds with received levels greater than or equal to 160 dB re 1 μPa (rms) during the proposed survey in 2014 and 2015 is as follows: 6 North Atlantic right, 41 humpback, 4 minke, 6 sei, 6 fin, 4 blue, and 166 sperm whales, which would represent 1.32/1.32, 0.353/4.96, 0.0014/0.0096, 0.058/1.68, 0.02/0.17, 0.468/0.909, and 1.259/7.255% of the affected regional populations/stocks, respectively. In addition, 4 northern bottlenose, 168 Cuvier's and *Mesoplodon* (i.e., True's, Gervais', Sowerby's, and Blainville's beaked whales), 66 dwarf sperm, and 66 pygmy sperm whales could be taken by Level B harassment during the proposed seismic survey, which would represent 0.01/unknown, unknown/1.286, unknown/2.369, unknown/1.744, and unknown/1.744% of the regional populations/stocks, respectively. Most of the cetaceans potentially taken by Level B harassment are delphinids; of the delphinids for which NMFS has regional population or stock abundance estimates for the northwest Atlantic Ocean, 499 bottlenose, 108 Atlantic white-sided, 2,112 Atlantic spotted, 1,448 pantropical spotted, 9,832 striped, 406 short-beaked common, 32 rough-toothed, and 684 Risso's dolphins could be taken by Level B harassment during the proposed seismic survey, which would represent unknown/0.644, 1.08/0.221, unknown/4.723, unknown/43.444, unknown/17.939, unknown/0.234, unknown/11.808, and unknown/3.748% of the regional populations/stocks, respectively. Of the remaining species for which NMFS has regional population or stock abundance estimates for the northwest Atlantic Ocean, 1,394 short-finned and 1,394 long-finned pilot whales, and 10 harbor porpoises could be taken by Level B harassment during the proposed seismic survey, which would represent 0.178/6.479, 0.178/5.253, and 0.002/0.013% of the regional population/stocks, respectively.

NMFS makes its small numbers determination on the numbers of marine mammals that would be taken relative to the populations of the affected species or stocks. NMFS calculates the number of animals as a percentage of the stock population for marine mammals in the U.S. EEZ. For USGS's proposed survey, approximately 80% in 2014 and 90% in 2015 of the tracklines occur within International Waters (i.e., the high seas) and are outside of the U.S. EEZ; therefore, the regional population is more applicable for NMFS's small numbers determinations as most of the ensonified area and estimated takes are further than 200 nmi from the U.S. coastline. The requested take estimates represented as a percentage of the stock in Table 4 (above) should be reduced to 20% and 10% of the calculated levels based on the amount of activity (i.e., 80% and 90%) planned to occur outside of the U.S. EEZ in 2014 and 2015. Using the approach of calculating the number of requested take estimates within the U.S. EEZ (20% in 2014 and 10% in 2015), the take estimates provided in the preceding paragraph should change as follows (rounding up): 2 North Atlantic right, 9 humpback, 2 minke, 2 sei, 2 fin, 2 blue, and 26 sperm whales, which would represent 0.44, 1.09, <0.01, 0.56, 0.06, 0.46, and 1.14% of the affected stocks, respectively; 26 Cuvier's and *Mesoplodon* (i.e., True's, Gervais', Sowerby's, and Blainville's beaked whales), 11 dwarf sperm, and 11 pygmy sperm whales, which would represent 0.4, 0.37, 0.29, and 0.29% of the affected stocks, respectively; 75 bottlenose, 17 Atlantic white-sided, 318 Atlantic spotted, 218 pantropical spotted, 1,476 striped, 62 short-beaked common, 6 rough-toothed, and 104 Risso's dolphins could be taken by Level B harassment during the proposed seismic survey, which would represent 0.1, 0.04, 0.71, 6.54, 2.69, 0.04, 2.21, and 0.57% of the affected stocks, respectively; and 210 short-finned and 210 long-finned pilot whales, and 2 harbor porpoises, which would represent 0.98, 0.79, and <0.01% of the affected stocks, respectively. No takes of pinnipeds are expected within the proposed study area. The requested take estimates represent a small number relative to the affected species' with a known regional population or stock size (i.e., all for which data are available are less than 6.54% of the regional populations).

No known current regional population or stock abundance estimates for the northwest Atlantic Ocean are available for the eight remaining species under NMFS's jurisdiction that could potentially be affected by Level B harassment over the course of the IHA. These species include the Bryde's whale, Fraser's, spinner, and Clymene dolphins, and the melon-headed, pygmy killer, false killer, and killer whales. Therefore, NMFS is using older abundance estimates or abundance estimates from other areas such as the northern Gulf of Mexico stock, regional ocean basins (e.g., eastern tropical Pacific Ocean), or global summation to aid its small numbers determination for these species. These abundance estimates are considered the best available information.

Bryde's whales are distributed worldwide in tropical and sub-tropical waters and their occurrence in the proposed study area is rare. In the western North Atlantic Ocean, Bryde's whales are reported from off the southeastern U.S. and southern West Indies to Cabo Frio, Brazil (Leatherwood and Reeves, 1983). No stock of Bryde's whales has been identified in U.S. waters off the Atlantic coast. The northern Gulf of Mexico population is considered a separate stock and has a best abundance estimate of 33 animals. In addition, there are estimated to be 20,000 to 30,000 animals in the North Pacific Ocean. Based on all of these factors, NMFS finds that the requested take estimate of 6 Bryde's whales represents a small number relative to the affected species' population size.

Fraser's dolphins are distributed worldwide in tropical waters and their occurrence in the proposed study area is rare. There is no abundance estimates for either the western North Atlantic or the northern Gulf of Mexico stocks. The western North Atlantic population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock. The numbers of Fraser's dolphins off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock, since it is rarely seen in any surveys. The population size for Fraser's dolphins is unknown; however, about 289,000 animals occur in the eastern tropical Pacific Ocean (Jefferson *et al.,* 2008). The estimated number of requested takes for 200 Fraser's dolphins represents 0.06% of the eastern tropical Pacific Ocean population. Fraser's dolphins are distributed worldwide in tropical waters and their occurrence in the proposed study area is rare. Based on all these factors, NMFS finds that the requested take estimate represents a small number relative to the affected species' population size.

Spinner dolphins are found in all tropical and sub-tropical oceans and their occurrence in the proposed study area is rare. The western North Atlantic population of spinner dolphins is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock. The numbers of spinner dolphins off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock since it was rarely seen in any of the surveys. The best abundance estimate available for northern Gulf of Mexico spinner dolphins is 11,441 animals. The estimated number of requested takes of 130 spinner dolphins represents 1.13% of the northern Gulf of Mexico stock. Based on all of these factors, NMFS finds that the requested take estimates represents a small number relative to the affected species' population size.

The Clymene dolphin is endemic to tropical and sub-tropical waters of the Atlantic, including the Caribbean Sea and Gulf of Mexico (Jefferson and Curry, 2003; Jefferson *et al.,* 2008). This species prefer warm waters and records extend from southern Brazil and Angola and north to Mauritania and New Jersey off the U.S. east coast (Jefferson *et al.,* 2008). Their occurrence in the proposed study area is rare. The abundance estimate for the Clymene dolphin in the western North Atlantic was 6,086 in 203; this estimate is older than eight years and is considered unreliable (Wade and Angliss, 1997; Mullin and Fulling, 2003). However, this abundance estimate is the first and only estimate to date for this species in the U.S. Atlantic EEZ and represents the best abundance estimate. The estimated numbers of requested takes of 411 Clymene dolphins represent 6.75% of the western North Atlantic 2003 stock or 318.6% of the northern Gulf of Mexico stock. Based on all of these factors, NMFS finds that the requested take estimate represents a small number relative to the affected species' population or stock size.

Melon-headed whales are distributed worldwide in tropical to sub-tropical waters and their occurrence in the proposed study area is rare. The western North Atlantic population is provisionally being considered a separate stock from the northern Gulf of Mexico stock, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock. The numbers of melon-headed whales off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock, since it was rarely seen in any surveys. The best abundance estimate available for northern Gulf of Mexico melon-headed whales is 2,235 animals. The estimated number of requested takes of 200 melon-headed whales represents 8.94% of the northern Gulf of Mexico stock. Based on all of these factors, NMFS finds that the requested take estimate represents a small number relative to the affected species' population or stock size.

The pygmy killer whale is distributed worldwide in tropical to sub-tropical waters and their occurrence in the proposed study area is rare. The western North Atlantic population of pygmy killer whales is provisionally being considered one stock for management purposes. The numbers of pygmy killer whales off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock, since it was rarely seen in any surveys. The best abundance estimate available for the northern Gulf of Mexico pygmy killer whale is 152 animals. In addition, there are estimated to be 39,000 pygmy killer whales in the eastern tropical Pacific Ocean. The estimated number of requested takes of 50 pygmy killer whales represents 32.89% of the northern Gulf of Mexico stock, and 0.13% of the eastern tropical Pacific Ocean. Based on all of these factors, NMFS finds that the requested take estimate represents a small number relative to the affected species' population or stock size.

The false killer whale is distributed worldwide throughout warm temperate and tropical oceans and their occurrence in the proposed study area is rare. No stock has been identified for false killer whales in U.S. waters off the Atlantic coast. The Gulf of Mexico population is provisionally being considered one stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock. The current population size for the false killer whale in the northern Gulf of Mexico is unknown because they survey data is more than 8 years old; however, the most recent abundance estimate pooled from 2004 to 2004 was 777 animals (Wade and Angliss, 1997; Mullin, 2007). The estimated number of requested takes of 30 false killer whales represents 3.86% of the northern Gulf of Mexico stock. Based on all of these factors, NMFS finds that the requested take estimate represents a small number relative to the affected species' population or stock size.

Killer whales are characterized as uncommon or rare in waters of the U.S. Atlantic EEZ (Katona *et al.,* 1988). Their distribution extends from the Arctic ice-edge to the West Indies, often in offshore and mid-ocean areas. There are estimated to be at least approximately 92,500 killer whales worldwide. The size of the western North Atlantic stock population off the eastern U.S. coast is unknown. The northern Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock. The best abundance estimate available for northern Gulf of Mexico killer whales is 28 animals. The estimated number of requested takes of 14 killer whales represents 0.02% of the worldwide population, and 50% of the northern Gulf of Mexico stock. Based on all of these factors, NMFS finds that the requested take estimate represents a small number relative to the affected species' population or stock size.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration of the implementation of the mitigation and monitoring measures, NMFS preliminarily finds that small numbers of marine mammals would be taken relative to the populations of the affected species or stocks. See Table 4 for the requested authorized take number of marine mammals.

Endangered Species Act

Of the species of marine mammals that may occur in the proposed survey area, several are listed as endangered under the ESA, including the North Atlantic right, humpback, sei, fin, blue, and sperm whales. Under section 7 of the ESA, USGS has initiated formal consultation with the NMFS, Office of Protected Resources, Endangered Species Act Interagency Cooperation Division, on this proposed seismic survey. NMFS's Office of Protected Resources, Permits and Conservation Division, has initiated formal consultation under section 7 of the ESA with NMFS's Office of Protected Resources, Endangered Species Act Interagency Cooperation Division, to obtain a Biological Opinion evaluating the effects of issuing the IHA on threatened and endangered marine mammals and, if appropriate, authorizing incidental take. NMFS would conclude formal section 7 consultation prior to making a determination on whether or not to issue the IHA. If the IHA is issued, USGS, in addition to the mitigation and monitoring requirements included in the IHA, would be required to comply with the Terms and Conditions of the Incidental Take Statement corresponding to NMFS's Biological Opinion issued to both USGS and NMFS's Office of Protected Resources.

National Environmental Policy Act

With USGS's complete application, USGS provided NMFS a ''Draft Environmental Assessment for Seismic Reflection Scientific Research Surveys During 2014 and 2015 in Support of Mapping the U.S. Atlantic Seaboard Extended Continental Margin and Investigating Tsunami Hazards,'' prepared by RPS Evan-Hamilton, Inc., in association with YOLO Environmental, Inc., GeoSpatial Strategy Group, and Ecology and Environment, Inc., on behalf of USGS. The EA analyzes the direct, indirect, and cumulative environmental impacts of the proposed specified activities on marine mammals including those listed as threatened or endangered under the ESA. Prior to making a final decision on the IHA application, NMFS would either prepare an independent EA, or, after review and evaluation of the USGS EA for consistency with the regulations published by the Council of Environmental Quality (CEQ) and NOAA Administrative Order 216–6, Environmental Review Procedures for Implementing the National Environmental Policy Act, adopt the EA and make a decision of whether or not to issue a Finding of No Significant Impact (FONSI).

Proposed Authorization

As a result of these preliminary determinations, NMFS proposes to issue an IHA to USGS for conducting the high-energy marine seismic survey in the northeast Atlantic Ocean off the Eastern Seaboard, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated. The proposed IHA language is provided below:

The NMFS hereby authorizes the U.S. Geological Survey, Pacific Coastal and Marine Geology Science Center, Mail Stop 999, 345 Middlefield Road, Menlo Park, California 94025, Lamont-Doherty Earth Observatory of Columbia University, P.O. Box 1000, 61 Route 9W, Palisades, New York 10964–8000, and National Science Foundation, Division of Ocean Sciences, 4201 Wilson Boulevard, Suite 725, Arlington, Virginia 22230 (herein referred to USGS) under section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA) (16 U.S.C. 1371(a)(5)(D)), to harass small numbers of marine mammals incidental to a high-energy marine geophysical (seismic) survey conducted by the R/V *Marcus G. Langseth* (*Langseth*) in the northeast Atlantic Ocean off the Eastern Seaboard, August to September 2014 and April to August 2015:

1. This Authorization is valid from August 15, 2014 through August 14, 2015.

2. This Authorization is valid only for the *Langseth's* specified activities associated with seismic survey operations as described in USGS's IHA application and ''Draft Environmental Assessment for Seismic Reflection Scientific Surveys During 2014 and 2015 in Support of Mapping the U.S. Atlantic Seaboard Extended Continental Margin and Investigating Tsunami Hazards'' that shall occur in the following specified geographic area (bounded by the following geographical coordinates):

40.5694° North, –66.5324° West;
38.5808° North, –61.7105° West;
29.2456° North, –72.6766° West;
33.1752° North, –75.8697° West;
39.1583° North, –72.8697° West;

The proposed activities for 2014 will generally occur within the outer portions of the study area. The proposed activities for 2015 will in-fill more of the study area. Water depths range from approximately 1,450 to 5,400 m (see Figure 1 and 2 of the IHA application); no survey lines will extend to water depths less than 1,000 m. The tracklines proposed for both 2014 and 2015 would be in International Waters (approximately 80% in 2014 and 90% in 2015) and in the U.S. EEZ, as specified in USGS's Incidental Harassment Authorization application and the associated USGS Environmental Assessment.

3. *Species Authorized and Level of Takes*

(a) The incidental taking of marine mammals, by Level B harassment only, is limited to the following species in the waters of the northeast Atlantic off the Eastern Seaboard:

(i) *Mysticetes*—see Table 4 for authorized species and take numbers.

(ii) *Odontocetes*—see Table 4 for authorized species and take numbers.

(iii) If any marine mammal species are encountered during seismic activities that are not listed in Table 4 for authorized taking and are likely to be exposed to sound pressure levels (SPLs) greater than or equal to 160 dB re 1 μPa (rms), then the USGS must alter speed or course or shut-down the airguns to avoid take.

(b) The taking by injury (Level A harassment), serious injury, or death of any of the species listed in Condition 3(a) above or the taking of any kind of any other species of marine mammal is prohibited and may result in the modification, suspension or revocation of this Authorization.

4. The methods authorized for taking by Level B harassment are limited to the following acoustic sources without an amendment to this Authorization:

(a) A 36 airgun array with a total volume of 6,600 cubic inches (in^3) (or smaller);

(b) A multi-beam echosounder; and

(c) A sub-bottom profiler.

5. 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 and/or by email to *Jolie.Harrison@noaa.gov* and *Howard.Goldstein@noaa.gov.*

6. *Mitigation and Monitoring Requirements*

The USGS is required to implement the following mitigation and monitoring requirements when conducting the specified activities to achieve the least practicable impact on affected marine mammal species or stocks:

(a) Utilize two, NMFS-qualified, vessel-based PSVO (except during meal times and restroom breaks, when at least one PSVO shall be on watch) to visually watch for and monitor marine mammals near the seismic source vessel during daytime airgun operations (from nautical twilight-dawn to nautical twilight-dusk) and before and during ramp-ups of airguns day or night.

(i) The *Langseth'*s vessel crew shall also assist in detecting marine mammals, when practicable.

(ii) PSVOs shall have access to reticle binoculars (7 x 50 Fujinon), big-eye binoculars (25 x 150), optical range finders, and night vision devices.

(iii) PSVO shifts shall last no longer than 4 hours at a time.

(iv) When feasible, PSVOs shall also make observations during daytime periods when the seismic system is not operating for comparison of animal abundance and behavioral reactions during, between, and after airgun operations.

(v) PSVOs shall conduct monitoring while the airgun array and streamer(s) are being deployed or recovered from the water.

(b) PSVOs shall 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; 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, and sun glare; and

(iii) The data listed under Condition 6(c)(ii) shall 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.

Passive Acoustic Monitoring

(c) Utilize the 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 NMFS-qualified PSO and/or expert bioacoustician (i.e., PSAO) shall monitor the PAM at all times in shifts no longer than 6 hours. An expert bioacoustician shall design and set up the PAM system and be present to operate to oversee PAM, and available when technical issues occur during the survey.

(d) Do and record the following when an animal is detected by the PAM:

(i) Notify the on-duty PSVO(s) immediately of the presence 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. The acoustic detection can also be recorded for further analysis.

Buffer and Exclusion Zones

(e) Establish a 160 dB re 1 μPa (rms) buffer zone as well as 180 and 190 dB re 1 μPa (rms) exclusion zone for marine mammals before the 2-string airgun array (6,600 in^3) is in operation; and a 180 and 190 dB re 1 μPa (rms) exclusion zone before a single airgun (40 in^3) is in operation, respectively. See Table 1 (above) for distances and exclusion zones.

Visual Monitoring at the Start of Airgun Operations

(f) Visually observe the entire extent of the exclusion zone (180 dB re 1 μPa [rms] for cetaceans; see Table 1 [above] for distances) using NMFS-qualified PSVOs, for at least 30 minutes prior to starting the airgun array (day or night).

(i) If the PSVO observes a marine mammal within the exclusion zone, USGS must delay the seismic survey until the marine mammal(s) has left the area. If the PSVO sees a marine mammal that surfaces, then dives below the surface, the PSVO shall wait 30 minutes. If the PSVO sees no marine mammals during that time, he/she should assume that the animal has moved beyond the exclusion zone.

(ii) If for any reason the entire radius cannot be seen for the entire 30 minutes (i.e., rough seas, fog, darkness), or if marine mammals are near, approaching, or within the exclusion zone, the airguns may not resume airgun operations.

(iii) If one airgun is already running at a source level of at least 180 dB re 1 μPa (rms), USGS may start the second airgun, and subsequent airguns, without observing the entire exclusion zone for 30 minutes prior, provided no marine mammals are known to be near the exclusion zone (in accordance with Condition 6[h] below).

Ramp-Up Procedures

(g) Ramp-up procedures at the start of seismic operations or after a shut-down—Implement 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 10 minutes, which means starting with the smallest airgun first and adding airguns 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 PSVOs shall monitor the 180 and 190 dB exclusion zone for cetaceans and pinnipeds, respectively, and if marine mammals are sighted within or about to enter the relevant exclusion zone, a power-down, or shut-down shall be implemented as though the full array were operational. Therefore, initiation of ramp-up procedures from a shut-down or at the beginning of seismic operations requires that the PSVOs be able to view the full exclusion zone as described in Condition 6(m) (below).

Power-Down Procedures

(h) Power-down the airgun(s) if a marine mammal is detected within, approaches, or enters the relevant exclusion zone (as defined in Table 1, above). A power-down means reducing the number of operating airguns to a single operating 40 in^3 airgun, which reduces the exclusion zone to the degree that the animal(s) is no longer in or about to enter it for the full airgun array. 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.

(i) Following a power-down, if the marine mammal approaches the small designated exclusion zone, the airguns must then be completely shut-down. Airgun activity shall not resume until the PSVO has visually observed the marine mammal(s) exiting the exclusion zone and is not likely to return, or has not been seen within the exclusion zone for 15 minutes for species with shorter dive durations (small odontocetes) or 30 minutes for species with longer dive durations (mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, killer, and beaked whales).

(j) Following a power-down and subsequent animal departure, the airgun operations may resume at full power. Initiation requires that PSVOs can effectively monitor the full exclusion zones described Condition 6(g). If the PSVO(s) sees a marine mammal within or about to enter the relevant zones, when a course/speed alteration, power-down, or shut-down will be implemented.

Shut-Down Procedures

(k) Shut-down the airgun(s) if a marine mammal is detected within, approaches, or enters the relevant exclusion zone (as defined in Table 1, above). A shut-down means all operating airguns are shut-down (i.e., turned off).

(l) Following a shut-down, if the PSVO has visually confirmed that the animal has departed the relevant exclusion zone (and is not likely to return) within a period less than or equal to 10 minutes after the shut-down, the airgun operations may resume at full power. If the PSVO has not observed the marine mammal(s) exiting the exclusion zone, the airgun operations shall not resume for 15 minutes for species with shorter dive durations (small odontocetes) or 30 minutes for species with longer dive durations (mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, killer, and beaked whales). Following a shut-down, the *Langseth* may resume following ramp-up procedures described in Condition 6(h).

Speed or Course Alteration

(m) 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 exclusion zone, further mitigation measures, such as a power-down or shut-down, shall be taken.

Survey Operations at Night

(n) 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.

(o) 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 PSO(s) on duty.

Mitigation Airgun

(p) Use of small-volume airgun (i.e., mitigation airgun) during turns and maintenance shall be operated at approximately one shot per minute and would not be operated for longer than three hours in duration. During turns or brief transits between seismic tracklines, one airgun will continue operating.

Special Procedures for Situations or Species of Concern

(q) If a North Atlantic right whale (*Eubalaena glacialis*) is visually sighted, the airgun array shall be shut-down regardless of the distance of the animal(s) to the sound source. The array shall not resume firing until 30 minutes after the last documented whale visual sighting.

(r) Concentrations of humpback (*Megaptera novaeangliae*), sei (*Balaenoptera borealis*), fin (*Balaenoptera physalus*), blue (*Balaenoptera musculus*), and/or sperm whales (*Physeter macrocephalus*) will be avoided if possible (i.e., exposing concentrations of animals to 160 dB), and the array will be powered-down if necessary. 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.).

7. Reporting Requirements

The USGS is required to:

(a) Submit a draft comprehensive report on all activities and monitoring results to the Office of Protected Resources, NMFS, within 90 days of the completion of the *Langseth's* cruise in the northwest Atlantic Ocean off the Eastern Seaboard after the end of phase 1 in 2014 and another draft comprehensive report after the end of phase 2 in 2015. 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 power-downs and shut-downs), 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 (based on visual observation) at received levels greater than or equal to 160 dB re 1 μPa (rms) and/or 180 dB re 1 μPa (rms) for cetaceans and 190 dB re 1 μPa (rms) for pinnipeds with a discussion of any specific behaviors those individuals exhibited; and (B) may have been exposed (based on modeled values for the 36 airgun array) to the seismic activity at received levels greater than or equal to 160 dB re 1 μPa (rms) and/or 180 dB re 1 μPa (rms) for cetaceans and 190 dB re 1 μPa (rms) for pinnipeds 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 Biological Opinion's Incidental Take Statement (ITS); and (B) mitigation measures of the Incidental Harassment Authorization. For the Biological Opinion, the report shall 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, NMFS, within 30 days after receiving comments from NMFS on the draft report. If NMFS decides that the draft report needs no comments, the draft report shall be considered to be the final report.

Reporting Prohibited Take

8. In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by this Authorization (if issued), such as an injury (Level A harassment), serious injury, or mortality (e.g., ship-strike, gear interaction, and/or entanglement), USGS shall immediately cease the specified activities and immediately 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* and

Howard.Goldstein@noaa.gov and the NMFS Greater Atlantic Region Marine Mammal Stranding Network at 866–755–6622 (*Mendy.Garron@noaa.gov*), and NMFS Southeast Region Marine Mammal Stranding Network at 877–433–8299 (*Blair.Mase@noaa.gov* and *Erin.Fougeres@noaa.gov*). The report must include the following information:

(a) Time, date, and location (latitude/longitude) of the incident; the name and type of vessel involved; the vessel's speed during and leading up to the incident; description of the incident; status of all sound source use 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 marine mammal observations in the 24 hours preceding the incident; species identification or description of the animal(s) involved; the fate of the animal(s); and photographs or video footage of the animal (if equipment is available).

USGS shall not resume its activities until NMFS is able to review the circumstances of the prohibited take. NMFS shall work with USGS to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. USGS may not resume their activities until notified by NMFS via letter, email, or telephone.

Reporting an Injured or Dead Marine Mammal With an Unknown Cause of Death

In the event that USGS discovers an injured or dead marine mammal, and the lead 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 described in the next paragraph), USGS will immediately 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* and *Howard.Goldstein@noaa.gov,* and the NMFS Greater Atlantic Region Marine Mammal Stranding Network (866–755–6622) and/or by email to the NMFS Greater Atlantic Regional Stranding Coordinator (*Mendy.Garron@noaa.gov*), and the NMFS Southeast Region Marine Mammal Stranding Network (877–433–8299) and/or by email to the Southeast Regional Stranding Coordinator (*Blair.Mase@noaa.gov*) and Southeast Regional Stranding Program Administrator (*Erin.Fougeres@noaa.gov*). The report must include the same information identified in Condition 8(a) above. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with USGS to determine whether modifications in the activities are appropriate.

Reporting an Injured or Dead Marine Mammal Not Related to the Activities

In the event that USGS 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 activities authorized in Condition 2 of this Authorization (e.g., previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), USGS shall 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* and *Howard.Goldstein@noaa.gov,* and the NMFS Greater Atlantic Marine Mammal Stranding Network (866–755–622), and/or by email to the Greater Atlantic Regional Stranding Coordinator (*Mendy.Garron@noaa.gov*), and the NMFS Southeast Regional Stranding Network (877–433–8299), and/or by email to the Southeast Stranding Coordinator (*Blair.Mase@noaa.gov*) and Southeast Regional Stranding Program Administrator (*Erin.Fourgeres@noaa.gov*), within 24 hours of the discovery. USGS shall provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS and the Marine Mammal Stranding Network. Activities may continue while NMFS reviews the circumstances of the incident.

Endangered Species Act (ESA) Biological Opinion and Incidental Take Statement (ITS)

9. USGS is required to comply with the Terms and Conditions of the ITS corresponding to NMFS's ESA Biological Opinion issued to both USGS and NMFS's Office of Protected Resources, Permits and Conservation Division.

10. A copy of this Authorization and the ITS must be in the possession of all contractors and PSOs operating under the authority of this Incidental Harassment Authorization.

Request for Public Comments

NMFS requests comments on our analysis, the draft authorization, and any other aspect of the notice of proposed IHA for USGS's proposed marine seismic survey in the Atlantic Ocean off the Eastern Seaboard. Please include with your comments any supporting data or literature citations to help inform our final decision on USGS's request for an MMPA authorization. Concurrent with the publication of this notice in the **Federal Register,** NMFS is forwarding copies of this application to the Marine Mammal Commission and its Committee of Scientific Advisors.

Dated: June 16, 2014.

Perry F. Gayaldo,

Deputy Director, Office of Protected Resources, National Marine Fisheries Service.

[FR Doc. 2014–14426 Filed 6–20–14; 8:45 am]

BILLING CODE 3510–22–P

15 APPENDIX G: COMMENTS RECEIVED IN RESPONSE TO NMFS FR NOTICE

MARINE MAMMAL COMMISSION

23 July 2014

Ms. Jolie Harrison, Chief
Permits and Conservation Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway
Silver Spring, MD 20910-3225

Dear Ms. Harrison:

The Marine Mammal Commission (the Commission), in consultation with its Committee of Scientific Advisors on Marine Mammals, has reviewed the application submitted by the U.S. Geological Survey (USGS), Lamont-Doherty Earth Observatory (LDEO), and National Science Foundation (NSF) seeking authorization under section 101(a)(5)(D) of the Marine Mammal Protection Act (the MMPA) to take small numbers of marine mammals by harassment. The taking would be incidental to a marine geophysical survey to be conducted off the east coast of the United States. The Commission also has reviewed the National Marine Fisheries Service's (NMFS) 23 June 2014 notice announcing receipt of the application and proposing to issue the authorization, subject to certain conditions (79 Fed. Reg. 35642).

Some issues raised in previous letters regarding geophysical surveys reflect Commission concerns that apply more broadly to incidental take authorization applications beyond USGS's proposed application. The Commission has recommended numerous times that NMFS adjust density estimates using some measure of uncertainty when available density data originate from different geographical areas and temporal scales and that it formulate policy or guidance shaping a consistent approach for how applicants should incorporate uncertainty in density estimates. NMFS has indicated that it is currently evaluating available density information and working on guidance that would outline a consistent approach for addressing uncertainty in specific situations where certain types of data are or are not available (78 Fed. Reg. 57354). Further, the Commission has recommended that NMFS follow a consistent approach of requiring the assessment of Level B harassment takes for specific types of sound sources (e.g., sub-bottom profilers, echosounders, side-scan sonar, and fish-finding sonar) by all applicants who propose to use them. NMFS has indicated that it is evaluating the broader use of those types of sources to determine under what specific circumstances requests for incidental taking would be advisable (or not) and also is working on guidance that would outline a consistent approach for addressing potential impacts from those types of sources (78 Fed. Reg. 57354). The Commission welcomes the opportunity to meet with NMFS to review these higher-level recommendations, as well as those specific to USGS's application.

BACKGROUND

USGS, with LDEO as the operator, proposes to conduct a high-energy, 2D geophysical survey in the U.S. exclusive economic zone (EEZ) and international waters of the northwest Atlantic Ocean from New England to Florida. The purpose of the proposed survey is to identify the outer limits of the U.S. continental shelf and study the sudden mass transport of sediments down the continental shelf that may pose significant tsunami-related hazards to Atlantic and Caribbean coastal communities. The survey would be conducted in waters estimated to be 1,400 to greater than 5,400 m in depth with approximately 3,165 km of tracklines during both phase I (up to 18 days in August–September 2014) and phase II (up to 18 days between April and August 2015). LDEO would use the R/V *Marcus G. Langseth*, owned by NSF, to operate a 36-airgun array (nominal source levels 236 to 265 dB re 1μPa (peak-to-peak)) at 9 m depth. The *Langseth* also would tow one hydrophone streamer, 8,000 m in length, during the survey. In addition, LDEO would operate a 10.5- to 13-kHz multibeam echosounder and a 3.5-kHz sub-bottom profiler continuously throughout the survey.

NMFS preliminarily has determined that, at most, the proposed activities would result in a temporary modification in the behavior of small numbers of up to 34 species of marine mammals and that any impact on the affected species would be negligible. NMFS does not anticipate any take of marine mammals by death or serious injury. It also believes that the potential for temporary or permanent hearing impairment will be at the least practicable level because of the proposed mitigation and monitoring measures. Those measures include monitoring exclusion and buffer zones and using power-down, shut-down, and ramp-up procedures. In addition, USGS would shut down the airguns immediately if and when a North Atlantic right whale is sighted, regardless of the distance from the *Langseth*. Ramp-up procedures would not be initiated until the right whale has not been seen at any distance for 30 minutes. Further, USGS would power down the array, if possible, when concentrations of humpback, sei, fin, blue, and/or sperm whales (six or more individuals that do not appear to be traveling and are feeding, socializing, etc.) are observed within the Level B harassment zone (based on 160 dB re 1 μPa).

Staff members from NMFS, NSF, USGS, LDEO, and the Commission met in March 2013 to discuss some of the Commission's ongoing concerns regarding the potential effects of geophysical surveys. Although a number of concerns were discussed and several resolved, the following sections highlight areas that, in the Commission's view, warrant further attention.

RATIONALE AND RECOMMENDATIONS

Uncertainty in estimating exclusion and buffer zones

The Commission continues to have concerns regarding the method used to estimate exclusion and buffer zones (based on Level A and B harassment, respectively) and the numbers of takes for USGS- and NSF-funded geophysical research. These concerns date back to 2010 (please refer to the Commission's 12 March, 19 April, and 24 June 2013 and 31 March 2014 letters for detailed rationale). Briefly, LDEO performs acoustic modeling for geophysical research conducted by the *Langseth*. For at least 6 years (and likely more than the last 10 years), LDEO has estimated exclusion and buffer zones using a simple ray trace–based modeling approach that assumes spherical spreading, a constant sound speed, and no bottom interactions (Diebold et al. 2010). That model does not incorporate environmental characteristics of the specific study area including sound speed profiles and refraction within the water column, bathymetry/water depth, sediment properties/bottom loss, or absorption coefficients. However, LDEO continues to believe that its model generally is conservative when compared to in-situ sound propagation measurements of the R/V *Maurice Ewing*'s arrays (i.e., 6-, 10-, 12-, and 20-airgun arrays) and the R/V *Langseth*'s 36-airgun array from the Gulf of Mexico (Tolstoy et al. 2004, Tolstoy et al. 2009, Diebold et al. 2010[1]). LDEO also has noted the model is most directly applicable to deep water (> 1,000 m). Diebold et al. (2010) noted the limited applicability of LDEO's model when sound propagation is dependent on water temperature, water depth, bathymetry, and bottom-loss parameters. They further indicated that modeling could be improved by including realistic sound speed profiles within the water column. In addition, Tolstoy et al. (2009) acknowledged that sound propagation depends on water depth, bathymetry, and tow depth of the array and that sound propagation varies with environmental conditions and should be measured at multiple locations.

LDEO has stated that the model for deep water overestimates the received sound levels at a given distance but is still valid for defining exclusion zones at various tow depths. However, LDEO indicated in Appendix A of the environmental assessment for the proposed survey that the calibration data show that at greater distances (4 to 5 km) sound reflected from the sea floor and refracted from the sub-seafloor dominate, while the direct arrivals become weak and/or incoherent (Figures 11, 12, and 16 in Appendix H of the NSF/USGS programmatic environmental impact statement for geophysical surveys (PEIS)). LDEO stated that aside from local topography effects, the region around the critical distance (~5 km in Figures 11 and 12 and ~4 km in Figure 16 in Appendix H of the NSF/USGS PEIS) is where the observed sound levels rise very close to the mitigation model curve. Although the observed sound levels occur primarily below the mitigation model curve, that finding further substantiates the fact that the model is not necessarily indicative of site-specific environmental conditions, including bathymetry and sound speed profiles. The reflective/refractive arrivals are the very measurements that should be accounted for in site-specific modeling and ultimately determine underwater sound propagation. Ignoring those factors is a serious flaw of LDEO's model. Furthermore, the estimated exclusion zones for the proposed survey (36-airgun array towed at 9 m in depth) are smaller[2] than previously authorized and the buffer zones are larger[3] than previously authorized (75 Fed. Reg. 44770; 76 Fed. Reg. 75525, 49737; 77 Fed. Reg. 25693, 41755). This is a bit perplexing as the Commission is unaware of any changes to LDEO's model[4]. All these shortcomings reinforce the Commission's ongoing concerns regarding the estimation of exclusion and buffer zones for USGS- and NSF-funded geophysical surveys.

Those concerns are based primarily on the failure to verify the use of LDEO's model under the specific environmental conditions that would be encountered with each survey. For that reason, the Commission has recommended that NMFS or the relevant entity estimate exclusion and buffer zones using either empirical measurements from the particular survey site <u>or</u> a model that accounts

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[1] Diebold et al. (2010) also presented data on the 18-airgun array from the Gulf of Mexico.
[2] 286 vs. 400 m for the 190-dB re 1 μPa threshold and 927 vs. 940 m for the 180-dB re 1 μPa threshold.
[3] 5,780 vs. 3,850 m for the 160-dB re 1 μPa threshold.
[4] Appendix H of the PEIS has been used in support of LDEO's model since it was available for public review in 2010 and, to the Commission's knowledge, has been unchanged since that time. Those figures have included the maximum sound pressure level trajectories and have been based on sound exposure levels, with a presumed 10 dB difference for sound pressure levels.

for the conditions in the proposed survey area. The model should incorporate operational parameters (e.g., tow depth, source level, number/spacing of active airguns) and site-specific environmental parameters (e.g., sound speed profiles, refraction in the water column, bathymetry/water depth, sediment properties/bottom loss, and wind speed). In March 2013, LDEO indicated that it might be able to compare its model to hydrophone data collected during previous surveys in environmental conditions other than those in the Gulf of Mexico[5] (i.e., deep and intermediate waters in cold water environments that may have surface ducting conditions, shallow-water environments, etc.). The Commission understands that LDEO has been analyzing hydrophone data from waters off Washington State to allow comparisons of empirically derived estimates to model-estimated exclusion and buffer zones, but those results do not appear to have been published yet. The Commission is pleased to hear of this work but encourages LDEO to make such comparisons at various sites, not just in waters off Washington, if it intends to continue using a model that does not incorporate site-specific parameters. The Commission recommended in its 24 June 2013 letter that such comparisons be made prior to submitting applications for geophysical surveys to be conducted in 2014. The Commission further recommended that if LDEO and NSF either do not have enough data to compare LDEO's modeled results to other environments, or choose not to assess the accuracy of the model, then they should re-estimate the exclusion and buffer zones and associated takes of marine mammals using site-specific parameters (including sound speed profiles, bathymetry, and bottom characteristics) for all future applications that use LDEO's model. Neither approach was used for the proposed incidental harassment authorization.

NMFS has indicated that NSF, LDEO, and other relevant entities (USGS, Scripps Institution of Oceanography (Scripps)) are providing sufficient scientific justification for their take estimates. The Commission disagrees with this conclusion, given that the estimates are based on LDEO's model or empirical measurements in the Gulf of Mexico, while recent activities would occur in areas such as the North Atlantic and the Antarctic. Environmental conditions in waters off New Jersey (up to 1,500 m in depth) indicate a surface duct at 50 m, in-water refraction, and bathymetry and sediment characteristics that reflect sound in summer. Further, conditions near the mid-Atlantic ridge (up to 5,000 m in depth) indicate a pronounced sound channel at approximately 1,000 m depth and a downward-refracting stratified surface layer in summer, with nearly identical sound speed profiles in spring and fall[6]. Although a surface duct likely is present in the proposed survey area, none of the site-specific parameters are accounted for in LDEO's model[7].

In a recent sound exposure modeling workshop that was attended by numerous entities (including NMFS, NSF, LDEO, USGS, and the Commission), experts confirmed that sound speed profiles and bathymetry/sediment characteristics were the most important factors affecting

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[5] Diebold et al. (2010) supported such an approach, stating that streamer data can provide an accurate assessment of sound exposure levels at the relevant ranges for mitigation in shallow-water environments (≤ 100 m). They further indicated it seems logical and advantageous that those data be monitored in real time to fine tune a priori mitigation zones in shallow-water environments.

[6] NSF and USGS's PEIS included environmental data from the continental shelf close to the proposed survey.

[7] NMFS has acknowledged that although the acoustic energy within the third and fourth lobes (330–667 Hz) of the impulsive waveform would be trapped in the surface duct and propagated to greater distances, those lobes represent only a fraction of the total acoustic energy (specifically for the LDEO New Jersey survey; 79 Fed. Reg. 38500). The Commission notes that the impulsive waveform includes sound energy in frequencies even greater than 667 Hz, including contributions from mid- and high-frequency sound that may be trapped in the surface duct and propagated further than sound below 330 Hz.

underwater sound propagation and should be included in related modeling. While LDEO presented various aspects of its model during the workshop and indicated that the model was fast, inexpensive, and simple to use, none of those attributes support its applicability or accuracy. Further, LDEO indicated that the model is more closely related to a source model that compares airgun arrays and that it is not representative of modeling in the actual environment. Therefore, the Commission remains concerned that the LDEO model is not based on best available science and does not support its continued use. For all of these reasons, the Commission recommends that NMFS (1) require USGS, LDEO, and NSF to re-estimate the proposed exclusion and buffer zones and associated takes of marine mammals using site-specific parameters (including sound speed profiles, bathymetry, and sediment characteristics at a minimum) for the proposed incidental harassment authorization and (2) impose the same requirement for all future incidental harassment authorizations submitted by USGS, LDEO, NSF, Scripps, Antarctic Support Contract (ASC), or any other related entity.

In 2011[8], NSF and USGS modeled sound propagation under various environmental conditions in their PEIS. LDEO and NSF (in cooperation with Pacific Gas and Electric Company) also used a similar modeling approach in the recent incidental harassment authorization application and associated environmental assessment for a geophysical survey of Diablo Canyon in California (77 Fed. Reg. 58256). These recent examples indicate that LDEO, NSF, and related entities are able to implement the recommended modeling approach, if required to do so by NMFS. The Commission understands the constraints imposed by the current budgetary environment, but notes that other agencies that contend with similar funding constraints incorporate modeling based on site-specific parameters. USGS, LDEO, NSF, and related entities (ASC, Scripps) should be held to that same standard. NMFS recently indicated that it does not, and does not believe it is appropriate to, prescribe the use of any particular modeling package (79 Fed. Reg. 38499). The Commission agrees that NMFS should not instruct applicants to use specific contractors or modeling packages, but it should hold applicants to the same standard, primarily one in which site- and operation-specific environmental parameters are incorporated into the models.

NMFS further indicated that based on empirical data (which illustrate the LDEO model's conservative exposure estimates for the Gulf of Mexico and preliminarily off Washington), it found that LDEO's model effectively estimates sound exposures or number of takes and represents the best available information for NMFS to reach its determinations for the authorization. However, for the survey off New Jersey, NMFS increased the exclusion zone radii by a factor of 50 percent (equivalent to approximately a 3-dB difference in received level at the zone edge) to be additionally precautionary (79 Fed. Reg. 38499). The Commission must question, if NMFS really believes the LDEO model is based on best available science, why it then extended the exclusion zones to be precautionary and if NMFS felt the need to be precautionary and extend the exclusion zones, why it did not then also extend the buffer zones and thus the estimated numbers of takes of marine mammals.

Density estimates

In estimating the numbers of potential takes for the proposed incidental harassment authorization, USGS used density data from the Ocean Biogeographic Information System Spatial

[8] The record of decision was signed in 2012.

Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP), specifically data originating from Navy Operating Area Density Estimates (NODE). USGS considered those estimates to be the best available data. However, those data apply only to the U.S. EEZ, which comprises only 20 percent of the proposed survey area in 2014 and 10 percent in 2015. It is unclear if USGS assumed the densities in areas outside the U.S. EEZ to be 0, if it applied the densities estimated for waters within the EEZ to those other areas, or if it did some permutation of those two methods[9]. In any case, the densities could have been underestimated.

Although NMFS indicated in the *Federal Register* notice for the proposed authorization that the OBIS-SEAMAP data were determined to be the best available information for density data, the Commission understands that NMFS subsequently determined that the data from the Navy's Atlantic Fleet Training and Testing Navy Marine Species Density Database (AFTT NMSDD) are superior and are now considered the best available. Therefore, the Commission understands that NMFS intends to use the AFTT NMSDD data to re-estimate the numbers of marine mammals that could be taken during the proposed survey. <u>The Commission agrees</u> that the AFTT NMSDD data are preferable and should be used to re-estimate the numbers of takes for all marine mammal species and used for the analyses required under both the MMPA and the Endangered Species Act (the ESA). Furthermore, <u>the Commission recommends</u> that the same methods be used to determine the densities for the analyses conducted under the MMPA and ESA.

For some species, the estimated numbers of takes may increase if the AFTT NMSDD data are used. It remains unclear whether any such increases in those estimates would change NMFS's proposed findings as to whether only "small numbers" of marine mammals would be taken or whether such takes would have a "negligible impact" on the affected species and stocks. This is particularly true because NMFS has yet to develop a clear policy setting forth more explicit criteria and/or thresholds for making those determinations, as recommended by the Commission. Such guidance would be particularly useful in a case like this, in which up to 43 percent of the pantropical spotted dolphin stock in the area, or perhaps even more[10], could be taken incidentally during the proposed survey activities. The Commission notes that NMFS, in its proposed authorization, estimated that 6.54 percent of the pantropical spotted dolphin stock would be affected– however, that estimate is based only on the portions of the survey that will occur within the U.S. EEZ. As previously stated, most of the proposed survey would occur in waters outside the EEZ and should be accounted for in both the authorization and the supporting analyses. Is NMFS suggesting that the taking prohibition of the MMPA does not apply to takes by U.S. citizens on the high seas outside the U.S. EEZ or that an incidental take authorization somehow is not needed for activities engaged in by U.S. citizens in those waters? Clearly the taking prohibition applies (see section 102(a)(1)), and, as such, an authorization is needed[11]. Further, that authorization can be issued only if the overall

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[9] USGS's application and environmental assessment indicated the model outputs of all four seasons from the NODE data were used to determine the <u>mean</u> density. However, in further correspondence, USGS indicated that areas beyond the U.S. EEZ were essentially classified as "no data", and <u>median</u> densities were calculated from only areas that had data within the EEZ. Curiously, if one obtains data from the OBIS-SEAMAP website and uses either of those two methods, the data in Table 4 of the *Federal Register* notice (and the relevant tables in the application and environmental assessment) are not reproducible and in some cases are underestimates of the OBIS-SEAMAP data.
[10] Based on the OBIS-SEAMAP data, those takes likely will increase when the takes are re-estimated using the AFTT NMSDD data.
[11] For previous incidental harassment authorizations for LDEO surveys conducted only in international waters of the North Atlantic, NMFS based its small numbers determination on the abundance of the regional population, most of

impact of the taking would be negligible and involve only small numbers of marine mammals. Accordingly, the Commission recommends that NMFS make its small numbers and negligible impact determinations based on the total numbers of marine mammals to be taken for the entire survey (including the combined 2014 and 2015 survey legs), both in the U.S. EEZ and in international waters. The Commission understands that NMFS is in the process of developing both a clearer policy to outline the criteria for determining what constitutes "small numbers" and an improved analytical framework for determining whether an activity will have a "negligible impact" for the purpose of authorizing takes of marine mammals and that NMFS plans to engage the Commission in that process at the appropriate time (79 Fed. Reg. 13626). As previously noted, clearer policies would be especially helpful for reviewing the proposed authorization, and the Commission encourages NMFS to complete its policy development as quickly as possible and awaits a meeting to engage in that policy process.

Under section 101(a)(5)(D)(iii) of the MMPA an incidental harassment authorization can be issued only after notice in the *Federal Register* and opportunity for public comment. However, that public review opportunity is meaningful only if the proposed authorization contains accurate information and the relevant analyses. If, subsequent to publication, substantive changes are made to the underlying information or NMFS's analyses, re-publication with a new comment opportunity is appropriate. In this instance, it appears that NMFS's published analyses were not based on the best available information and that it may have significantly underestimated the likely numbers of takes for at least some of the marine mammal species and stocks that occur in the proposed survey area. That being the case, the Commission recommends that NMFS publish a revised proposed authorization in the *Federal Register* with updated estimated numbers of takes and small numbers and negligible impact analyses to provide a more informed public comment opportunity. Further, the Commission recommends that, to the extent possible, NMFS strive to identify and incorporate any substantive changes that might be made in a proposed incidental harassment authorization prior to publication in the *Federal Register*.

Monitoring measures

In previous letters, the Commission has indicated that monitoring and reporting requirements should be sufficient to provide a reasonably accurate assessment of the manner of taking and the numbers of animals taken by the proposed activity, specifically to verify that only small numbers of marine mammals are being taken and that the impacts are negligible. The Commission continues to believe those assessments need to account for animals at the surface but not detected and for animals present but underwater and not available for sighting, which are accounted for by g(0) and f(0) values. NMFS's most recent response to the Commission's comments indicated that the MMPA implementing regulations require that applicants include monitoring that will result in "an increased knowledge of the species, the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities . . ." This increased knowledge of the level of taking could be qualitative or relative in nature, or it could be more directly quantitative (79 Fed. Reg. 38503). The Commission believes that NMFS misinterpreted its implementing regulations in its response. Those regulations state that applicants are to specify—

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which originated from NMFS's stock assessment reports (see Tables 2 in 78 Fed. Reg. 10142 and 78 Fed. Reg. 22249 for the Mid-Atlantic Ridge survey).

> The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities, and suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such activity.

Although this portion of the regulations[12] is not particularly clear, it appears that the phrase "increased knowledge" is intended to modify the clause "of the species" and not "the level of taking or impacts on the populations of marine mammals that are expected to be present while conducting activities". If the phrase "increased knowledge of" is intended to apply throughout the remainder of the provision, as NMFS suggests, then the portion requiring the applicant to provide "suggested means of minimizing burdens…" makes no sense. A better interpretation of the provision is that the applicant is to suggest monitoring and reporting measures that will (1) increase the knowledge regarding the species and (2) provide the necessary information regarding the level of incidental taking that occurs and the impacts of such taking on the affected marine mammal populations. Such an interpretation is consistent with the statutory structure, which under section 101(a)(5)(D)(iv) requires that NMFS "modify, suspend, or revoke an authorization" if it finds, among other things, that the authorized taking is having more than a negligible impact or that more than small numbers of marine mammals are being taken. It is through the prescribed monitoring and reporting requirements that NMFS collects the information necessary to make those determinations. As such, those requirements need to be sufficient to provide accurate information on the numbers of marine mammals being taken and the manner in which they are taken, not merely better information on the qualitative nature of the impacts. Accordingly, the Commission continues to believe that appropriate g(0) and f(0) values are essential for making accurate estimates of the numbers of marine mammals taken during surveys. To be applicable for the proposed survey, the corrections should be based on the ability of the protected species observers to detect marine mammals rather than a hypothetical optimum derived from scientific studies (e.g., from NMFS's shipboard surveys).

Therefore, the Commission again recommends that NMFS consult with USGS, LDEO, NSF, and other relevant entities (e.g., Scripps, ASC) 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 by incorporating applicable g(0) and f(0) values. NMFS recently stated that although it does not generally believe that post-activity take estimates using f(0) and g(0) are *required* to meet the monitoring requirement of the MMPA, in the context of the NSF and LDEO's monitoring plan, NMFS agreed that developing and incorporating a way to better interpret the results of their monitoring (perhaps a simplified or generalized version of g(0) and f(0)) is a good idea. NMFS further stated it would consult with the Commission and NMFS scientists prior to finalizing the recommendations (79 Fed. Reg. 38503). The Commission welcomes such a meeting.

[12] The Commission also questions whether the cited regulation is even the relevant one upon which NMFS should be relying. It merely specifies what applicants should be suggesting when applying for an incidental take authorization. NMFS has an independent responsibility under the MMPA to specify monitoring and reporting requirements that are sufficient for it determine that the statutory requirements are being met.

The Commission looks forward to collaborating with NMFS on the various guidance documents and issues raised in this letter. Please contact me if you have questions concerning the Commission's recommendations.

Sincerely,

Rebecca J. Lent, Ph.D.
Executive Director

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July 23, 2014

Via electronic mail sent to ITP.Goldstein@noaa.gov
Ms. Jolie Harrison
Supervisor, Incidental Take Program
Permits and Conservation Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway
Silver Spring, MD 20910

RE: Comments on the National Marine Fisheries Service Incidental Harassment Authorization for the Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to a Marine Geophysical Survey in the Atlantic Ocean off the Eastern Seaboard, August to September 2014 and April to August 2015 (RIN 0648-XD214)

Dear Ms. Harrison:

Clean Ocean Action (COA) submits the following comments in response to the National Marine Fisheries Service (NMFS) request for comments for the proposed incidental harassment authorization (IHA) for the takes of marine mammals incidental to a marine geophysical survey in the Atlantic Ocean off the Eastern Seaboard, August to September 2014 and April to August 2015 (RIN 0648-XD214).[1]

The United States Geological Survey (USGS), Lamont-Doherty Earth Observatory of Columbia University (L-DEO), and the National Science Foundation propose to conduct a 2-D seismic vessel survey in the Atlantic Ocean off the Eastern Seaboard between August and September 2014 and April and August 2015 to identify the outer limits of the United States continental shelf and study potential tsunami-related hazards ("Proposed Project"). The Proposed Project includes the use of an array of 36 airguns with a total volume of approximately 6,600 in^3, in conjunction with a multibeam echosounder and a sub-bottom profiler. The nominal source levels of the airgun arrays range from 236 to 265 decibels (dB) re: 1 µPa (peak-to-peak), and airguns would fire every 20 to 24 seconds, 24 hours a day, for a17 to 18 day period set to commence on August 15, 2014. Similar survey activities will also be conducted in an as yet unconfirmed timeframe between April and August 2015. The area to be surveyed is an irregularly shaped region of the Atlantic Ocean continental shelf that is positioned between 241 km (130 nmi) and 648.2 km (350 nmi) from the coast of the United States.

[1] 79 Fed. Reg. at 35642 (Monday, June 23, 2014) (hereafter "NMFS IHA").

NMFS issued its proposed IHA for takes of 19,497 marine mammals by harassment under section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA). The Proposed Project is subject to regulations under the National Environmental Policy Act (NEPA) and must also request a 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]

For the reasons detailed herein, Clean Ocean Action urges denial of the NMFS IHA on the grounds that a full Environmental Impact Statement (EIS) should be completed and the potential impacts to marine mammals are incompatible with the goals, mandates, and prohibitions of the MMPA. A full EIS is necessary to remedy issues of incomplete information, inadequate assessment of impacts, and insufficient evaluation of alternatives and mitigation measures. Importantly, the Proposed Project should not be conducted during the spring and summer months, which are the peak of marine mammal (and other marine species) feeding, breeding, and/or calving activity off the mid-Atlantic coast. Moreover, NMFS should ensure that best available science and regulatory review are incorporated into the EIS and IHA, require stronger mitigation measures, and consider different times of year for the Proposed Project.

II. NOAA must prepare a specific EIS because there are significant environmental impacts from the Proposed Project

For the reasons discussed below, we strongly urge NMFS to prepare an EIS for this project prior to the further consideration of the issuance of an IHA. We understand that an EA was drafted in May 2014 for this project; this document tiers to a Programmatic EIS that was finalized in 2011. Given the broad scope of this PEIS and the restricted scope of the May 2014 EA, an updated EIS would provide information necessary to making an informed decision about issuance of the IHA. Specifically, an EIS would include complete scientific substantiation for the project, a thorough analysis of all direct, indirect, and cumulative environmental impacts (including use of the acoustic guidelines that NOAA recently drafted and received comments on, which account for best available science), and in-depth consideration of a full range of alternatives to the project. Moreover, to meet its NEPA obligations, the NEPA document must be made available for public review and comment.[4]

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[2] Section 7 of the ESA (16 U.S.C. 1531 et seq.) 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.

[4] *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").

A. Purpose of NEPA and EA and trigger 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.[5] To assure transparency and thoroughness, agencies also must "to the fullest extent possible...[e]ncourage and facilitate public involvement" in decision-making.[6] Despite the fact that a draft Environmental Assessment (EA) was released in May 2014, the public was not offered an opportunity to comment on the Proposed Project until the issuance of the proposed IHA on June 23, 2014, less than two months before the study was scheduled to begin.

The purpose of an EA is to assist the agency in determining whether the project may significantly affect the environment and therefore require a full EIS.[7] An agency may avoid preparing a full EIS if the agency: (1) prepares an environmental assessment identifying and analyzing the action's environmental effects; and (2) makes a finding of no significant impact, which presents the agency's reasons for concluding that the action's environmental effects are not significant.[8] NEPA requires federal agencies to prepare an EIS for all "major federal actions significantly affecting the quality of the human environment."[9] A full EIS is required if "substantial questions are raised as to whether a project...may cause significant degradation of some human environmental factor."[10] To trigger this requirement, the plaintiff "need *not show* that significant effects will *in fact* occur;" but rather, "raising substantial questions whether a project may have a significant environmental effect is sufficient."[11]

Whether an action may have "significant" impacts on the environment is determined by considering the "context" and "intensity" of the action.[12] "Context" means the significance of the project "must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality."[13] Intensity of the action is

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[5] See, e.g. 40 C.F.R. § 1500.1.
[6] 40 C.F.R. §1500.2(d
[7] 42 U.S.C. §4332(2)(C); 40C.F.R. §1508.9.
[8] 40 C.F.R. §§ 150l.4(b), (e); 1508.9; 1508.1.3.
[9] 42 U.S.C. § 4332(2)(C); see also 40 C.F.R. § 1501.4. The Act defines the "human environment" as including "the natural and physical environment and the relationship of people with that environment…This means that economic or social effects are not intended by themselves to require preparation of an environmental impact statement. When an environmental impact statement is prepared and economic or social and natural or physical environmental effects are interrelated, then the environmental impact statement will discuss all of these effects on the human environment." 40 C.F.R. § 1508.14.
[10] *Idaho Sporting Congress v. Thomas*, 137 F.3d 1146, 1149-50 (9th Cir. 1998).
[11] *Id*. (emphases in original).
[12] 40 C.F.R. § 1508.27.
[13] Id. § 1508.27(a).

determined by considering the following factors: (1) impacts that may be both beneficial and adverse. A significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial; (2) the degree to which the proposed action affects public health or safety; (3) unique characteristics of the geographic area such as proximity to ecologically critical areas; (4) the degree to which the effects on the quality of the human environment are likely to be highly controversial; (5) the degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks; (6) the degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration; (7) whether the action is related to other actions with individually insignificant but cumulatively significant impacts; (8) the degree to which the action may 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; (9) the degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the federal Endangered Species Act; (10) whether the action threatens a violation of Federal, State, or local law or requirements imposed for the protection of the environment.[14] The presence of one or more significant effects can trigger the need for a full EIS.[15] Based on the nature of potential impacts to marine life from the Proposed Project and the incomplete analysis of such impacts in the EA (discussed further below), a full EIS must be prepared for this study and the issuance of an IHA before this process is completed would be premature. Furthermore, given that the EA drafted for the Proposed Project tiers to a Programmatic EIS that was finalized in 2011, an updated EIS would provide information necessary to making an informed decision about issuance of the IHA.

B. Potential impacts from sound-producing sources other than seismic airguns were not evaluated.

Neither the NMFS IHA nor the EA upon which it relies have offered any meaningful evaluation of the potential impacts that other sound-producing sources used in the Proposed Project may have on marine species. Of particular concern, the NMFS IHA indicates that a high-frequency Kongsberg EM 122 multibeam echosounder will operate concurrently with airgun operations. The multibeam echosounder produces sound in the 10.5 to 13.0 kHz frequency range, which is within the optimal hearing spectrum for many odontocete species that may occur in the study area. A 12-kHz multibeam echosounder system operated by an Exxon survey vessel off the

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[14] 40 C.F.R. § 1508.27(b)(1)-(10).

[15] S*ee, 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).

coast of Madagascar was implicated by an independent scientific review panel (ISRP) in the mass-stranding of approximately 100 melon-headed whales (*Peponocephala electra*) in 2008.[16] The report of the ISRP stated, "all other possible factors considered were determined by the ISRP to be unlikely causes for the initial behavioral response."[17]

Furthermore, a 2002 seismic expedition in the Gulf of California, also lead by L-DEO, employed a similar multibeam sonar system with a center frequency of 15.5 kHz and source levels of 237 dB. Beaked whale strandings observed in the area of the survey in September 2002 may have been linked to the use of this technology – a federal judge responded by ordering the ship to cease operations.[18]

Based on the correlation between these previous stranding events and the use of multibeam sonar technology, it is imperative that NMFS fully assess the potential for this source to impact marine mammals both on its own and in concert with seismic airgun blasts.

C. The analysis of alternatives in the EA was incomplete.

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."[19] The CEQ regulations require NMFS to "rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated."[20] "A 'viable but unexamined alternative renders [the] environmental impact statement inadequate.'"[21]

The EA does not devote sufficient discussion to alternatives, including alternative times of year and additional mitigation and monitoring activities. In its discussion of the No Action alternative, the EA does not adequately qualify the benefits of the No Action alternative, in which the Proposed Project would not proceed and 19,497 marine mammals would not be subject to harassment, in relation to the costs. The "Alternative Action" alternative does not

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[16] Southall, B.L., Rowles, T., Gulland, F., Baird, R. W., and Jepson, P.D. 2013. Final report of the Independent Scientific Review Panel investigating potential contributing factors to a 2008 mass stranding of melon-headed whales (*Peponocephala electra*) in Antsohihy, Madagascar.
[17] Id.
[18] Cox, T.M., Ragen, T.J., Read, A.J., Vos, E., Baird, R.W., Balcomb, K., Barlow, J., Caldwell, J., Cranford, T., Crum, L., D'Amico, A., D'Spain, G., Fernandez, A., Finneran, J., Gentry, R., Gerth, W., Gulland, F., Hildebrand, J., Houser, D., Hullar, T., Jepson, P.D., Ketten, D., MacLeod, C.D., Miller, P., Moore, S., Mountain, D.C., Palka, D., Ponganis, P., Rommel, S., Rowles, T., Taylor, B., Tyack, P., Wartzok, D., Gisiner, R., Mead, J., and Benner, L. 2006. Understanding the impacts of anthropogenic sound on beaked whales. *Journal of Cetacean Resource Management* **7**: 177-187.
[19] 42 U.S.C. §§ 4332(2)(C)(iii), 4332(2)(E).
[20] 40 C.F.R. § 1502.14(a).
[21] *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)).

actually evaluate any alternate times of year to conduct the survey, which are important considerations that deserve full assessment given the magnitude of marine mammal takes during the proposed study periods.

The two legs of the Proposed Project are planned to take place between the spring and late summer (August to September 2014 and April to August 2015). This timeframe is of critical importance to many cetacean species that may occur in the study area, including several endangered species. The critically endangered North Atlantic right whale migrates northward to the waters off New England and the Bay of Fundy in the spring and summer months, and is also feeding and nursing during this time period.[22] Other species known to feed, breed, and/or calve in the area of the Proposed Project during this timeframe include the Minke whale,[23] Bryde's whale,[24] sei whale,[25] fin whale,[26] blue whale,[27] sperm whale,[28] pygmy sperm whale,[29] dwarf sperm whale,[30] northern bottlenose whale,[31] bottlenose dolphin,[32] Atlantic white-sided dolphin, Atlantic spotted dolphin, pantropical spotted dolphin,[33] striped dolphin, spinner dolphin,[34] Clymene dolphin,[35] short-beaked common dolphin,[36] Risso's dolphin,[37] melon-

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[22] NOAA Fisheries, Office of Protected Resources. North Atlantic Right Whales (*Eubalaena glacialis*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/rightwhale_northatlantic.htm.
[23] NOAA Fisheries, Office of Protected Resources. Minke Whale (*Balaenoptera acutorostrata*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/minkewhale.htm.
[24] NOAA Fisheries, Office of Protected Resources. Bryde's Whale (*Balaenoptera edeni*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/brydeswhale.htm.
[25] NOAA Fisheries, Office of Protected Resources. Sei Whale (*Balaenoptera borealis*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/seiwhale.htm.
[26] NOAA Fisheries, Office of Protected Resources. Fin Whale (*Balaenoptera physalus*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/finwhale.htm.
[27] NOAA Fisheries, Office of Protected Resources. Blue Whale (*Balaenoptera musculus*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/bluewhale.htm.
[28] NOAA Fisheries, Office of Protected Resources. Sperm Whales (*Physeter macrocephalus*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/spermwhale.htm.
[29] NOAA Fisheries, Office of Protected Resources. Pygmy Sperm Whale (*Kogia breviceps*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/pygmyspermwhale.htm.
[30] NOAA Fisheries, Office of Protected Resources. Dwarf Sperm Whale (*Kogia sima*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/dwarfspermwhale.htm.
[31] NOAA Fisheries, Office of Protected Resources. Northern Bottlenose Whale (*Hyperoodon ampullatus*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/northernbottlenosewhale.htm.
[32] NOAA Fisheries, Office of Protected Resources. Bottlenose Dolphin (*Tursiops truncatus*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/bottlenosedolphin.htm.
[33] NOAA Fisheries, Office of Protected Resources. Pantropical Spotted Dolphin (*Stenella attenuata*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/spotteddolphin_pantropical.htm.
[34] NOAA Fisheries, Office of Protected Resources. Spinner Dolphin (*Stenella longitrostris*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/spinnerdolphin.htm.
[35] NOAA Fisheries, Office of Protected Resources. Clymene Dolphin (*Stenella clymene*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/clymenedolphin.htm.
[36] NOAA Fisheries, Office of Protected Resources. Short-Beaked Common Dolphin (*Delphinus delphis*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/commondolphin_shortbeaked.htm.

headed whale,[38] false killer whale,[39] killer whale,[40] and short-finned pilot whale.[41] Based on the high frequency of vital behaviors that take place in the spring and summer months, it is prudent for NMFS to assess alternate times of year for the Proposed Project, especially during the winter, when many species may be located outside of the survey area.

Should it be determined that the Proposed Project must continue as planned for the summer of 2014 and spring/summer of 2015, we urge NMFS to consider alternatives with stronger mitigation measures including pre-survey observations, aerial surveys, larger exclusion zones and lower sound thresholds, suspension of activities in low light and night conditions (or at the very least, requiring visual observers equipped with night-vision technologies during these conditions), post-survey monitoring, and other methods to detect marine mammals beyond visual observation and acoustic monitoring.

II. NMFS must ensure that its IHA complies with the MMPA.

The MMPA places a "moratorium on the taking" of marine mammals.[42] Any authorization to take marine mammals must result in the incidental take of only "small numbers of marine mammals of a species or population stock," and can have no more than a "negligible impact" on species and stocks. Furthermore, NMFS must provide for the monitoring and reporting of such takings and must prescribe methods and means of affecting the "least practicable adverse impact" on the species or stock and their habitat.[43]

A. Scientific evidence supports marine mammal harassment below the 160-dB Level B threshold and potential for injury below the 180/190-dB Level A threshold

The proposed IHA uses the single sound pressure level of 160 dB re 1 µPa (RMS) as a threshold for behavioral, sub-lethal take in all marine mammal species affected by the proposed survey.[44] This approach does not reflect the best available science, and the choice of threshold is not sufficiently conservative in several important respects. In fact, five of the world's leading biologists and bioacousticians working in this field recently characterized the 160-dB threshold

[37] NOAA Fisheries, Office of Protected Resources. Risso's Dolphin *(Grampus griseus*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/rissosdolphin.htm.
[38] NOAA Fisheries, Office of Protected Resources. Melon-headed Whale (*Peponocephala electra*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/melonheadedwhale.htm.
[39] NOAA Fisheries, Office of Protected Resources. False Killer Whale (*Pseudorca crassidens*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/falsekillerwhale.htm.
[40] NOAA Fisheries, Office of Protected Resources. Killer Whale (*Orcinus orca*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/killerwhale.htm.
[41] NOAA Fisheries, Office of Protected Resources. Short-finned Pilot Whale (*Globicephala macrorhynchus*). Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/pilotwhale_shortfinned.htm.
[42] 16 U.S.C. § 1371(a).
[43] 16 U.S.C. § 1371(a)(5)(A) & (D).
[44] 79 Fed. Reg. at 14801.

as "overly simplified, scientifically outdated, and artificially rigid."**[45]** Furthermore, NMFS has released draft acoustic guidance that is currently being finalized; these guidelines should be incorporated into take estimations.

Using a single sound pressure level of 160-dB for harassment represents a major step backward from recent programmatic authorizations. For Navy sonar activity, for example, NMFS has incorporated linear risk functions into its analysis, which endeavor to account for risk and individual variability and to reflect the potential for take at relatively low source levels.**[46]**

Furthermore, current scientific literature establishes that behavioral disruption can occur at substantially lower received levels for some marine mammal species, including these that will be impacted by the Proposed Project. For example, the startup of a seismic survey has been shown to cause endangered fin and humpback whales to stop vocalizing – a behavior essential to breeding and foraging.**[47]** Similarly, a low-frequency, high-amplitude fish shoal imaging device was recently found to silence humpback whales at a distance of up to 200 kilometers, where received levels ranged from 5 to 22 dB above ambient noise levels.**[48]** Groups of humpback whales in the wild have been observed to exhibit avoidance behaviors at a distance of two kilometers from a small airgun array; the received levels in these trials were 159 dB re: 1 μPa^2 peak-to-peak.[49] Blue whale behavioral changes in response to a small airgun array have also been monitored. Researchers tracked a blue whale traveling and vocalizing in the vicinity of a vessel firing a four-gun array with a source level of 215 dB re: 1 μPa^2 peak-to-peak and noted that at a distance of 10 kilometers from the vessel (where the received level was estimated to be 143 dB re: 1 μPa^2 peak-to-peak), the whale ceased vocalizations for an hour and noticeably changed course.[50] The literature also shows that harbor porpoises are acutely sensitive to a range of anthropogenic sounds, including airguns. They 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 them abandoning habitat in response to pulsed sounds

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[45] 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.

[46] *See, e.g.*, 74 Fed. Reg. 4844, 4844-4885 (Jan. 27, 2009).

[47] Clark, C.W., and Gagnon, G.C. 2006. Considering the temporal and spatial scales of noise exposures from seismic surveys on baleen whales. (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).

[48] Risch, D., Corkeron, P.J., Ellison, W.T., and van Parijs, S.M., Changes in humpback whale song occurrence in response to an acoustic source 200 km away, PLoS ONE 7(1): e29741. doi:10.1371/journal.pone.0029741 (2012).

[49] McCauley, R.D., Jenner, M.N., Jenner, C., McCabe, K.A., and Murdoch, J. 1998. The response of humpback whales (*Megaptera novaeangliae*) to offshore seismic survey: Preliminary results of observations above a working seismic vessel and experimental exposures. *Appea Journal*: 692-706.

[50] McDonald, M.A., Hildebrand, J.A., and Webb, S.C. 1995. Blue and fin whale observed on a seafloor array in the Northeast Pacific. *Journal of the Acoustical Society of America* **98**: 712-721.

at very low received levels, well below 120 dB.**[51]** Cuvier's beaked whales exhibited alarming behavioral impacts when exposed to sonar at low received levels of 89-127dB re: 1 μPa.[52]

Furthermore, evidence in the scientific literature has indicated that temporary threshold shifts (TTS) can occur in cetaceans at source levels lower than proposed for this survey. As NMFS itself cites, a recent study involved the exposure of a captive harbour porpoise to one airgun firing on three occasions at an average source level of 201 dB re: 1 μPa^2 peak-to-peak.[53] In addition to avoidance behavior exhibited by the animal during the trials, the researchers estimated through modeling that the onset of TTS that did not fully subside until *55 hours after exposure*.[54] Moreover, NMFS cannot rationally assume that other marine mammals will not incur injury at noise levels below those in the Proposed Project. The Lucke *et al.* study demonstrates that TTS can occur at different levels for different species of cetaceans. Moreover, controlled exposure trials in which harbor seals were exposed to small airguns firing for one hour at source levels ranging from 215 to 224 dB re: 1 μPa^2 peak-to-peak revealed dramatic physiological and behavioral responses, including a fright response evidenced by significant drops in heart rate; decreased stomach temperatures indicating a cessation of feeding; and rapid swimming away from the noise source.[55] Thus, NMFS cannot assume that TTS and even permanent threshold shifts (PTS) would be unlikely for marine mammals in the area of this Proposed Project.

A number of other recent studies indicate that anthropogenic sound can induce PTS at lower levels than anticipated.**[56]** New data indicate that mid-frequency cetaceans have greater

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[51] *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).

[52] DeRuiter, S.L., Southall, B.L., Calambokidis, J., Zimmer, W.M.X., Sadykova, D., Falcone, E.A., Friedlaender, A.S., Joseph, J.E., Moretti, D., Schoor, G.S., Thomas, L., and Tyack, P.L. 2013. First direct measurements of behavioural responses by Cuvier's beaked whales to mid-frequency active sonar. *Biology Letters* **9**: 20130223 1 (2013).

[53] Lucke, Klaus, Siebert, U., Lepper, P. a, & Blanchet, M.-A. (2009). Temporary shift in masked hearing thresholds in a harbor porpoise (*Phocoena phocoena*) after exposure to seismic airgun stimuli. *The Journal of the Acoustical Society of America*, 125(6): 4060-70.

[54] Lucke, K., Siebert, U., Lepper, P.A., and Blanchet, M.-A. 2009. Temporary shift in masked hearing thresholds in a harbor porpoise (*Phocoena phocoena*) after exposure to seismic airgun stimuli. *Journal of the Acoustical Society of America* 125: 4060-4070. Emphasis added.

[55] Thompson, D., Sjoberg, M., Bryant, M.E., Lovell, P., and Bjorge, A. 1998. Behavioral and physiological responses of harbour (*Phoca vitulina*) and grey (*Halichoerus grypus*) seals to seismic surveys. Report to European Commission of BROMMAD Project. MAS2 C7940098.

[56] Kastak, D., Mulsow, J., Ghoul, A., and Reichmuth, C. 2008. Noise-induced permanent threshold shift in a harbor seal [abstract], *Journal of the Acoustical Society of America* **123**: 2986; Kujawa, S.G., and Liberman, M.C. 2009. Adding insult to injury: cochlear nerve degeneration after "temporary" noise-induced hearing loss, *Journal of Neuroscience* **29**: 14077-14085.

sensitivity to sounds within their best hearing range than was previously thought.[57] NMFS must also consider that even behavioral disturbance can amount to a Level A take if it interferes with essential life functions. For example, TTS can impair reproductive success and fitness that would constitute harm or Level A harassment. Beaked whales are sensitive to noise, and it is not necessarily the auditory damage that causes the injury. Sounds cause beaked whales to change their behavior, including panic response and rapid surfacing, which results in an injury similar to decompression sickness ("the bends").[58]

Although the proposed IHA NMFS cites many studies that show low-frequency sounds in general and seismic surveys in particular can have significant behavioral impacts to marine mammals well below 160 dB,[59] NMFS nonetheless continues to rely upon a Level B harassment threshold of 160 dB. Additionally, in light of the best available science, NMFS cannot rationally defend its conclusion that the proposed survey will not lead to any Level A impacts and will have no more than negligible impacts on these species or stocks. As such, NMFS should modify its threshold estimates; this would in turn lead to larger exclusion zones around the survey and may significantly increase the estimated number of marine mammal takes incidental to the Proposed Project.

III. NMFS must take best available science and the precautionary principle into account.

Several experts in marine mammal bioacoustics have underscored our extremely limited understanding of the potential auditory and behavioral impacts to marine mammals from the use of seismic airguns and other sound-producing technologies. Darlene R. Ketten, a marine biologist and neuro-anatomist at the Woods Hole Oceanographic Institution, has written, "[a]t this time we have insufficient data to accurately predetermine the underwater acoustic impact for anthropogenic sources."[60] Other published scientists have noted, "[g]iven the current state of knowledge…the risk of seismic sources causing hearing damage to marine mammals cannot be dismissed as negligible."[61] Scientists have also commented on the variability in how a seismic source could affect a marine mammal based on the orientation of the source relative to

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[57] See discussion in Wood, J., Southall, B.L. and Tollit, D.J. 2012. PG&E offshore 3-D Seismic Survey Project EIR – Marine Mammal Technical Draft Report. SMRU Ltd.; Marine Mammal Commission, Marine Mammals and Noise: A Sound Approach to Research Management, Report to Congress, at 46 (March 2007).

[58] Cox, T.M., Ragen, T.J., Read, A.J., Vos, E., Baird, R.W., Balcomb, K., Barlow, J., Caldwell, J., Cranford, T., Crum, L., D'Amico, A., D'Spain, G., Fernandez, A., Finneran, J., Gentry, R., Gerth, W., Gulland, F., Hildebrand, J., Houser, D., Hullar, T., Jepson, P.D., Ketten, D., MacLeod, C.D., Miller, P., Moore, S., Mountain, D.C., Palka, D., Ponganis, P., Rommel, S., Rowles, T., Taylor, B., Tyack, P., Wartzok, D., Gisiner, R., Mead, J., and Benner, L. 2006. Understanding the impacts of anthropogenic sound on beaked whales. *Journal of Cetacean Resource Management* **7**: 177-187.

[59] 79 Fed. Reg. at 14787.

[60] Ketten, D.R. Marine Mammal Auditory Systems: A Summary of Audiometric and Anatomical Data and Implications for Underwater Acoustic Impacts. Polarforschung, 72. Jahrgung, Nr. 2/3, pp. 79-92.

[61] Gordon, J.C.D., Gillespie, D., Potter, J., Frantzis, A., Simmonds, M.P., Swift, R., and Thompson, D. 2004. A Review of the Effects of Seismic Survey on Marine Mammals. *Marine Technology Society Journal* **37**: 14-32.

the animal, which is not considered in the Proposed Project. A 2004 review paper on the effects of seismic surveys on marine mammals stated, "[m]arine mammals will be distributed in a variety of positions relative to a seismic array and the signal they receive may have a complicated and variable nature."[62] A study of the environmental implications of marine seismic surveys conducted in Australia published in 2000 concluded, "[i]t was believed slight differences in the orientations of receivers to each array, alignments and depths of array components and of functioning air guns within each array contributed to the measured differences. Again this exemplified the difficulty of predicting the received air gun level for a specific air gun array."[63]

Because of this high degree of uncertainty in our understanding of impacts to marine mammals from airgun sources, compounded by the variability in the level of impact based on the position of the source relative to a marine mammal, NMFS should be precautionary in its assessment of incidental takes. Precaution and use of the best available science are fundamental tenets of the Obama Administration's National Ocean Policy. One of the Principles in the 2010 Final Recommendations of the Interagency Ocean Policy Task Force report urges the use of best available science and the precautionary approach: "Decisions affecting the ocean…should be informed by and consistent with the best available science. Decision-making will also be guided by a precautionary approach as reflected in the Rio Declaration of 1992."[64] Responsible application of the precautionary principle to the NMFS IHA would reasonably have led to the denial of marine mammal takes incidental to the Proposed Project.

IV. NMFS's take estimates for marine mammals for which no population or stock data are available are speculative and may be significant underestimations.

The NMFS IHA acknowledges that "No known current regional population or stock abundance estimates for the northwest Atlantic Ocean are available for…eight…species under NMFS's jurisdiction that could potentially be affected by Level B harassment over the course of the IHA,"[65] and yet still determines that takes of these species will be negligible. These species include the Bryde's whale, Fraser's dolphin, spinner dolphin, Clymene dolphin, melon-headed whale, pygmy killer whale, false killer whale, and killer whale. NMFS has assigned take

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[62] Id.

[63] McCauley, R.D., Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M-N., Penrose, J.P., Prince, R.I.T., Adhitya, A., Murdoch, J., and McCabe, K. 2000. Marine seismic surveys – A study of environmental implications. *Appea Journal* 692-708.

[64] The White House Council on Environmental Quality. Final Recommendations Of The Interagency Ocean Policy Principle 15 of the Rio Declaration 1992 reads, "in order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall be not used as a reason for postponing cost-effective measures to prevent environmental degradation."

[65] 79 Fed. Reg. at 35671.

estimates for these species based on old data or on population or stock abundance from other oceanic regions, without further indication of how these data were applied to the Proposed Project area. In total, takes of over 1,000 individuals from these eight species are authorized. In the absence of any data from the region in which the survey is to take place, it is not clear how these takes were assigned and what, if any, measures would be taken during the survey if it is determined that take numbers for these animals were significantly miscalculated.

V. Conclusion

For the reasons detailed above, Clean Ocean Action urges denial of the NMFS IHA. The Proposed Project threatens serious harm to numerous species of marine mammals and is therefore contrary to the goals, mandates, and prohibitions of the MMPA. Furthermore, a full EIS should be completed prior to the consideration of the IHA, to remedy issues of incomplete information, inadequate assessment of impacts, and insufficient evaluation of alternatives and mitigation measures. Importantly, the Proposed Project should not be conducted during the spring and summer months, which are the peak of marine mammal (and other marine species) feeding, breeding, and/or calving activity off the mid-Atlantic. Moreover, NMFS should ensure that best available science and regulatory review are incorporated into the EIS and IHA, require stronger mitigation measures, and consider different times of year for the Proposed Project.

Sincerely,

Cindy Zipf
Executive Director
Clean Ocean Action

Cassandra Ornell
Staff Scientist
Clean Ocean Action

NRDC
THE EARTH'S BEST DEFENSE

OCEANA

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By Electronic Mail

July 23, 2014

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Re: **Comments on the proposed Incidental Harassment Authorization (IHA) for USGS Atlantic Seismic Survey**

Dear Ms. Harrison:

On behalf of our organizations and our more than a million members, we write to submit comments on the proposed Incidental Harassment Authorization (IHA) for the take of marine mammals related to a proposed U.S. Geological Survey, Lamont-Doherty Earth Observatory of Columbia University (L-DEO), and National Science Foundation (NSF) (collectively hereafter USGS) geophysical seismic survey in the Atlantic Ocean off the Eastern Seaboard, August to September 2014 and April to August 2015. 79 Fed. Reg. 35642 (June 23, 2014).

Our organizations are profoundly concerned about NMFS's intention to permit high-intensity seismic surveys in this large Atlantic region—spanning from Massachusetts to South Carolina and covering more than 6,300 km of track lines—because of the significant environmental harm of airgun exploration itself, the sensitivity and endangered status of numerous marine species found within the proposed study area, and the cumulative impact of this and other planned activity in the Atlantic. We are also deeply troubled by the poor analysis undertaken in support of this project, which should have received far more rigorous review.

It is undisputed that sound is a fundamental element of the marine environment. Whales, fish, and other wildlife depend on it for breeding, feeding, navigating, and avoiding predators – in short, for their survival and reproduction – and USGS's proposed action would degrade the acoustic environment along a significant swath of the Eastern Seaboard. To conduct the survey, USGS plans to tow an array of 36 high-volume airguns behind its ship, firing intense impulses of compressed air—almost as loud as explosives—roughly every 20 seconds, 24 hours per day, for weeks on end. In addition, USGS intends to operate a multi-beam echosounder—a system similar to the one found to have likely caused a mass stranding of melon-headed whales on Madagascar—and a sub-bottom profiler continuously during the seismic operations.

Increasingly, the available science demonstrates that these blasts disrupt baleen whale behavior and impair their communication on a vast scale; that they harm a diverse range of other marine mammals; and that they can significantly impact fish and fisheries, with unknown but potentially substantial effects on coastal communities. Given the location of the proposed multi-year survey, it could well affect endangered and sensitive species across most of the U.S. east coast, including the highly endangered right whale.

The MMPA dictates that, before permitting this action, NMFS must ensure that the project employs mitigation to obtain the least practicable impact. Unfortunately, the proposed project falls far short of this standard. Instead, it provides an analysis that consistently tends to understate impacts and fails to require available mitigation measures. Shockingly, the survey does not identify or attempt to avoid any biologically important habitat within the activity's vast survey area. Instead, NMFS relies on mitigation that the Courts have rightly described in other contexts as "woefully inadequate and ineffectual."

As a result of the near-total failure to consider site-specific data, the survey lines directly overrun several areas of established heightened biological significance. For example, the survey runs alongside Georges Bank, which is among the most diverse, productive, and trophically complex marine temperate areas in the world. In addition, the survey plans to blast through the southern portion of established mating and foraging grounds of the last North Atlantic right whales, among the most imperiled large whales on the planet; runs across a number of bio-rich canyons and seamounts off the mid-Atlantic states; crisscrosses an area of probable importance to beaked whales, one of the species identified as most sensitive to sound; and will be sounding its airguns for days through loggerhead sea turtle critical habitat. The survey needlessly harms marine mammals in direct disregard of the Marine Mammal Protection Act and recklessly impacts fish and sea turtles as well.

Given the intense controversy over seismic surveys in the Atlantic region, it is a matter of some amazement to all of our organizations that NMFS did not subject this survey application to meaningful scrutiny. We urge that NMFS deny the IHA or USGS withdraw its application, and that—at minimum—USGS revise its proposed mitigation measures in the ways discussed below, including by redrawing its survey lines to reflect well-established areas of heightened biological significance, and by providing meaningful site-specific analysis.

I. BACKGROUND: ENVIRONMENTAL IMPACTS

A large seismic airgun array can produce effective peak pressures of sound higher than those of virtually any other man-made source save explosives;[1] and although airguns are vertically oriented within the water column, horizontal propagation is so significant as to make them, even under present use, one of the leading contributors to low-frequency ambient noise thousands of miles from any given survey.[2] Indeed, the enormous scale of this acoustic footprint has now been confirmed by studies of seismic in numerous regions around the globe, including the Arctic, the northeast Atlantic, Greenland, and Australia.

It is well established that the high-intensity pulses produced by airguns can cause a range of impacts on marine mammals, fish, and other marine life, including broad habitat displacement, disruption of vital behaviors essential to foraging and breeding, loss of biological diversity, and, in some circumstances, injuries and mortalities.[3] Consistent with their acoustic footprint, most of these impacts are felt on an extraordinarily wide geographic scale – especially on endangered baleen whales, whose vocalizations and acoustic sensitivities overlap with the enormous low-frequency energy that airguns put in the water. 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 – over an area at least 100,000 square nautical miles in size, and can cause baleen whales to abandon habitat over the same scale.[4]

Similarly, airgun noise can also mask the calls of vocalizing baleen whales over vast distances, substantially compromising their ability to communicate, feed, find mates, and engage in other vital behavior.[5] The intermittency of airgun pulses hardly mitigates this effect since their acoustic energy spreads over time and can sound virtually continuous at distances from the array.[6] According to recent modeling from Cornell and NOAA, the highly endangered North Atlantic right whale is particularly vulnerable to masking effects from airguns and other sources

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[1] National Research Council, *Ocean Noise and Marine Mammals* (2003).

[2] Nieukirk, S.L., Stafford, K.M., Mellinger, D.K., Dziak, R.P., and Fox, C.G., Low-frequency whale and seismic airgun sounds recorded in the mid-Atlantic Ocean, *Journal of the Acoustical Society of America* 115: 1832-1843 (2004).

[3] *See, e.g.*, Hildebrand, J.A., Impacts of anthropogenic sound, *in* Reynolds, J.E. III, Perrin, W.F., Reeves, R.R., Montgomery, S., and Ragen, T.J., eds., *Marine Mammal Research: Conservation beyond Crisis* (2006); Weilgart, L., The impacts of anthropogenic ocean noise on cetaceans and implications for management. *Canadian Journal of Zoology* 85: 1091-1116 (2007).

[4] 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); Clark, C.W., pers. comm. with M. Jasny, NRDC (Apr. 2010); *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).

[5] Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., van Parijs, S., Frankel, A., and Ponirakis, D., Acoustic masking in marine ecosystems as a function of anthropogenic sound sources (2009) (IWC Sci. Comm. Doc. SC/61/E10).

[6] *Id.*; Weilgart, L. (ed.), Report of the workshop on alternative technologies to seismic airgun surveys for oil and gas exploration and their potential for reducing impacts on marine mammals, 31 Aug. – 1 Sept., 2009, Monterey, Calif. (2010) (available at www.okeanos-stiftung.org/okeanos/download.php?id=19).

given the acoustic and behavioral characteristics of its calls.[7] As discussed further below, the exposure levels implicated in all of these studies are lower – indeed orders of magnitude lower on a decibel scale – than the threshold used to evaluate airgun behavioral impacts in the proposed IHA. Repeated insult from airgun surveys, over months and seasons, would come on top of already urbanized levels of background noise and, cumulatively and individually, would pose a significant threat to populations of marine mammals.

Airguns are known to affect a broad range of other marine mammal species beyond the endangered great whales. For example, sperm whale foraging appears to decline significantly on exposure to even moderate levels of airgun noise, with potentially serious long-term consequences;[8] and harbor porpoises have been seen to engage in strong avoidance responses fifty miles from an array.[9] Seismic surveys have been implicated in the long-term loss of marine mammal biodiversity off the coast of Brazil.[10] Broader work on other sources of undersea noise, including noise with predominantly low-frequency components, indicates that beaked whale species would be highly sensitive to seismic noise as well.[11]

Airgun surveys also have important consequences for the health of fisheries. For example, airguns have been shown to dramatically depress catch rates of various commercial species (by 40-80%) over thousands of square kilometers around a single array,[12] leading fishermen in some parts of the world to seek industry compensation for their losses. Other impacts on commercially harvested fish include habitat abandonment – one hypothesized explanation for the fallen catch rates – reduced reproductive performance, and hearing loss.[13] Even brief playbacks of

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[7] Clark et al., Acoustic masking in marine ecosystems as a function of anthropogenic sound sources; Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., Van Parijs, S.M., Frankel, A., and Ponirakis, D., Acoustic masking in marine ecosystems: intuitions, analysis, and implication, *Marine Ecology Progress Series* 395: 201-222 (2009).

[8] Miller, P.J.O., Johnson, M.P., Madsen, P.T., Biassoni, N., Quero, M., and Tyack, P.L., Using at-sea experiments to study the effects of airguns on the foraging behavior of sperm whales in the Gulf of Mexico, *Deep-Sea Research I* 56: 1168-1181 (2009).

[9] 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).

[10] Parente, C.L., Pauline de Araújo, J., and Elisabeth de Araújo, M., Diversity of cetaceans as tool in monitoring environmental impacts of seismic surveys, *Biota Neotropica* 7(1) (2007).

[11] Tyack, P.L., Zimmer, W.M.X., Moretti, D., Southall, B.L., Claridge, D.E., Durban, J.W., Clark, C.W., D'Amico, A., DiMarzio, N., Jarvis, S., McCarthy, E., Morrissey, R., Ward, J., and Boyd, I.L. (2011), Beaked whales respond to simulated and actual Navy sonar, PLoS ONE 6(3): e17009. Doi:10.1371/journal.pone.0017009; Soto, N.A., Johnson, M., Madsen, P.T., Tyack, P.L., Bocconcelli, A., and Borsani, J.F. (2006), Does intense ship noise disrupt foraging in deep-diving Cuvier's beaked whales (Ziphius cavirostris)? Mar. Mamm. Sci. 22: 690-699.

[12] Engås, A., Løkkeborg, S., Ona, E., and Soldal, A.V., Effects of seismic shooting on local abundance and catch rates of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*), *Canadian Journal of Fisheries and Aquatic Sciences* 53: 2238-2249 (1996); *see also* Skalski, J.R., Pearson, W.H., and Malme, C.I., Effects of sounds from a geophysical survey device on catch-per-unit-effort in a hook-and-line fishery for rockfish (*Sebastes ssp.*), *Canadian Journal of Fisheries and Aquatic Sciences* 49: 1357-1365 (1992).

[13] McCauley, R.D., Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M.-N., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdoch, J. and McCabe, K., Marine seismic surveys: analysis and propagation of air-gun signals, and effects of air-gun exposure on humpback whales, sea turtles, fishes, and squid (2000) (report by Curtin U. of Technology); McCauley, R., Fewtrell, J., and Popper, A.N., High intensity anthropogenic sound damages fish ears, *Journal of the Acoustical Society of America* 113: 638-642 (2003); Scholik, A.R., and Yan, H.Y., Effects of boat engine noise on

predominantly low-frequency noise from speedboats have been shown to significantly impair the ability of some fish species to forage.[14] Recent data suggest that loud, low-frequency sound also disrupts chorusing in black drum fish, a behavior essential to breeding in this commercial species.[15] Several studies indicate that airgun noise can kill or decrease the viability of fish eggs and larvae.[16]

The amount of disruptive activity under consideration in this proposed IHA is substantial, especially when put into the context of cumulative impacts in the region from other activities.

II. PURPOSE AND NEED OF STUDY

The stated purpose of the study is twofold: (1) to identify the outer limits of the U.S. continental shelf, also referred to as the ECS as defined by Article 76 of the Convention of the Law of the Sea; and (2) to study the sudden mass transport of sediments down the continental shelf as submarine landslides that may pose tsunamigenic (i.e. tsunami-related) hazards. The first concerns us because of its implications for expanded oil and gas exploration in the region, and the second offers little to substantiate its immediate need.

First, the study is designed to establish the outer limits of the U.S. continental shelf, also referred to as the Extended Continental Shelf (ECS), as defined by Article 76 of the Convention of the Law of the Sea. The ECS is key in determining any entitlement of the U.S. to sovereign rights in the area beyond 200 nautical miles. One of the primary uses of such a determination is to establish mineral rights. This study coincides precisely with the Obama administration's recent release of its Environmental Impact Statement on oil and gas exploration off the East Coast, which gave the green-light to begin related seismic exploration. Within months, the Bureau of Ocean Energy Management will start issuing permits for seismic exploration, letting industry troll from New Jersey to Florida with arrays of high-powered airguns. That exploration overlaps with the southern half of this proposed study area. Any consideration of this study – and in particular the cumulative impact assessment – must include consideration of the fact that this study's underlying purpose may be to increase the area in the Mid-Atlantic that is open to oil and gas exploration and drilling and, therefore, must include an analysis of longer-term related

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the auditory sensitivity of the fathead minnow, *Pimephales promelas*, *Environmental Biology of Fishes* 63: 203-209 (2002).

[14] Purser, J., and Radford, A.N., Acoustic noise induces attention shifts and reduces foraging performance in three-spined sticklebacks (Gasterosteus aculeatus), PLoS One, 28 Feb. 2011, DOI: 10.1371/journal.pone.0017478 (2011).

[15] Clark, C.W., pers. comm. with M. Jasny, NRDC (Apr. 2010).

[16] Booman, C., Dalen, J., Leivestad, H., Levsen, A., van der Meeren, T., and Toklum, K., Effecter av luftkanonskyting på egg, larver og yngel (Effects from airgun shooting on eggs, larvae, and fry), *Fisken og Havet* 3:1-83 (1996) (Norwegian with English summary); Dalen, J., and Knutsen, G.M., Scaring effects on fish and harmful effects on eggs, larvae and fry by offshore seismic explorations, *in* Merklinger, H.M., *Progress in Underwater Acoustics* 93-102 (1987); Banner, A., and Hyatt, M., Effects of noise on eggs and larvae of two estuarine fishes, *Transactions of the American Fisheries Society* 1:134-36 (1973); L.P. Kostyuchenko, Effect of elastic waves generated in marine seismic prospecting on fish eggs on the Black Sea, *Hydrobiology Journal* 9:45-48 (1973).

effects on marine species and habitat of the various sources of increased disruption and harm caused by an influx of oil and gas exploration and drilling in the region.

Second, the study is designed to capture sediment thickness and geologic structure purportedly in order to study the possible risks and triggers of submarine landslides. However, in the cursory 1-page discussion of the purpose and need for the project, the Draft Environmental Assessment offers no analysis of the ability to obtain this information by modeling or alternate means, no discussion of related survey data that may be available for extrapolation, nor any prediction of the actual risk to the Eastern Seaboard of a tsunami-related submarine landslide. Without such basic information, it is impossible to ascertain the need for this study, or for any portion of the study—an essential consideration for the agency in meeting its regulatory mandate under the MMPA's mitigation provision.

III. MITIGATION & IMPACTS

The requested action has the potential for temporary or permanent hearing loss and other physical effects including stranding and death; masking and reduced effectiveness of communication; vessel strike and collision; entanglement; and stress and behavioral disturbance of marine mammals. In order to issue an Incidental Take Authorization (ITA) under section 101(a)(5)(D) of the MMPA, NMFS must set forth mitigation that ensures a means of effecting the least practicable impact. The mitigation here falls far short of that high bar on various fronts.

A. Failure to Consider Time-Area Restrictions

Time and area restrictions designed to protect high-value habitat are one of the most effective means to reduce the potential impacts of noise and disturbance, including noise from oil and gas exploration.[17] It was for this express reason that NOAA, in 2011, established a working group on Cetacean Density and Distribution Mapping, to define marine mammal hotspots for management purposes.[18] Incredibly, the proposed IHA does not consider any areas for closure, trackline avoidance, or seasonal planning for any species.[19] More specifically:

[17] *See, e.g.*, Agardy, T., Aguilar Soto, N., Cañadas, A., Engel, M., Frantzis, A., Hatch, L., Hoyt, E., Kaschner, K., LaBrecque, E., Martin, V., Notarbartolo di Sciara, G., Pavan, G., Servidio, A., Smith, B., Wang, J., Weilgart, L., Wintle, B., and Wright, A, A global scientific workshop on spatio-temporal management of noise, Report of workshop held in Puerto Calero, Lanzarote, June 4-6, 2007 (2007); Dolman, S., Aguilar Soto, N., Notabartolo di Sciara, G., Andre, M., Evans, P., Frisch, H., Gannier, A., Gordon, J., Jasny, M., Johnson, M., Papanicolopulu, I., Panigada, S., Tyack, P., and Wright, A., Technical report on effective mitigation for active sonar and beaked whales (2009) (working group convened by European Cetacean Society); OSPAR Commission, Assessment of the environmental impact of underwater noise (2009) (report issued as part of OSPAR Biodiversity Series, London, UK); Convention on Biological Diversity, Scientific synthesis on the impacts of underwater noise on marine and coastal biodiversity and habitats (2012) (UNEP/CBD/SBSTTA/16/INF/12).

[18] Memorandum from Dr. Jane Lubchenco, Undersecretary of Commerce for Oceans and Atmosphere, to Nancy Sutley, Chair, Council on Environmental Quality at 2 (Jan. 19, 2010).

[19] Nor does the proposed IHA consider state-specific and regional efforts to identify such areas and species of heightened concern. For example, the study makes no mention of the recent work done in New York State to identify what they refer to as the Species of Greatest Conservation need (SGCN). This effort was conducted by the

1. Time-area restrictions for marine mammals

The study area includes important marine mammal habitat that was not considered for time-area restrictions.[20]

(a.) Georges Bank

Georges Bank is a region rich with marine life, ranging from plankton to marine mammals and is well-recognized as among the most diverse, productive, and trophically complex marine temperate areas in the world.[21] As a result of this abundant food, the edge of Georges Bank is a foraging area for many cetaceans including right whales,[22] humpback whales,[23] sei whales,[24] beaked whales, fin whales,[25]sperm whales,[26] pilot whales, spotted dolphins, striped dolphins, offshore bottlenose dolphins, Risso's dolphins, and common dolphins.[27] There are high densities of foraging cetaceans during all parts of the year, but the summer months (June through October) have the highest densities.[28] Indeed, due to the high densities and diversity of marine mammals, Georges Bank is a popular whale watching location during the summer and early fall.

In addition to cetaceans, Georges Bank contains a high concentration of Illex and Loligo squid, which support important commercial fisheries in this area and are an important food source for mammals and for commercially important species such as tuna and swordfish. Illex are present in this area in largest numbers in the summer months, May through September.

New York Department of Environmental Conservation, Bureau of Marine Resources staff in consultation with regional experts, and it culminated in the compilation and mapping of a list of, e.g., marine deep subtidal SGCN. These species and this effort should have been considered in planning the regional study.

[20] We also would note that while we appreciate the inclusion in the Draft Environmental Assessment of the species-specific distribution and habitat use, these maps do not account for or correct for survey effort over the region. Often, survey effort tends to be concentrated along the shore, and so, the animal occurrence maps run the real risk of over-emphasizing the importance of these waters relative to the deeper waters that make up most of the study area.

[21] Link, J., Overholtz, W., O'Reilly, J., Green, J., Dow, D., Palka, D., et al. (2008). The Northeast U.S. continental shelf Energy Modeling and Analysis exercise (EMAX): Ecological network model development and basic ecosystem metrics. Journal of Marine Systems, 74(1-2), 453-474.

[22] http://www.dfo-mpo.gc.ca/Library/344232.pdf (Table 2-3 (p. 156)). P. 160 says fin whales are there year round. P. 161 says sei whales are found there spring and summer. P. 164 says humpbacks can be seen there in summer. P. 166 discusses sperm whales being there

[23] *See* http://www.nature.com/news/2003/030804/full/news030804-1.html.

[24] *Id.* at p. 161.

[25] *Id.* at p. 160.

[26] *Id.* at pp. 156, 166.

[27] Hamazaki, T. (2002). Spatiotemporal prediction models of cetacean habitats in the mid-western North Atlantic ocean(from Cape Hatteras, North Carolina, U. S. A. to Nova Scotia, Canada). Marine Mammal Science, 18(4), 920-939; Palka, D. (2006). Summer abundance estimates of cetaceans in US North Atlantic navy operating areas. US Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc, 06-03; Selzer, L., & Payne, P. (1988). The distribution of white-sided dolphins (Lagenorhynchus acutus) and common dolphins (Delphinus delphis) vs. environmental features of the continental shelf of the northeastern United States. Mar. Mammal Sci, 4, 141-153.

[28] Winn, H. (1982). A characterization of marine mammals and turtles in the Mid-and North Atlantic areas of the US outer continental shelf. Final report. Sponsored by the Bureau of Land Management under contract AA551-CT8-48. 450pp.

On the southern edge of Georges Bank, three undersea canyons – Oceanographer, Gilbert, and Lydonia Canyon – cut into the continental shelf. The three canyons range in depth from approximately 500 feet to 7,700 feet and in length from 22 to 30 miles. However, the full extension of the canyons includes their channels and fan valleys and can be more than twice as long.[29] The canyons support a uniquely diverse set of species (326 species have been identified in the canyons),[30] and the depth, ruggedness, and isolation of the canyons has kept them relatively protected from human impacts while also rendering them extremely vulnerable to disturbance. Endangered sperm whales come to the canyons to forage on squid.[31] Other deep-diving marine mammals, like endangered and highly-depleted North Atlantic right whales, beaked whales, pilot whales and various species of dolphins, have also been observed along the shelf break in the Atlantic Ocean, and it is very likely that they use canyon and seamount productive zones as foraging or migration stops.[32] For example, marks on the seafloor at sites off of Gilbert and Lydonia canyons were inferred to be beaked whale foraging tracks.[33] These distinctive and pristine marine gems require special attention and protection.

Because of the incredibly rich diversity of species that congregate around Georges Bank throughout the year and, most heavily, during the summer months, the survey should be prohibited from entering Georges Bank or the slope waters off Georges Bank, and the survey track lines should be designed to ensure a buffer zone minimally sufficient to minimize potential behavioral impacts on naïve deep-diving whales and disruption of communication with baleen whales.

To the extent that survey lines cut across the three identified canyons – Oceanographer, Gilbert, and Lydonia – the agency should redraw them to avoid overrunning these important foraging waters and to ensure a sufficient buffer between the track line and the canyon.

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[29] Pratt RM. 1967. The seaward extension of submarine canyons off the northeast coast of the United States. Deep Sea Research 14:409-420.
[30] Hecker B, Blechschmidt G, Gibson P. 1980. Epifaunal Zonation and Community Structure in Three Mid- and North Atlantic Canyons. In: Final Report: Canyon Assessment Study in the Mid- and North Atlantic Areas of the US Outer Continental Shelf. Prepared for the U.S. Department of the Interior; Kelly NE, Shea EK, Metaxas A, Haedrich RL, Auster PJ. 2010. Biodiversity of the Deep-Sea Continental Margin Bordering the Gulf of Maine (NW Atlantic): Relationships among Sub-Regions and to Shelf Systems. PLoS ONE 5(11): e13832.
Moore JA, Hartel KE, Galbraith JK, Turnipseed M, Southworth M, Watkins E. 2003. Biodiversity of Bear Seamount, New England Seamount Chain: Results of exploratory trawling. Journal of Northwest Atlantic Fishery Science 31: 363-372.
[31] Hendrickson LC. 2004. Population biology of the northern shortfin squid (Illex illecebrosus) in the Northwest Atlantic Ocean and initial documentation of a spawning area. ICES Journal of Marine Science 61: 252-266; Sperm Whales (Physeter macrocephalus) Species Profile, NOAA Fisheries Office of Protected Resources. Available at http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/spermwhale.htm.
[32] Kaschner, K. 2007. Air-breathing visitors to seamounts: Marine Mammals. Chapter 12 Section A. Pp 230-238 in Pitcher T.J., Morato T., Hart P.J.B., Clark M.R., Haggan N. and Santos R.S. (eds) Seamounts: Ecology, Conservation and Management. Fish and Aquatic Resources Series, Blackwell, Oxford, UK; North Atlantic Right Whales (Eubalaena glacialis) Species Profile, NOAA Fisheries Office of Protected Resources. Available at http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/rightwhale_northatlantic.htm.
[33] Auster PJ, Watling L. 2009. Beaked whale foraging areas inferred by gouges in the seafloor. Marine Mammal Science 26(1): 226-233.

(b.) Mid-Atlantic submarine canyons

As discussed above, submarine canyons support high concentrations and a great diversity of marine wildlife. Physically, they are complex, with outcrops, steep slopes, and different classes of substrates. They also provide a high flux of fine-particle nutrients and often encompass areas of upwelling, which are associated with high biological productivity.

In the mid-Atlantic there are several major submarine canyons, including Norfolk, Washington, Baltimore, Wilmington, Hudson, and Veatch. It is difficult to determine from USGS's application when one of its survey track lines crosses a canyon, but it does appear that the 2014-9 (Phase 1) survey line cuts through Hudson Canyon.

Because of its established importance of this habitat as a biologically rich foraging ground for numerous species of marine mammals and other marine life, the survey line should be redrawn to avoid Hudson Canyon. To the extent that other survey lines cut across these additional identified canyons, the agency should redraw them to avoid overrunning these important foraging waters and to ensure a sufficient buffer between the track line and the canyon.

(c.) Seamounts

Seamounts are rare oases of life in the cold darkness of the deep sea, fostering a remarkable diversity and concentration of marine life. Strong currents and circulation patterns around the seamounts create turbulent waters that enhance mixing of surface and deep water, transport nutrients, and concentrate food supply.[34] The increased production in and around these features echoes up throughout the water column and food chain to create biodiversity "hotspots" in the open ocean.[35]

Bear, Physalia, Mytilus, and Retriever seamounts are underwater mountains that rise as high as 12,000 feet above the ocean floor. At almost 20 miles across, Bear Seamount is the largest of the four, and it rises to the shallowest depth, approximately 3500 feet below the surface. These "biological islands" in the deep sea are ideal incubators for new life, due in large part to their unique topography and current patterns.[36] Currents around these features intensify and form eddies, trapping larvae and other small organisms in a closed loop over each seamount.[37] The substrate on the seamounts varies widely, and – due to the variety of bottom types – many different species can be found living in close proximity to each other, leading scientists to refer

[34] Worm B, Lotze HK, Myers RA. 2003. Predator diversity hotspots in the blue ocean. PNAS 100(17): 9884-9888.
[35] Morato T, Hoyle SD, Allain V, Nicol SJ. 2010. Seamounts are hotspots of pelagic biodiversity in the open ocean. PNAS 107(21): 9707–9711.
[36] Moore JA, Hartel KE, Galbraith JK, Turnipseed M, Southworth M, Watkins E. 2003. Biodiversity of Bear Seamount, New England Seamount Chain: Results of exploratory trawling. Journal of Northwest Atlantic Fishery Science 31: 363-372.
[37] Mills S. 2003. Seamount Coral Communities. NOAA Ocean Explorer Mountains in the Sea. Available at http://oceanexplorer.noaa.gov/explorations/03mountains/background/larvae/larvae.html.

to the seamounts as ocean oases.[38] Six hundred and thirty species have been identified on these seamounts.[39]

Recent studies suggest that this seamount chain – i.e. Bear, Physalia, Mytilus, and Retriever – may act as a dispersal corridor, helping species to cross the Atlantic.[40] This has implications for species resilience, providing a potential mechanism for long-distance dispersal and thus adaptability in the face of changing environmental conditions. It also highlights the interconnectedness of these underwater habitats, underscoring the importance of protecting all four seamounts.

The survey lines currently run across or approach the Bear, Physalia, Mytilus, and Retriever seamounts. **The survey lines should be modified and redesigned to avoid the four seamounts in order to ensure the least practicable impact on marine mammals and should include a buffer zone to minimize marine mammal take.**

(d.) North Atlantic right whale habitat

The cetacean of greatest concern in the region is the North Atlantic right whale, a species that has a minimum population of only about 450 whales and is considered one of the most imperiled large whales on the planet. **In order to protect this species and comply with its obligations under the Endangered Species Act, NMFS must exclude all of the North Atlantic right whale's year-round feeding and mating habitat areas from seismic and vessel activities.** These areas include both designated critical habitat as well as areas that have not yet been designated as critical habitat but are known to be important habitat. As NMFS has repeatedly stated, "the loss of even a single individual [North Atlantic right whale] may contribute to the extinction of the species" and "preventing the mortality of one adult female a year" may alter this outcome.[41]

We would also note, and USGS and NMFS need to account for the fact that right whales are found throughout the region and their movements are not so neatly confined to seasonal and life-cycle-related areas in the way the Draft Environmental Assessment suggests. This need is increased because real-time visual monitoring is very difficult for right whales, especially during

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[38] Moore JA. 2003. Biodiversity on the New England Seamounts. NOAA Ocean Explorer Mountains in the Sea Logs. Available at http://oceanexplorer.noaa.gov/explorations/03mountains/logs/summary/summary.html.
[39] Kelly NE, Shea EK, Metaxas A, Haedrich RL, Auster PJ. 2010. Biodiversity of the Deep-Sea Continental Margin Bordering the Gulf of Maine (NW Atlantic): Relationships among Sub-Regions and to Shelf Systems. PLoS ONE 5(11): e13832.
[40] Moore JA, Vecchione M, Collette BB, Gibbons R, Hartel KE. 2004. Selected fauna of Bear Seamount (New England Seamount chain), and the presence of "natural invader' species. Arch. Fish. Mar. Res. 51 (1-3): 241-250; Moore JA, Auster PJ, Calini D, Heinonen K, Barber K, Hecker B. 2008. False Boarfish Neocyttus helgae in the Western North Atlantic. Bulletin of the Peabody Museum of Natural History 49(1).
[41] *See* 69 Fed. Reg. 30,857, 30,858 (June 1, 2004); *see also* 73 Fed. Reg. 60,173, 60,173 (Oct. 10, 2008); 72 Fed. Reg. 34,632, 34,632 (June 25, 2007); 66 Fed. Reg. 50,390, 50,392 (Oct. 3, 2001).

high sea states, nighttime operations, and other low-visibility conditions, and is further complicated by the size of the impact zone that the monitoring effort would have to cover.[42]

(e.) Other areas identifiable through habitat mapping

NMFS has not attempted any systematic analysis of marine mammal habitat for purposes of establishing time-area closures within the study area.

i. Predictive mapping — Over the past few years, researchers have developed at least two predictive models to characterize densities of marine mammals in the area of interest: the NODE model produced by the Naval Facilities Engineering Command Atlantic, and the Duke Marine Lab model produced under contract with the Strategic Environmental Research and Development Program. Until Duke has produced its new cetacean density model, pursuant to NOAA's CetMap program, NMFS should use these sources, which represent best available science to identify important marine mammal habitat and ensure the least practicable impact. Species of particular importance, aside from the North Atlantic right whale, include the five other large whale species listed under the Endangered Species Act, *i.e.*, blue, fin, sei, humpback, and sperm whales; and beaked whales and harbor porpoises, whose vulnerability to anthropogenic noise is well recognized.

ii. Persistent oceanographic features — Marine mammal densities are correlated over medium to large scales with persistent ocean features, such as currents, productivity, and surface temperature, as well as with concentrations in other marine species, such as other apex predators and fish.[43] The occurrence of these features is often predictable enough to define core areas of biological importance on a year-round or seasonal basis.[44] Analysis of these features should figure in predictive mapping, but can be used to supplement maps that do not take dynamic features into account.

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[42] *E.g.*, Barlow, J., and Gisiner, R., Mitigation and monitoring of beaked whales during acoustic events, *Journal of Cetacean Research and Management* 7: 239-249 (2006); 72 Fed. Reg. 46846, 46875 (Aug. 21, 2007) (SURTASS LFA rulemaking); Dolman, S., Aguilar de Soto, N., Notabartolo di Sciara, G., Andre, M., Evans, P., Frisch, H., Gannier, A., Gordon, J., Jasny, M., Johnson, M., Papanicolopulu, I., Panigada, S., Tyack, P., and Wright, A., Technical report on effective mitigation for active sonar and beaked whales (2009) (report from European Cetacean Society); Parsons, E.C.M., Dolman, S.J., Jasny, M., Rose, N.A., Simmonds, M.P., and Wright, A.J., A critique of the UK's JNCC seismic survey guidelines for minimising acoustic disturbance to marine mammals: Best practice? *Marine Pollution Bulletin* 58: 643-651 (2009).

[43] Hyrenbach, K.D., Forney, K.A., and Dayton, P.K. (2000), Marine protected areas and ocean basin management, *Aquatic Conservation: Marine and Freshwater Ecosystems* 10:437-458.

[44] *Id.* ("Design Recommendations for Pelagic MPAs" include the use of persistent oceanographic features like sea temperature to define core areas for protection).

2. Time-area restrictions for sea turtles and fish

The proposed study area overlaps with populations of sea turtles, including green, leatherback, loggerhead, hawksbill, and Kemp's Ridley. The recovery plan for the Northwest Atlantic population of loggerhead sea turtles notes that seismic surveying, among other activities, threaten these populations.[45] And recent analysis of sea turtle hearing confirms that loggerheads and other sea turtles have their greatest acoustic sensitivity below 400 Hz, where much of the energy produced by airguns is concentrated.[46] Given these findings, as well as the global significance of the region for loggerheads, all important habitats for endangered and threatened sea turtles in the area of interest should be avoided. In particular, important foraging and migrating habitat should receive consideration for time-area closure and all critical habitat should be avoided.

For example, the survey area currently cuts through large swaths of recently designated loggerhead *Sargassum* critical habitat.[47] *Sargassum* is a genus of seaweed that lives on the surface water of the open ocean, forming large floating mats. These mats provide essential forage, cover, and transport habitat for post-hatchlings and early juvenile loggerhead sea turtles.[48] Satellite imagery data – referenced in NMFS' own loggerhead critical habitat designation – found *Sargassum* in a widespread area of the Atlantic Ocean from Cape Hatteras and waters there north, and found that the *Sargassum*'s presence was particularly concentrated in the summer months.[49] As NMFS explained in support of its critical habitat designation, the science shows that *Sargassum* production varies by season, and in the Atlantic, has the greatest biomass occurring off the coast after July.[50] The physical forces that aggregate *Sargassum* also aggregate pollutants and debris, making this habitat especially vulnerable.[51]

Important turtle foraging and migrating habitat should receive consideration for time-area closure, and all loggerhead sea turtle critical habitat should be avoided during the summer months when *Sargassum* is present.

Similarly, the proposed IHA should consider excluding important fish habitat areas, including waters above the soft bottom Northeast U.S. Continental Shelf Large Marine Ecosystem (LME), which is considered essential fish habitat (EFH).

B. Failure to Adequately Consider Reasonable Mitigation and Monitoring Measures

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[45] *Id.*

[46] Piniak, W.E.D., Mann, D.A., Eckert, S.A., and Harms, C.A., Amphibious hearing in sea turtles, *in* Popper, A.N., and Hawkins, A., eds., *The Effects of Noise on Aquatic Life* at 83-88 (2012).

[47] *See* http://www.nmfs.noaa.gov/pr/species/turtles/images/loggerhead_critical_habitat_map.jpg.

[48] 79 FR 39883.

[49] 79 FR 39882.

[50] 79 FR 39882.

[51] *Id.*

The proposed IHA does not adequately consider, or fails to consider at all, a number of other reasonable measures that could significantly reduce take from the proposed activities. These measures include, but are not limited to:

1. **Survey design standards and review**

NMFS should require that the airgun survey vessel use the lowest practicable source level, minimize horizontal propagation of the sound signal, and minimize the density of track lines consistent with the purposes of the survey.[52] While cursory consideration is given to the source level, little explanation of the conclusion that a 36 airgun array is required is offered. We would note that, in the past, the California Coastal Commission has required the U.S. Geological Survey to reduce the size of its array for seismic hazards work, and to use alternative seismic technologies to reduce acoustic intensities during earthquake hazard surveys to their lowest practicable level.[53]

2. **Multi-beam echosounder**

NMFS should also require use of an alternative multi-beam echosounder to the one presently proposed. An industrial multibeam echosounder employed by Exxon occurred in close spatial and temporal association with a mass stranding of melon-headed whales off Madagascar, in 2008; a similar ;[54] a comparable multibeam sonar system—with a center frequency of 15.5 kHz and associated source levels of 237 dB—was used by a Lamont-Doherty Earth Observatory research survey prior to the Gulf of California beaked whale strandings in September 2002, with which the survey was closely correlated, and may have played a role in that event as well.[55] Regardless of the potential for strandings in the present case, it is clear that high-power, lower-frequency echosounders have the potential to impact marine mammal behavior, especially of

[52] Parsons, E.C.M., Dolman, S.J., Jasny, M., Rose, N.A., Simmonds, M.P., and Wright, A.J., A critique of the UK's JNCC seismic survey guidelines for minimising acoustic disturbance to marine mammals: Best practice? *Marine Pollution Bulletin* 58: 643-651 (2009); Burns, J., Clark, C., Ferguson, M., Moore, S., Ragen, T., Southall, B., and Suydam, R., Expert panel review of monitoring and mitigation protocols in applications for incidental harassment authorizations related to oil and gas exploration, including seismic surveys, in the Chukchi and Beaufort Seas (2010) (NMFS Expert Panel Review 2010); Brower, H., Clark, C.W., Ferguson, M., Gedamke, J., Southall, B., and Suydam, R., Expert panel review of monitoring protocols in applications for incidental harassment authorizations related to oil and gas exploration in the Chukchi and Beaufort Seas, 2011: Statoil and ION Geophysical (2011) (NMFS Expert Panel Review 2011).

[53] *See, e.g.*, California Coastal Commission, Staff Recommendation on Consistency Determination No. CD-16-00 (2000) (review of USGS survey off southern California).

[54] Southall, B.L., Rowles, T., Gulland, F., Baird, R. W., and Jepson, P.D. 2013. Final report of the Independent Scientific ReviewPanel investigating potential contributing factors to a 2008 mass stranding of melon-headed whales (*Peponocephala electra*) in Antsohihy, Madagascar.

[55] Cox, T.M., Ragen, T.J., Read, A.J., Vos, E., Baird, R.W., Balcomb, K., Barlow, J., Caldwell, J., Cranford, T., Crum, L., D'Amico, A., D'Spain, G., Fernández, A., Finneran, J., Gentry, R., Gerth, W., Gulland, F., Hildebrand, J., Houser, D., Hullar, T., Jepson, P.D., Ketten, D., MacLeod, C.D., Miller, P., Moore, S., Mountain, D., Palka, D., Ponganis, P., Rommel, S., Rowles, T., Taylor, B., Tyack, P., Wartzok, D., Gisiner, R., Mead, J., and Benner, L., Understanding the impacts of anthropogenic sound on beaked whales. 7 *J. Cetacean Res. Manage.* 177-187 (2006); Hildebrand, J., Impacts of anthropogenic sound, *in* Ragen, T.J., Reynolds III, J.E., Perrin, W.F., Reeves, R.R., and Montgomery, S. (eds.), *Marine Mammal Research: Conservation beyond Crisis* 101-123 (2006).

odontocetes, over a wide spatial scale—and to a far greater extent than has previously been supposed for this category of sound source.[56] Given the acoustic characteristics of the Langseth's echosounder, use of an alternative for part or all of the survey must be considered.

3. Sound source validation

Relatedly, NMFS should require USGS to validate the assumptions about propagation distances used to establish safety zones and calculate take (*i.e.*, at minimum, the 160 dB and 180 dB isopleths). Sound source validation has been required of Arctic operators for several years, as part of their IHA compliance requirements, and has proven useful for establishing more accurate, *in situ* measurements of safety zones and for acquiring information on noise propagation.[57]

4. Adequate safety zone distances

NMFS should reconsider the size of the safety zone. The proposed IHA proposes establishing a safety zone of 180 dB re 1 µPa (with a 500 m minimum) around the seismic array. Gedamke et al. (2011), whose lead author is the present director of NMFS' Bioacoustics Program, has put traditional means of estimating safety zones into doubt. That paper demonstrates through modeling that, when uncertainties about impact thresholds and intraspecific variation are accounted for, a significant number of whales could suffer temporary threshold shift (*i.e.*, hearing loss) beyond 1 km from a relatively small seismic array (source energy level of 220 dB re 1 $\mu Pa^2(s)$) – a distance that seems likely to exceed NMFS's estimates.[58] Moreover, a recent dose-response experiment indicates that harbor porpoises are substantially more susceptible to temporary threshold shift than the two species, bottlenose dolphins and belugas, that had previously been tested.[59] And a number of recent studies suggest that the relationship between temporary and permanent threshold shift may not be as predictable as previously believed.[60]

Finally, NMFS should consider establishing larger shutdown zones for certain target species. Although time/area closures are a more effective means of reducing cumulative exposures of wildlife to disruptive and harmful sound, these expanded safety zones have value in minimizing disruptions, and potentially in reducing the risk of hearing loss and injury, outside the seasonal

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[56] The point is echoed by Southall et al., Final Report of the Independent Scientific Review Panel.

[57] *See, e.g.*, Burns et al., Expert Panel Review (2010), *supra*; Brower et al., Expert Panel Review (2011), *supra*.

[58] Gedamke, J., Gales, N., and Frydman, S., Assessing risk of baleen whale hearing loss from seismic surveys: The effect of uncertainty and individual variation, *Journal of the Acoustical Society of America* 129: 496-506 (2011).

[59] Lucke, K., Siebert, U., Lepper, P.A., and Blanchet, M.-A., Temporary shift in masked hearing thresholds in a harbor porpoise (*Phocoena phocoena*) after exposure to seismic airgun stimuli, *Journal of the Acoustical Society of America* 125: 4060-4070 (2009).

[60] Kastak, D., Mulsow, J., Ghoul, A., Reichmuth, C., Noise-induced permanent threshold shift in a harbor seal [abstract], *Journal of the Acoustical Society of America* 123: 2986 (2008) (sudden, non-linear induction of permanent threshold shift in harbor seal during TTS experiment); Kujawa, S.G., and Liberman, M.C., Adding insult to injury: Cochlear nerve degeneration after "temporary" noise-induced hearing loss, *Journal of Neuroscience* 29: 14077-14085 (2009) (mechanism linking temporary to permanent threshold shift).

closure areas.[61] Visual sighting of any individual right whale at any distance should trigger shut-down; for other species, shut-down should occur if aggregations are observed within the 160 dB isopleth around the sound source.

5. Adequate real-time monitoring

It is well established that real-time visual shipboard monitoring is difficult for all marine mammal and sea turtle species, especially at night and during high sea states and fog.[62] Supplemental methods that have been used on certain other projects include hydrophone buoys and other platforms for acoustic monitoring, aerial surveys, shore-based monitoring, and the use of additional small vessels. Here, the real-time monitoring effort proposed in the IHA is inadequate.

While NMFS seems to require two observers for the airgun survey during the majority of the time (it notes that there will be only one observer during meal times and bathroom breaks) – the minimum number necessary to maintain 360-degree coverage around the seismic vessel –it otherwise sets forth requirements that are inconsistent with survey conventions and with prior studies of observer effectiveness. *First*, NMFS would allow visual and acoustic observers to work at four-hour stretches. That four-hour work cycle doubles the amount of time conventionally allowed for marine mammal observation aboard NMFS survey vessels, and is even less appropriate for conditions where, as here, an animal's health is at stake. *Second*, NMFS offers no details about the training requirements of its vessel-based observers. Yet, as UK data have demonstrated, use of observers with no meaningful experience in marine mammal observation, such as ships' crew, results in extremely low levels (approaching zero percent) of detection and compliance.[63] NMFS should require field experience in marine mammal observation of any observer.

Furthermore, the study only requires passive acoustic monitoring ("PAM") as practicable with no further guidance on when monitoring is or isn't practicable. There is no reason why PAM should not be mandated. Furthermore, with only one expert bioacoustician on board, the proposed IHA suggests that he or she would "ideally" monitor the PAM system 24 hours per day. This is wholly unrealistic, and it fails to account for the study design which runs non-stop for weeks on end. No consideration is made of the heightened need for PAM during low visibility or night-time hours.

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[61] *See* MMS, Final Programmatic Environmental Assessment, Arctic Outer Continental Shelf Seismic Surveys – 2006, OCS EIS/EA MMS 2006-038 at 110-111 (June 2006) (noting sensitivity of baleen whale cow-calf pairs).

[62] *See, e.g.*, Barlow, J., and Gisiner, R., Mitigation and monitoring of beaked whales during acoustic events, *J. Cetacean Res. Manage.* 7: 239-249 (2006); Parsons, E.C.M., Dolman, S.J., Jasny, M., Rose, N.A., Simmonds, M.P., and Wright, A.J., A critique of the UK's JNCC seismic survey guidelines for minimising acoustic disturbance to marine mammals: Best practice? *Marine Pollution Bulletin* 58: 643-651 (2009).

[63] Stone, C.J., The effects of seismic surveys on marine mammals in UK waters: 1998-2000 (2003) (Joint Nature Conservation Committee Report 323); *see also* Parsons et al., A critique of the UK's JNCC seismic survey guidelines, *supra*. It is worth noting that the "inexperienced" marine mammal observers involved in the UK study usually still received some basic training. Stone, The effects of seismic surveys, *supra*.

Indeed, the proposed IHA makes no consideration of limiting activities in low-visibility conditions or at night, which can reduce the risk of ship-strikes and near-field noise exposures.

6. Technology-based mitigation

New technology represents a promising means of reducing the environmental footprint of seismic exploration. Industry experts and biologists participating in a September 2009 workshop on airgun alternatives reached the following conclusions: that airguns produce a great deal of "waste" sound and generate peak levels substantially higher than needed for offshore exploration; that a number of quieter technologies are either available now for commercial use or can be made available within the next five years; and that governments should accelerate development and use of these technologies through both research and development funding and regulatory engagement.[64]

Among the technologies discussed in the 2009 workshop report are engineering modifications to airguns, which can cut emissions at frequencies not needed for exploration; controlled sources, such as marine vibroseis, which can dramatically lower the peak sound currently generated by airguns by spreading it over time; various non-acoustic sources, such as electromagnetic and passive seismic devices, which in certain contexts can eliminate the need for sound entirely; and fiber-optic receivers, which can reduce the need for intense sound at the source by improving acquisition at the receiver.[65] An industry-sponsored report by Noise Control Engineering made similar findings about the availability of greener alternatives to seismic airguns, as well as alternatives to a variety of other noise sources used in oil and gas exploration.[66]
Considerable current effort is focused on developing quieting technologies for use in offshore exploration. Last winter, BOEM convened an international workshop on noise-reduction alternatives for deep-penetration seismic exploration, pile-driving for offshore construction, and shipping for offshore development in general. Findings of that workshop, which were released in a BOEM report, emphasize the promise of vibroseis.[67] Last June, parties to *NRDC v. Jewell* entered into a settlement agreement that establishes a timeframe for industry development and testing of three vibroseis prototypes;[68] and Geo-Kinetics has made substantial recent progress in bringing its own vibroseis unit to commercial viability, with an array potentially becoming available later this year. In 2012, BP North America patented a different noise-reduction

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[64] Weilgart, L. ed., Report of the workshop on alternative technologies to seismic airgun surveys for oil and gas exploration and their potential for reducing impacts on marine mammals, 31 Aug. – 1 Sept., 2009, Monterey, Calif. (2010), *available at* www.okeanos-stiftung.org/okeanos/download.php?id=19.

[65] *Id.*

[66] Spence, J., Fischer, R., Bahtiarian, M., Boroditsky, L., Jones, N., and Dempsey, R., Review of existing and future potential treatments for reducing underwater sound from oil and gas industry activities (2007) (NCE Report 07-001) (prepared by Noise Control Engineering for Joint Industry Programme on E&P Sound and Marine Life). Despite the promise indicated in the 2007 and 2010 reports, neither NMFS nor BOEM has attempted to develop noise-reduction technology for seismic or any other noise source, aside from BOEM's failed investigation of mobile bubble curtains.

[67] CSA Ocean Sciences, Quieting Technologies for Reducing Noise During Seismic Surveying and Pile Driving Workshop. Summary Report for the US Dept. of the Interior (2014) (BOEM rep. no. 2014-061).

[68] Settlement Agreement, NRDC v. Jewell, Case No. 2: 10-cv-01882 (E.D. La.) (settlement filed June 18, 2013).

method—one that uses software to stagger bursts of airgun fire, in order to reduce the effective source level of the array.[69]

The proposed IHA, however, fails to include any requirement to use or test the use of new technologies in the USGS Atlantic survey.

IV. IMPACTS ANALYSIS

A. Failure to Set Proper Thresholds for Marine Mammal Take

In addition to not implementing measures that would reduce take, NMFS has underestimated marine mammal take from the proposed study. The reasons for this are manifold, but lie principally in the agency's mistaken adoption of a 160 dB threshold for Level B take and its failure to adequately calculate impacts from masking. Nor has NMFS performed a sensitivity analysis to determine how significantly its take and impact estimates would differ if some of its core assumptions – such as its 160 dB threshold – are wrong.

1. Illegal threshold for behavioral take

NMFS uses a single sound pressure level (160 dB re 1 µPa (RMS)) as a threshold for behavioral, sublethal take in all marine mammal species from seismic airguns. This approach simply does not reflect the best available science, and the choice of threshold is not sufficiently conservative in several important respects. Indeed, five of the world's leading biologists and bioacousticians working in this field have characterized the present threshold, in a comment letter to NMFS, as "overly simplified, scientifically outdated, and artificially rigid."[70] *See* 40 C.F.R. § 1502.22. NMFS must use a more conservative threshold for the following reasons:

The agency's use of a single, non-conservative, bright-line threshold for all species flies in the face of recent science and is untenable. In particular, the 160 dB threshold is non-conservative, since the scientific literature establishes that behavioral disruption can occur at substantially lower received levels for some species.

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 – over an area at least 100,000 square nautical miles in size, and can cause baleen whales to abandon habitat over the same scale.[71] Similarly, a low-frequency, high-amplitude fish mapping device was found to

[69] A. Ross and R.L. Abma, Offshore prospecting signal processing controlled source signaling, U.S. Patent 20,120,147,701 (June 14, 2012) (*available at*: http://www.faqs.org/patents/app/ 20120147701).
[70] Clark, C., Mann, D., Miller, P., Nowacek, D., and Southall, B., Comments on Arctic Ocean Draft Environmental Impact Statement at 2 (Feb. 28, 2012).
[71] 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); Clark, C.W., pers. comm. with M. Jasny, NRDC (Apr. 2010); *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).

silence humpback whales at distance of 200 km, where received levels ranged from 88 to 110 dB; and several other studies clearly indicate disruption of biologically significant behaviors in baleen whales are drastically lower received levels than considered here.[72] Sperm whale foraging success, as measured by buzz rate, appears to decline significantly on exposure to airgun received levels above 130 dB (RMS), with potentially serious long-term consequences.[73] Harbor porpoises are known to be acutely sensitive to a range of anthropogenic sources, including airguns. They have been observed to engage in avoidance responses fifty miles from a seismic airgun array – a result that is consistent with both captive and wild animal studies showing them abandoning habitat in response to pulsed sounds at very low received levels, well below 120 decibels (re 1 µPa (RMS)).[74] Beaked whales, though never tested experimentally for their response to airgun noise, have shown themselves to be sensitive to various types of anthropogenic sound, going silent, abandoning their foraging, and avoiding sounds at levels of 140 dB and potentially well below.[75]

Little if any of these data were available in 1999, when the High Energy Seismic Survey panel issued the report on which the 160 dB threshold is purportedly based;[76] since that time, the literature on ocean noise has expanded enormously due to massive increases in research funding from the U.S. Navy, the oil and gas industry, and other sources. The evidentiary record for a lower threshold in this case substantially exceeds the one for mid-frequency sonar in *Ocean Mammal Institute v. Gates*, 546 F. Supp.2d 960, 973-75 (D.Hawaii 2008), in which a Hawaiian

[72] See, e.g., Risch, D., Corkeron, P.J., Ellison, W.T., and van Parijs, S.M., Changes in humpback whale song occurrence in response to an acoustic source 200 km away, PLoS ONE 7(1): e29741. doi:10.1371/journal.pone.0029741 (2012); Cerchio, S., Strindberg, S., Collins, T., Bennett, C., and Rosenbaum, H., Seismic surveys negatively affect humpback whale singing activity off Northern Angola, *PLoS ONE* 9(3): e86464. doi:10.1371/journal.pone.0086464 (2014); Castellote, M., Clark, C.W., and Lammers, M.O., Acoustic and behavioural changes by fin whales (*Balaenoptera physalus*) in response to shipping and airgun noise, *Biological Conservation* 147: 115-122 (2012).

[73] Miller, P.J.O., Johnson, M.P., Madsen, P.T., Biassoni, N., Quero, M., and Tyack, P.L., Using at-sea experiments to study the effects of airguns on the foraging behavior of sperm whales in the Gulf of Mexico, *Deep-Sea Research I* 56: 1168-1181 (2009).

[74] *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); Kastelein, R.A., Verboom, W.C., Jennings, N., and de Haan, D., Behavioral avoidance threshold level of a harbor porpoise (Phocoena phocoena) for a continuous 50 kHz pure tone, *Journal of the Acoustical Society of America* 123: 1858-1861 (2008); Kastelein, R.A., Verboom, W.C., Muijsers, M., Jennings, N.V., and van der Heul, S., The influence of acoustic emissions for underwater data transmission on the behavior of harbour porpoises (Phocoena phocoena) in a floating pen, *Mar. Enviro. Res.* 59: 287-307 (2005); Olesiuk, P.F., Nichol, L.M., Sowden, M.J., and Ford, J.K.B., Effect of the sound generated by an acoustic harassment device on the relative abundance and distribution of harbor porpoises (Phocoena phocoena) in Retreat Passage, British Columbia, *Mar. Mamm. Sci.* 18: 843-862 (2002).

[75] Soto, N.A., Johnson, M., Madsen, P.T., Tyack, P.L., Bocconcelli, A., and Borsani, J.F., Does intense ship noise disrupt foraging in deep-diving Cuvier's beaked whales (*Ziphius cavirostris*)? *Mar. Mamm. Sci.* 22: 690-699 (2006); Tyack, P.L., Zimmer, W.M.X., Moretti, D., Southall, B.L., Claridge, D.E., Durban, J.W., Clark, C.W., D'Amico, A., DiMarzio, N., Jarvis, S., McCarthy, E., Morrissey, R., Ward, J., and Boyd, I.L., Beaked whales respond to simulated and actual Navy sonar, *PLoS ONE* 6(3):e17009.doi:10.13371/journal.pone.0017009 (2011) (beaked whales); California State Lands Commission, Draft Environmental Impact Report (EIR) for the Central Coastal California Seismic Imaging Project at H-47 (2012) (CSLC EIR No. 758).

[76] High Energy Seismic Survey Team, High energy seismic survey review process and interim operational guidelines for marine surveys offshore Southern California (1999).

District Court judge invalidated a NMFS threshold that ignored documented impacts at lower received levels as arbitrary and capricious.

In addition, 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 linear risk functions that endeavor to account for risk and individual variability and to reflect the potential for take at relatively low levels. 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 linear risk functions that endeavor to account for risk and individual variability and to reflect the potential for take at relatively low levels.[77]

The use of a multi-pulse standard for behavior harassment is non-conservative, since it does not take into account the spreading of seismic pulses over time beyond a certain distance from the array.[78] NMFS' own Open Water Panel for the Arctic – which has included some of the country's leading marine bioacousticians – has twice characterized the seismic airgun array as a mixed impulsive/continuous noise source and has stated that NMFS should evaluate its impacts on that basis.[79] That analysis is supported by the masking effects model referenced above, in which several NMFS scientists have participated; by a number of papers showing that seismic exploration in the Arctic, the east Atlantic, off Greenland, and off Australia has raised ambient noise levels at significant distances from the array;[80] and, we expect, by the modeling efforts of NOAA's Sound Mapping working group, whose public release is supposed to occur in early July. NMFS should not ignore this science.

The threshold's basis in the root mean square ("RMS") of sound pressure, rather than in peak pressure, is non-conservative. Studies have criticized the use of RMS for seismic because of the degree to which pulsed sounds must be "stretched," resulting in significant potential underestimates of marine mammal take.[81]

Finally, NMFS must consider that even behavioral disturbance can amount to Level A take if it interferes with essential life functions through secondary effects. For example, displacement

[77] *See, e.g.*, 74 Fed. Reg. 4844, 4844-4885 (Jan. 27, 2009).

[78] *See* Expert Panel Review 2011.

[79] *Id.*; *see also* Expert Panel Review 2010.

[80] Gedamke, J., Ocean basin scale loss of whale communication space: potential impacts of a distant seismic survey, Biennial Conference on the Biology of Marine Mammals, November-December 2011, Tampa, FL (2011) (abstract); Nieukirk, S.L., Klinck, H., Klinck, K., Mellinger, D.K., and Dziak, R.P., Seismic airgun sounds and whale vocalization recorded in the Fram Strait and Greenland Sea, Biennial Conference on the Biology of Marine Mammals, November-December 2011, Tampa, FL (2011) (abstract); Nieukirk, S.L., Mellinger, D.K., Moore, S.E., Klinck, K., Dziak, R.P., Goslin, J., Sounds from airguns and fin whales recorded in the mid-Atlantic Ocean, 1999-2009, *Journal of the Acoustical Society of America* 131:1102- 1112 (2012); Nieukirk, S.L., Stafford, K.M., Mellinger, D.K., Dziak, R.P., and Fox, C.G., Low-frequency whale and seismic airgun sounds recorded in the mid-Atlantic Ocean, *Journal of the Acoustical Society of America* 115: 1832-1843 (2004); Roth, E.H., Hildebrand, J.A., Wiggins, S.M., and Ross, D., Underwater ambient noise on the Chukchi Sea continental slope, *Journal of the Acoustical Society of America* 131:104-110 (2012).

[81] Madsen, P.T., Marine mammals and noise: Problems with root-mean-squared sound pressure level for transients, *Journal of the Acoustical Society of America* 117:3952-57 (2005).

from migration paths can result in heightened risk of ship strike or predation; and some sound sources can cause. beaked whales to change their behavior, resulting in pathologies consistent with decompression sickness. NMFS must take into account the best available science and set lower thresholds for Level A take, which, as noted above, would lead to larger exclusion zones around the survey.

NMFS must revise the thresholds and methodology used to estimate take from airgun use. Specifically, we urge the following:

i. NMFS should employ a combination of specific thresholds for which sufficient species-specific data are available and generalized thresholds for all other species.[82] These thresholds should be expressed as linear risk functions where appropriate. If a single risk function is used for most species, the 50% take parameter for all the baleen whales and odontocetes occurring in the area should not exceed 140 dB (RMS), per the February 2012 recommendation from Dr. Clark and his colleagues. At least for sensitive species such as harbor porpoises and beaked whales, NMFS should use a threshold well below that number, reflecting the high levels of disturbance seen in these species at 120 dB (RMS) and below. Recent analysis by the California State Lands Commission provides another alternative, differentiating among low-frequency, mid-frequency, and high-frequency cetaceans in a manner that is generally consistent with Southall et al (2007).[83]

ii. Data on species for which specific thresholds are developed should be included in deriving generalized thresholds for species for which less data are available.

iii. In deriving its take thresholds, NMFS should treat airgun arrays as a mixed acoustic type, behaving as a multi-pulse source closer to the array and, in effect, as a continuous noise source further from the array, per the findings of the 2011 Open Water Panel cited above.

iv. Behavioral take thresholds for the impulsive component of airgun noise should be based on peak pressure rather than on RMS, or dual criteria based on both peak pressure and RMS should be used. Alternatively, NMFS should use the most biologically conservative method of calculating RMS, following Madsen (2005). (See section IV.C. below for additional detail.)

[82] By "thresholds," we mean either bright-line thresholds or linear risk functions.

[83] California State Lands Commission, Draft Environmental Impact Report at Chap. 4.4 and App. H, *supra*; *see also* Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran. J.J., Gentry, R.L., Greene, C.R., Jr., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A., and Tyack, P.L., Marine mammal noise exposure criteria: Initial scientific recommendations, *Aquatic Mammals* 33:411-521 (2007).

2. Erroneous "small numbers" and "negligible impact" determinations

Any authorization to take marine mammals must result in the incidental take of only "small numbers of marine mammals of a species or population stock," and can have no more than a "negligible impact" on species and stocks.[84] Furthermore, NMFS must provide for the monitoring and reporting of such takings and must prescribe methods and means of effecting the "least practicable adverse impact" on the species or stock and their habitat.[85] The thresholds used in the proposed IHA do not reflect the best available science and the proposal does not meet the MMPA's requirement that authorized take only affect small numbers of animals and have a negligible impact.

In particular, adverse impacts on North Atlantic right whales are never negligible. USGS has requested authorization to take by harassment six North Atlantic right whales. These whales are critically endangered, with only approximately 450 individuals in existence.[86] NMFS has determined that even one mortality or serious injury, other than natural causes, of a North Atlantic right whale could have harmful population level impacts and impede recovery.[87] At present annual mortality and serious injury of right whales already exceeds this rate from entanglement in fishing gear and ship strikes, as right whales sustain an average of 4 serious injuries and mortalities each year.[88] Interference with feeding or mating that could occur from displacement or disturbance from the proposed survey could be harmful for the right whales.

NMFS has also blatantly disregarded the MMPA's prohibition on allowing the take of more than small numbers of marine mammals.[89] For example, the proposed take for pantropical spotted dolphins is 1,448.[90] This amounts to 43.44% of the stock. Although there is no numerical cut-off for "small numbers,"[91] courts have concluded that "[a] definition of 'small number' that permits the potential taking of as much as 12% of the population of a species is plainly against Congress' intent."[92]

NMFS' explanation for how its take authorization is limited to small numbers is irrational. The agency cuts the anticipated take numbers by 80-90% -- by the portion of the project that occurs outside the U.S. EEZ. However, the MMPA clearly prohibits agencies from taking marine mammals on the high seas.[93] Since the take prohibition applies outside the EEZ as well as in U.S. waters, NMFS must make a negligible impact and small numbers determination to authorize take for the populations in both the U.S. EEZ and on the high seas outside the U.S. EEZ. Authorizing

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[84] *See* 16 U.S.C. § 1371(a)(5)(D)(i).
[85] 16 U.S.C. § 1371(a)(5)(A) & (D).
[86] National Marine Fisheries Service, Draft Stock Assessment Reports (North Atlantic right whale) (2013).
[87] 73 Fed. Reg. at 60,176.
[88] *Id.*
[89] 16 U.S.C. § 1371(a)(5)(D)(i).
[90] The potential biological removal for pantropical spotted dolphins is 17. National Marine Fisheries Service, Draft Stock Assessment Reports (2013).
[91] *See* H.R. Rep. No. 97-228 (1981), reprinted in 1981 U.S.C.C.A.N. 1458, 1469 ("[small numbers] is not capable of being expressed in absolute numerical limits.").
[92] *Natural Res. Def. Council v. Evans*, 279 F. Supp. 2d at 1129, 1152 (N.D. Cal. 2003).
[93] 16 U.S.C. § 1372(a)(1) ("it is unlawful for any person . . . .to take any marine mammal on the high seas"); *Ctr. for Biological Diversity v. Nat'l Science Found.*, 2002 U.S. Dist. LEXIS 22315 (N.D. Cal. 2002).

take of marine mammals outside the EEZ without complying with all MMPA take authorization requirements violates the MMPA.[94] Accordingly, NMFS must demonstrate compliance with these standards and may not issue the authorization without fully analyzing and authorizing all take contemplated under this action. Moreover, pantropical spotted dolphins may be quite vulnerable to seismic activities as documented by a 2004 stranding incident for which sonar activities could have been the cause.[95]

Finally, NMFS' reliance on marine mammal avoidance of the seismic survey to mitigate the take of marine mammals is improper. Rather, displacement of marine mammals by noise pollution is itself harassment. Furthermore, displacement of whales can drive them into shipping lanes increasing the likelihood of a collision with a vessel, or into fishing areas and risk entanglement.

3. Failure to analyze masking effects or set thresholds for masking

The proposed IHA fails to consider masking effects from the mixed impulsive/continuous noise source airguns. Some biologists have analogized the increasing levels of noise from human activities to a rising tide of "smog" that is already shrinking the sensory range of marine animals by orders of magnitude from pre-industrial levels.[96] Masking of natural sounds begins when received levels rise above ambient noise at relevant frequencies.[97] Accordingly, NMFS must evaluate the loss of communication space – and consider the extent of acoustic propagation – at far lower received levels than the proposed IHA currently employs.

Researchers at NOAA and Cornell have created a model that quantifies impacts on the communication space of marine mammals. That published model has already been applied to shipping noise off Massachusetts and off British Columbia, and the same researchers involved in the Massachusetts study have applied it to airgun surveys as well.[98] Additionally, researchers at

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[94] 16 U.S.C. § 1372(a)(1).

[95] NMFS, Stock Assessment Report for Pantropical Spotted Dolphin (*Stenella atenuata*): Western North Atlantic Stock (Oct. 2007).

[96] *See also* Bode, M., Clark, C.W., Cooke, J., Crowder, L.B., Deak, T., Green, J.E., Greig, L., Hildebrand, J., Kappel, C., Kroeker, K.J., Loseto, L.L., Mangel, M., Ramasco, J.J., Reeves, R.R., Suydam, R., Weilgart, L., Statement to President Barack Obama of Participants of the Workshop on Assessing the Cumulative Impacts of Underwater Noise with Other Anthropogenic Stressors on Marine Mammals (2009); Clark, C., and Southall, B., Turn down the volume in the ocean, *CNN.com*, Jan. 20, 2012, *available at* www.cnn.com/2012/01/19/opinion/clark-southall-marine/index.html; McDonald, M.A., Hildebrand, J.A., and Wiggins, S.M., Increases in deep ocean ambient noise in the Northeast Pacific west of San Nicolas Island, California, *Journal of the Acoustical Society of America* 120: 711-718 (2006).

[97] Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., van Parijs, S., Frankel, A., and Ponirakis, D., Acoustic masking in marine ecosystems as a function of anthropogenic sound sources (2009) (IWC Sci. Comm. Doc. SC/61/E10); Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., Van Parijs, S.M., Frankel, A., and Ponirakis, D., Acoustic masking in marine ecosystems: intuitions, analysis, and implication, *Marine Ecology Progress Series* 395: 201-222 (2009). *See also* Castellote, M., Clark, C.W., and Lammers, M.O., Potential negative effects in the reproduction and survival on fin whales (*Balaenoptera physalus*) by shipping and airgun noise (2010) (IWC Scientific Committee Doc. No. SC/62/E3).

[98] Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., van Parijs, S., Frankel, A., and Ponirakis, D., Acoustic masking in marine ecosystems as a function of anthropogenic sound sources (2009) (IWC Sci. Comm. Doc. SC/61/E10); Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., Van Parijs, S.M., Frankel, A., and Ponirakis, D., Acoustic masking in marine ecosystems: intuitions, analysis, and implication, *Marine Ecology Progress Series* 395:

BP, working with colleagues at the University of California and the North Slope Borough, are applying the model to an analysis of masking effects from seismic operations in the Beaufort Sea.[99] Remarkably, the proposed IHA – instead of applying the Cornell/NOAA model – simply states that masking effects on marine mammals would be "minor." Failure to adequately account for the toll of masking ultimately effects the accuracy of the agency's take and negligible impact findings.

4. Failure to set proper thresholds for hearing loss

As you know, NMFS is presently revising its criteria for temporary and permanent auditory impacts and, by extension, direct tissue injury.[100] Several of the signatories to this letter, based on consultation and review by three bioacousticians, have submitted extensive comments on the draft criteria, which address, among other issues, new data that have appeared since the Southall et al. study was published in 2007. These include, inter alia, data indicating that harbor porpoises experience threshold shift on exposure to airgun signals at substantially lower levels than the two mid-frequency cetaceans (bottlenose dolphins and beluga whales) previously tested.[101] None of these considerations, and few of the relevant studies appearing since 2007, appear to be discussed in the IHA.

Hearing loss remains a very significant risk where, as here, the agency has not required aerial monitoring as standard mitigation, appears unwilling to restrict operations in low-visibility conditions, has set safety zone bounds that are inadequate to protect high-frequency cetaceans, and has not firmly established seasonal exclusion areas for biologically important habitat. NMFS should take a conservative approach and apply a more precautionary standard.

5. Failure to set proper thresholds for high- and mid-frequency sources

NMFS has also failed to adequately consider the potential impacts from or set an appropriate take threshold for the survey's multi-beam echosounder and sub-bottom profiler. NMFS mentions but then discounts the 2008 mass stranding in Madagascar of 100 melon-headed whales associated with the use of a 12kHz multi-beam echosounder. This is the same frequency echosounder as the one proposed for use in this project. Instead, NMFS simply suggests that the risk "may be very low" because these systems are used worldwide and there is a lack of direct evidence – other than the melon-headed whale incident, of course – of other such responses. To

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201-222 (2009); Williams, R., Ashe, E., Clark, C.W., Hammond, P.S., Lusseau, D., and Ponirakis, D., Inextricably linked: boats, noise, Chinook salmon and killer whale recovery in the northeast Pacific, presentation given at the Society for Marine Mammalogy Biennial Conference, Tampa, Florida, Nov. 29, 2011 (2011).

[99] Fleishman, E., and Streever, B., Assessment of cumulative effects of anthropogenic underwater sound: project summary and status, at 2 (2012).

[100] NOAA, Draft guidance for assessing the effects of anthropogenic sound on marine mammals: Acoustic threshold levels for onset of permanent and temporary threshold shifts (Dec. 23, 2013).

[101] Lucke, K., Siebert, U., Lepper, P.A., and Blanchet, M.-A., Temporary shift in masked hearing thresholds in a harbor porpoise (*Phocoena phocoena*) after exposure to seismic airgun stimuli, *Journal of the Acoustical Society of America* 125: 4060-4070 (2009).

essentially discount and ignore such a significant stranding is in stark conflict with NMFS' obligation under the MMPA to ensure the least practicable impact.

6. Failure to Adequately Assess Impacts on the North Atlantic Right Whale

The highly endangered North Atlantic right whale (*Eubalaena glacialis*) is considered to be one of the most endangered species of large whales in the world. Indeed, as NMFS has repeatedly stated, "the loss of even a single individual [North Atlantic right whale] may contribute to the extinction of the species" and "preventing the mortality of one adult female a year" may alter this outcome. 69 Fed. Reg. 30,857, 30,858 (June 1, 2004); *see also* 73 Fed. Reg. 60,173, 60,173 (Oct. 10, 2008); 72 Fed. Reg. 34,632, 34,632 (June 25, 2007); 66 Fed. Reg. 50,390, 50,392 (Oct. 3, 2001).

The affected study area abuts and enters the North Atlantic right whale year-round feeding and mating grounds. As discussed above, a single seismic source can significantly reduce right whale communication range on a population scale. Recent modeling from Cornell and NOAA shows the right whale to be particularly vulnerable to masking effects from airguns and other low-frequency noise given the acoustic and behavioral characteristics of its calls.[102] Seismic surveys in the North and Mid-Atlantic areas could add cumulatively to the high levels of noise that right whales already experience from commercial shipping in their foraging grounds and along their migratory route. The advent of airgun noise on top of these other acoustic intrusions could significantly affect right whale vital rates over large scales. For example, modeling of right whale foraging in the Great South Channel, an area subject to high levels of ship traffic, has found that decrements in the whales' sensory range had a larger impact on food intake than even patch-density distribution, and are likely to compromise fitness in this endangered species.[103]

In addition to the threat of noise impacts to right whales, any expansion of the EEZ and larger opening up of this region to oil and gas exploration and drilling poses the risk of increasing ship strikes, the leading cause of death for right whales. More than half (10 out of 14) of the post-mortem findings for right whales that died from significant trauma in the northwest Atlantic between 1970 and 2002 indicated that vessel collisions were a contributing cause of death (in the cases where presumed cause of death could be determined);[104] and these data are likely to

[102] Clark et al., Acoustic masking in marine ecosystems as a function of anthropogenic sound sources; Clark et al., Acoustic masking in marine ecosystems: intuitions, analysis, and implication.

[103] Mayo, C.S., Page, M., Osterberg, D., and Pershing, A., On the path to starvation: The effects of anthropogenic noise on right whale foraging success, North Atlantic Right Whale Consortium: Abstracts of the Annual Meeting (2008).

[104] Moore, M. J., Knowlton, A.R., Kraus, S.D., McLellan, W.A., and Bonde, R.K., Morphometry, gross morphology and available histopathology in North Atlantic right whale (*Eubalena glacialis*) mortalities (1970-2002), *Journal of Cetacean Research and Management* 6:199-214 (2004).

grossly underestimate the actual number of animals struck, as animals struck but not recovered, or not thoroughly examined, cannot be accounted for.[105]

Further, some types of anthropogenic noise have been shown to induce near-surfacing behavior in right whales, increasing the risk of ship-strike at relatively moderate levels of exposure, as noted in the next section below. It is possible that mid-frequency sub-bottom profilers and the multi-beam echosounder could produce the same effects – increasing the risk to right whales posed by other nearby ships – and both should be treated conservatively.

The study does not include any time-areas closures to reduce impacts on right whales, nor does it provide any quantitative or even detailed qualitative analysis of masking effects or other cumulative, sub-lethal impacts on right whales.

7. Failure to Adequately Assess Cumulative Impacts of the Activity

In its Draft Environmental Assessment – upon which the proposed IHA relies – USGS failed to adequately analyze the cumulative impacts of its survey. 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.'" 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."

The agency has failed to meet the statutory requirements of NEPA and its regulations because it improperly limited the scope of the EA and failed to include sufficient information on the cumulative impacts of the project on marine mammals, fish, and sea turtles. The agency's cumulative impacts analysis improperly discounts cumulative impacts because the noise pollution is temporary. This rationale is flawed because impacts can accumulate even if there is no accumulation of sound.

Acoustic disturbance can result in long-term avoidance or abandonment of habitat, particularly in naïve populations. For example, following a single Navy exercise in the Northern Bahamas, in 2000, 14 beaked whales and several other marine mammals stranded and virtually the entirety of the population disappeared from the area. Even if animals do not suffer death or permanent injury or habitat abandonment from a single event, recurring acoustic disturbance increases the likelihood that a seismic survey will interfere with essential functions such as breeding, feeding, and communications. Therefore, noise pollution even when temporary can have cumulative effects on animal populations.

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[105] Reeves, R.R., Read, A., Lowry, L., Katona, S.K., and Boness, D.J., Report of the North Atlantic right whale program review, 13–17 March 2006, Woods Hole, Massachusetts (2007) (prepared for the Marine Mammal Commission).

Moreover, regional populations or stocks of marine mammals, or other wildlife, may be repeatedly exposed to disturbance from seismic, sonar, and ship noise. NMFS and USGS must analyze both the auditory and behavioral impacts of repeated exposure to noise pollution on a population that may alter behavior. Repeated exposure that causes temporary threshold shift could amplify the impact of a subsequent exposure. In some animals, temporary threshold shift can result in permanent threshold shift. USGS must at least evaluate intermittent exposure to multiple seismic and other acoustically disturbing activities.

The cumulative impacts analysis must include a full evaluation of the cumulative impacts of oil and gas seismic surveys planned for and anticipated in the Atlantic; the NSF seismic survey off New Jersey and any other NSF or USGS planned surveys; and military training and testing sonar activities. The failure to evaluate the cumulative impacts of temporally and spatially adjacent activities in the environmental assessment falls short of NEPA's requirements and results in a misrepresentation of the activities ultimate impact.

Additionally, concurrent activities can accumulate sound in habitat, and the EA's determination that project is only a "minor contribution" to overall noise is flawed. NOAA has already developed cetacean noise maps for the mid-Atlantic area where this project occurs. It shows that certain areas are already ensonified by vessel traffic at levels that are near the thresholds for some acoustically sensitive species. USGS and NMFS must analyze the noise pollution cumulatively with the project. While the EA describes other proximate activities, it lacks meaningful analysis of the cumulative impacts of these projects.

8. Failure to Analyze Impacts on Fish and Other Species of Concern

The survey considered in the proposed IHA has the potential to detrimentally affect multiple fish species, harm vital fish habitat, and conflict with multiple fisheries. Indeed, airgun surveys are known to significantly affect the distribution of some fish species, which can impact commercial and recreational fisheries and could also displace or reduce the foraging success of marine mammals that rely on them for prey. As one study has noted, fishermen in various parts of the world have complained for years about declines in their catch rates during oil and gas airgun surveys, and in some areas have sought industry compensation for their losses.[106] Airguns have been shown experimentally to dramatically depress catch rates of some commercial fish species, by 40 to 80% depending on catch method, over thousands of square kilometers around a single array.[107] Large-scale displacement is likely to be responsible for the fallen catch rates: studies have shown both horizontal (spatial range) and vertical (depth) displacement in a number of

[106] McCauley *et al.*, Marine seismic surveys: analysis and propagation of air-gun signals, and effects of air-gun exposure.

[107] Engås, A., Løkkeborg, S., Ona, E., and Soldal, A.V., Effects of seismic shooting on local abundance and catch rates of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*), *Canadian Journal of Fisheries and Aquatic Sciences* 53: 2238-2249 (1996); *see also* Løkkeborg, S., Ona, E., Vold, A., Pena, H., Salthaug, A., Totland, B., Øvredal, J.T., Dalen, J. and Handegard, N.O., Effects of seismic surveys on fish distribution and catch rates of gillnets and longlines in Vesterålen in summer 2009 (2010) (Institute of Marine Research Report for Norwegian Petroleum Directorate).

other commercial species on a similar spatial scale.[108] Impacts on fisheries were found to last for some time beyond the survey period, not fully recovering within 5 days of post-survey monitoring.[109] Airguns also have been shown to substantially reduce catch rates of rockfish, at least to the distances (less than 5 km) observed in the experiment.[110] Yet the IHA ignores the potential for acoustic impacts on Essential Fish Habitat and assumes without support that effects on both fish and fisheries would be localized and "minor." NMFS must improve its scant analysis.

V. COMPLIANCE WITH OTHER STATUTES

A. Magnuson-Stevens Fishery Conservation and Management Act ("Magnuson Act")

USGS did not provide any meaningful analysis of the proposed action's impacts on essential fish habitat. NMFS has 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").

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 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." The essential fish habitat consultation should include an evaluation of the effects of the action on essential fish habitat and proposed mitigation. 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 EFH consultation here is inadequate because it assumes that noise does not affect habitat. This is in error because noise pollution is indeed a habitat concern. The EA is similarly inadequate in that it wrongly concludes that "[t]here would be no anticipated negative impacts on Essential Fish Habitat (EFH)."

As discussed above, the impacts of seismic surveys on fish are documented. Sound can impact fish habitat because it can alter the ability of fish to communicate, avoid predators, and locate

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[108] Slotte, A., Hansen, K., Dalen, J., and Ona, E., Acoustic mapping of pelagic fish distribution and abundance in relation to a seismic shooting area off the Norwegian west coast, *Fisheries Research* 67:143-150 (2004).

[109] Engås *et al.*, Effects of seismic shooting.

[110] Skalski, J.R., Pearson, W.H., and Malme, C.I., Effects of sounds from a geophysical survey device on catch-per-unit-effort in a hook-and-line fishery for rockfish (*Sebastes ssp.*), *Canadian Journal of Fisheries and Aquatic Sciences* 49: 1357-1365 (1992).

prey. Studies indicate auditory damage can result from noise, including airguns. Seismic surveys alter the habitat in ways that cause displacement and disturbance of fish and decreased catch, as well as mortality to fish eggs and larvae. Therefore, seismic surveys do impair essential fish habitat. The acoustic environment is a key element of habitat. Indeed, NMFS recently recognized that the best scientific data indicates that sound can be an essential characteristic of habitat. Accordingly, the agency identified noise as a primary constituent element of critical habitat for beluga whales.

The proposed project area is essential fish habitat for dozens of species. As noted in the EA, about 600 species of fish occur in the survey area It contains essential fish habitat for several highly migratory species, including albacore tuna, big eye tuna, bluefin tuna, skipjack tuna, yellowfin tuna, skipjack, swordfish, blue marlin, longbill spearfish, roundscale spearfish, white marlin, and several species of shark -- thresher, dusky, blue, white tip, bignosee, bigeye thresher, tiger, basking, longfin mako, and angel. There are also several adjacent coastal EFH areas, and the Georges Bank seamounts are unique habitat with rich fish biodiversity.

Some of the fish species with EFH in the project area are imperiled and vulnerable to negative impacts from the project. For example, juvenile and adult Atlantic bluefin tuna have essential fish habitat in the project area, and this imperiled fish uses deep waters from 50 meter isobaths to the extent of the U.S. EEZ along much of the Eastern Seaboard. Atlantic bluefin tuna remain overfished with overfishing occurring despite being at year 16 of a 20 year rebuilding plan. While fishing continues to be the primary threat to Atlantic bluefin tuna, seismic surveys have been linked to declines of tuna species. Muhling et al. (2011) estimated drastic reductions in probabilities of bluefin tuna larval occurrence in current spawning areas in the late spring: 39–61% by 2050 and 93–96% by the end of the 21st century.

White marlin forage from Cape Cod to Cape Hatteras. Juvenile EFH for white marlin extends almost the entire project area from the shelf break out to the U.S. EEZ and much of the area is also EFH for adults. The most recent stock assessment for white marlin suggests that the species has low productivity, has been declining since the beginning of the fishery, and is clearly overfished. White marlin has experienced significant declines in its Atlantic range coincident with its decline in abundance.

Atlantic cod also have EFH adjacent to and partly within the action area. Much of the coastal and offshore waters off New England out to the U.S. EEZ are EFH for Atlantic cod. According to NOAA's 2013 stock assessment, the Gulf of Maine spawning stock biomass is more than 80% below target levels. The Georges Bank spawning stock biomass currently constitutes only seven percent of the agency's goal. Moreover, "[r]ecruitment for both stocks has been well below average in nearly every year since the 1980s."

Dusky and thresher sharks have habitat along the coast and off the continental shelf break. Dusky sharks are considered a species of concern by NMFS and have declined to approximately 15 to 20% of their 1970 abundance levels. Sharks are long-lived and have low fecundity thus making them vulnerable to depletion. Dusky sharks are classified as endangered under the IUCN Redlist.

Thresher sharks in the Atlantic are declining and have declined by about 70% and are considered vulnerable by the IUCN.

The agencies should have identified which areas of essential fish habitat are within the project area and evaluated the impact of the proposed project on those habitat areas. Ultimately, NMFS should have considered mitigation, alternatives, and recommended conservation actions that would protect essential fish habitat.

B. Endangered Species Act ("ESA")

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 . . . ." To accomplish this goal, agencies must consult with the delegated agency of the Secretary of Commerce or Interior whenever their actions "may affect" a listed species. NMFS has the discretion to impose terms, conditions, and mitigation on any authorization.

The ESA not only bans the acts of parties directly causing a take, but also bans the acts of third parties whose acts bring about the taking. NMFS may not approve the seismic survey unless it first obtains authorization for take under the ESA.

NMFS' decision to issue an incidental harassment authorization is an action triggering the duty to comply with section 7 of the ESA. The ESA's consultation requirement applies to Federal agencies taking any action. NMFS states that it is engaged in formal consultation on the proposed seismic survey.

As described thoroughly above, 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 surveys can have harmful impacts on listed marine mammals, which must be fully and accurately vetted through the consultation process. Accordingly, NMFS must complete consultation and obtain any take authorizations before authorizing the proposed seismic survey here. Moreover, NMFS should adopt robust mitigation measures such as those described in the alternatives section above to avoid adverse impacts to listed species.

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.

Additionally, NMFS should also evaluate the impact on new sea turtle and potential right whale critical habitat. The survey area occurs partly in newly designated critical habitat for North Atlantic loggerhead sea turtles. This designation includes migratory habitat and overwintering habitat in the nearshore waters, as well as offshore sargassum habitat adjacent to or in the project area. NMFS must therefore evaluate the impact of the proposed activity on loggerhead sea turtles and their habitat. The final critical habitat rule notes that noise pollution is considered an activity that could alter habitat conditions in migratory pathways for the loggerhead sea turtles. The survey area is also located southeast of currently designated Northeast right whale critical habitat – an area which was designated because it represents the species' feeding habitat. Recent studies have further shown that mid-Atlantic coastal areas is a key migratory route between calving and feeding grounds. NMFS has indicated that it intends to amend the 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, NMFS must fully comply with the ESA and develop a robust biological opinion based on the best available science. We further urge NMFS to establish more stringent mitigation measures to protect ESA-listed species than are currently proposed by the IHA.

C. 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 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." The marine mammals and fish that will be affected by the seismic survey are all "natural resources" protected by the coastal states' coastal management programs. Accordingly, states should be given the opportunity to review the IHA for consistency with their coastal management programs.

VI. CONCLUSION

For the above reasons, and in light of the serious potential impacts of the proposed study, we urge that NMFS deny the IHA or USGS withdraw its application. At minimum, USGS should revise its proposed mitigation measures in the ways discussed above, including by redrawing its survey lines to reflect well-established areas of heightened biological significance and by providing meaningful site-specific analysis.

Very truly yours,

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