Protected Species Mitigation and Monitoring Report

3-D Seismic Survey
in the Northwest Atlantic Ocean off New Jersey

1 July 2014 – 23 July 2014

R/V *Marcus G. Langseth*

Prepared for

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for submission to

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Cruise ID No.	**MGL1405**	**411 N. Sam Houston Parkway E.**	
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1. EXECUTIVE SUMMARY

The National Science Foundation (NSF) owned research vessel *Marcus G. Langseth* (R/V *Langseth*), operated under an existing Cooperative Agreement by Lamont-Doherty Earth Observatory (L-DEO) of Columbia University, conducted a portion of a seismic survey in the Northwest Atlantic Ocean approximately 25 to 85 kilometers (15.5 to 52.8 miles) off the coast of New Jersey. The operational activities conducted were in support of a research survey led by the State University of New Jersey at Rutgers (Rutgers) with funding from the U.S. National Science Foundation (NSF). The purpose of the survey was to collect and analyze data on the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to the present. The 3-D seismic reflection survey would investigate features such as river valleys cut into coastal plain sediments now buried under a kilometer of younger sediment and flooded by today's ocean.

The R/V *Langseth* departed State University of New York (SUNY) Maritime College in New York on 1 July 2014 and began surveying on 3 July 2014. The survey was interrupted by a severe weather system on July 4, during which time the survey was temporarily suspended. The R/V *Langseth* returned to port at Brooklyn Port Authority from 10 July 2014 through 19 July 2014 for repairs and maintenance. Upon returning to the survey area and encountering more mechanical issues, the R/V *Langseth* returned to the Brooklyn Port Authority on 23 July 2014 when the survey was suspended. This report, therefore, only covers the portion of the survey undertaken in 2014. As only a small portion of the survey was completed and the data acquired was insufficient to meet the scientific goals for the program, the survey will potentially be rescheduled during a similar timeframe in 2015.

This report serves to comply with the reporting obligations required pursuant to the Marine Mammal Protection Act and Endangered Species Act for the portion of the survey that was completed. L-DEO submitted an application to the National Marine Fisheries Service (NMFS) for an Incidental Harassment Authorization (IHA) that would allow for the potential harassment of marine mammals that may occur during the marine geophysical survey. An Incidental Harassment Authorization (IHA) (Appendix A) and an Incidental Take Statement (ITS) were granted on 1 July 2014. US Fish and Wildlife Service (USFWS) issued a Letter of Concurrence (LOC) on March 5, 2014 that the proposed actions may affect, but were not likely to adversely affect, the roseate tern or piping plover. In addition, NMFS issued its Final EA and Finding of No Significant Impact (FONSI) for this project. Mitigation measures were implemented to minimize potential impacts to marine mammals and endangered or threatened sea turtles and sea birds throughout the duration of the survey. Mitigation measures included, but were not limited to, the use of NMFS approved Protected Species Observers (PSOs) for both visual and acoustic monitoring, establishment of safety radii, and implementation of ramp-up, power-down and shut-down procedures.

RPS was contracted by L-DEO to provide continuous protected species observation coverage. Pursuant to the contract, PSOs monitored and reported on the presence and behavior of marine species, and directed the implementation of the mitigation measures for the research activity as described in the NSF Final Environmental Assessment and FONSI (prepared pursuant to the National Environmental Policy Act), LOC issued by USFWS, and the IHA and ITS issued by NMFS. Additionally, PSO activities were consistent with the PSO standards identified in the Programmatic Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) for Marine Seismic Research funded by the National Science Foundation or Conducted by the U.S. Geological Survey and Record of Decision (referred to herein as the PEIS), to which the NSF Final EA tiered. Four PSOs and one dedicated passive

acoustic monitoring (PAM) Operator were present on board the R/V *Langseth* throughout the survey in this capacity.

PSOs undertook a combination of visual and acoustic watches, conducting a total of 183 hours of visual observations and 23 hours 46 minutes of acoustic monitoring during the survey.

This visual monitoring effort produced a project total of 41 protected species detection records; 12 for cetaceans and 29 for sea turtles. Shelled sea turtles constituted the majority of sightings with 29 detection records. There were 10 detections of small odontocetes and two detections of mysticetes. Acoustic monitoring effort did not result in any acoustic detection.

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Detections of protected species resulted in 11 mitigation actions being implemented, all shut-downs of the acoustic source, with a total duration of 50 minutes of mitigation down-time.

A known 13 shelled sea turtles, 10 loggerhead sea turtles and three unidentified shelled sea turtles were observed were observed to be within the predicted 166 dB re 1 µPa zone.

A project summary sheet of observation effort, detection, and operational totals for this survey on the R/V *Langseth* can be found in APPENDIX B.

2. INTRODUCTION

The following report details protected species monitoring and mitigation as well as seismic survey operations undertaken as part of the 3-D marine geophysical survey on board the R/V *Langseth* from 1 July to 23 July 2014 in the northwest Atlantic Ocean off the coast of New Jersey. This report only covers the portion of the survey undertaken in 2014, approximately 61 hours. As only a small portion of the survey was completed, the survey is anticipated to be rescheduled during a similar timeframe in 2015.

This document serves to meet the reporting requirements dictated in the IHA and ITS issued by NMFS on 1 July 2014 for the portion of the survey that was completed. The IHA and ITS authorized non-lethal 'takes' of Level B harassment of specific marine mammals and sea turtles incidental to a marine seismic survey program. NMFS has stated that seismic source received sound levels greater than 160 dB could potentially disturb marine mammals, temporarily disrupting behavior, such that they could be considered as 'takes'. Potential consequences of Level B harassment could include effects such as temporary threshold shifts in hearing, as well as disruption of behavioral patterns, including, but not limited to migration, breathing, nursing, breeding, feeding, or sheltering. A safety or exclusion zone was established for sound levels greater than 180 dB re 1 µPa (rms) for which the sound source must be powered down or shut down to avoid exposing cetaceans to these higher sound levels, where permanent hearing threshold shifts might occur. It is unknown to what extent cetaceans exposed to seismic noise of this level would express these effects, and in order to take a precautionary approach, NMFS required that provisions such as safety radii, power-downs and shut-downs be implemented to mitigate for these potential adverse effects. Although the ITS did not define reporting requirements for sea turtles, monitoring and mitigation information for sea turtles has been included.

US Fish and Wildlife Service issued a Letter of Concurrence on March 5, 2014 that the proposed actions may affect but were not likely to adversely affect the roseate tern or piping plover. Mitigation for endangered seabirds would include shutdowns in the event the seabirds were observed diving within the 180 dB zone (Level A zone). No specific reporting requirements were identified for encounters with endangered seabirds; however, they would have been included in this report along with mitigation actions if there had been any.

2.1. Project Overview and location

This initial phase of the survey was conducted off the coast of New Jersey in the northwest Atlantic Ocean, approximately 25 to 85 kilometers from the coast within an area approximately defined by 39.3 to 39.7° North and 73.2 to 73.8° West, where water depths ranged from approximately 22 to 50 meters (Figure 1). The region is outside of U.S. state waters and within federal waters and the U.S. Exclusive Economic Zone (EEZ). The R/V *Langseth* deployed one array of four airguns (or "source elements") as an energy source, with 6 spares. The receiving system consisted of two 3000-meter long Sentry Solid Streamer Sercel conventional hydrophone streamers towed with a separation of 317.5 meters in addition to 24 P-cable hydrophone streamers, each with a length of 50 meters and separated by 12.5 meters. Streamers cables were towed at a depth of approximately 4.5 meters. As the source array was towed along the survey lines, the hydrophone streamer received the returning acoustic signals and transferred the data to the onboard processing system. Equipment malfunctions aboard the R/V

Langseth prevented the full deployment of the seismic equipment, and although ~44 hours of data were collected while repairs were attempted; none of it met the requirements needed to address the research objectives.

The goals of the proposed research were to collect and analyze data on the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to the present, illuminating features such as river valleys cut into coastal plain sediments, now buried under a kilometer of younger sediment and flooded by today's ocean, which cannot be resolved using 2-D seismic data. To achieve these goals, the lead Principal Investigator (PI), Dr. G. Mountain, and Co-PIs, Drs. N. Nedimovic, J. Austin and C. Fulthorpe proposed to (1) map sequences around existing Integrated Ocean Drilling Program (IODP) Expedition 313 drill sites using 3D seismic reflection survey techniques; and (2) analyze their spatial/temporal evolution. Objectives include 1) establishing the known Ice House base-level changes on the stratigraphic record; 2) providing greater understanding of the response of near shore environments to changes in elevation of global sea level; and 3) determining the amplitudes and timing of global sea-level changes during the mid-Cenozoic. The R/V *Langseth*'s cruising speed was about 10-12 knots during transits and varied between 4 and 5 knots during the seismic survey.

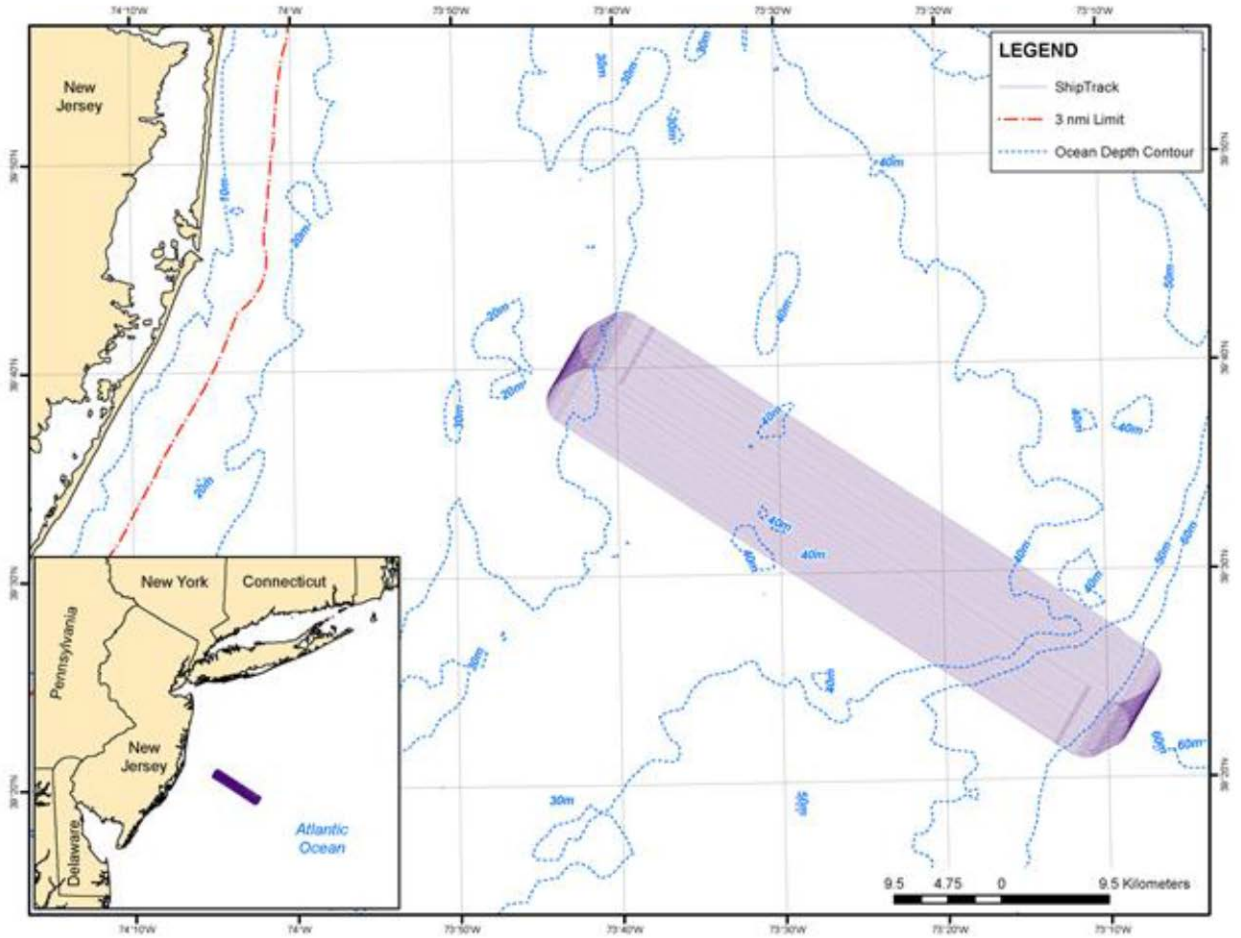

Figure 1. Location of the 3-D marine geophysical survey in the Atlantic Ocean off the coast of New Jersey

2.2. Acoustic Sources

The seismic acoustic source consisted of one towed source sub-array deployed just aft of the vessel. Only four of the 10 source elements on the sub-array were utilized. The source lements were towed at a depth of 4.5 meters and were situated 42 meters from the Navigational Reference Point (NRP), which was located on the PSO observation tower.

Each source array utilized a mixture of Bolt 1500LL and Bolt 1900LLX elements ranging in volume from 40 in³ to 220 in³, with an operating pressure of 1,950 pounds per square inch (psi). The sub-array contained ten elements, with the first and last spaced 16 meters apart. Only four source elements on each sub-array were active during survey acquisition, with the six others utilized as spares. The total volume of the sub-array was 700 in³. Although both 1400 in^3 and 700 in^3 sources were analysed and authorized for use, after operating the 700 in^3 source, it was determined to be an appropriate source size to meet the research objectives and was the only source level used during the survey. Each discharge of the source consisted of a single brief pulse of sound (duration of approximately 0.03 second) with the dominant frequency components ranging from zero to 188 hertz (Hz). The nominal source levels of the source sub-arrays on the R/V *Langseth* ranged from 246 to 253 dB re: 1 µPa (peak-to-peak).

The shot interval for the survey was 12.5 meters, equating to approximately 5.4 seconds at typical survey speed. The sound signal receiving system used during acquisition of the transect lines were one 3000 meter hydrophone streamer on3 to 4 July, and two 3000 meter hydrophone streamers and 24 P-cables that were partially deployed on 7 to 8 July. The hydrophone streamers received the returning acoustic signals and transferred the data to the processing system located on board the vessel. Due to the length and placement of the cables, the manoeuvrability of the vessel was limited to turns of five degrees per minute while the gear was being towed.

An additional sound source included a Kongsberg EM 122 multibeam echo sounder (MBES) that was in use throughout most of the operations to map seafloor topography. The hull-mounted MBES emitted brief pulses of sound (also called a ping) (10.5 to 13.0 kilohertz (kHz)) in a fan-shaped beam that extended downward and to the sides of the ship. The nominal source level for the MBES was 242 dB re: 1 µPa.

The R/V *Langseth* also operated a Knudsen Chirp 3260 sub-bottom profiler (SBP) concurrently during acoustic source and echo sounder operations to provide information about the sedimentary features and bottom topography. The hull-mounted SBP emitted a ping with a dominant frequency component at 3.5 kHz. The nominal source level for the profiler was 204 dB re: 1 µPa.

3. MITIGATION AND MONITORING METHODS

The PSO monitoring program on the R/V *Langseth* was established to meet the standards set forth in the PEIS, NSF Final EA, USFWS LOC, and the IHA and ITS requirements that were issued to the L-DEO by NMFS, which included both monitoring and mitigation objectives. The survey mitigation program was designed to minimize potential impacts of the R/V *Langseth*'s seismic program on sea turtles, marine

mammals, and other protected species of interest. The following monitoring protocols were followed to meet these objectives.

- Visual observations protocols were established to provide real-time sighting data, allowing for the implementation of mitigation procedures as necessary.
- A Passive Acoustic Monitoring system was operated to augment visual observations and provide additional marine mammal detection data.
- Effects of marine mammals and marine turtles exposed to sound levels constituting take were observed and documented; the nature of the probable consequences were discussed when possible.

In addition to the mitigation objectives outlined in the PEIS, NSF Final EA,USFWS LOC, IHA, and ITS, PSOs collected and analyzed necessary data mandated by the IHA (see Appendix A) and ITS.

3.1. VISUAL MONITORING SURVEY METHODOLOGY

There were five trained and experienced PSOs on board to conduct the monitoring for marine species, record and report on observations, and request mitigation actions in accordance with the PEIS, NSF Final EA, USFWS LOC, IHA and ITS. The PSOs on board were NMFS approved and held certifications from a recognized Joint Nature Conservation Committee (JNCC) course and/or approved Bureau of Ocean Energy Management (BOEM) course. Visual monitoring was primarily carried out from an observation tower (Figure 2) located 18.9 meters above the water surface, which afforded the PSOs a 360 degree viewpoint around the acoustic source.

Figure 2. Protected Species Observer observation tower with mounted big-eye binoculars

The PSO tower was equipped with Fujinon 7x50 binoculars as well as two mounted 25x150 Big-eye binoculars. Inside the tent located in the middle of the platform was a laptop for data collection as well as a telephone for communication with the PAM station, bridge, or main lab. Also inside the tent was a monitor that displayed current information about the vessel's position, speed, and heading, along with

water depth, wind speed and direction, and source activity. Most observations were held from the tower; however, when there was severe weather or poor environmental conditions, observations would be performed from the bridge (12.8 meters above sea level) or the catwalk (12.3 meters above sea level) in front of the bridge. Night Quest NQ2200 Night Vision Devices were also available on the ship in the event that an acoustic detection of a marine mammal was made during non-visual conditions such that PSOs could attempt to make a visual sighting of the animal, but the night vision devices were not used during this survey.

Visual monitoring methods were implemented in accordance with the survey requirements outlined in the IHA and ITS. At least one PSO, but most often two PSOs, watched for marine species at all times while the acoustic source operated during daylight periods and whenever the vessel was underway when the acoustic source was not active.

When the acoustic source was activated from silence, PSOs maintained a two-person watch for 30 minutes prior to the activation of the source. Visual watches commenced each day before civil twilight dawn, beginning as soon as the safety radii were visible, and continued past civil twilight dusk until the safety radii became obscured. Start of observation times ranged from 5:05 to 5:20 local time, while end of observation times ranged from 20:30 to 20:55 local time.

A visual monitoring schedule was established by the PSOs where each person completed visual observations watches which varied in length between one to four hours, two to three times a day, for a total of six to seven hours of visual monitoring per day. This schedule was arranged to ensure that two PSOs were on visual observation duty at all times except during meal breaks when PSOs would each maintain a solo watch so that the entire team could eat while maintaining both visual and acoustic monitoring. Solo watches lasted less than 45 minutes and occurred each day at meal times. As noted previously, however, two PSOs were always on duty during ramp-up.

Observations were focused forward of the vessel and to the sides but with regular sweeps through the area around the active acoustic source. PSOs searched for blows indicating the presence of a marine mammal, splashes or disturbances to the sea surface, the presence of large flocks of feeding seabirds and other sighting cues indicating the possible presence of a protected species.

Upon the visual detection of a protected species, PSOs would first identify the animal's range to the acoustic source while identifying the observed animal (cetacean, pinniped, sea turtle, or sea bird) to determine which safety radius applied. The visual PSOs would then notify the PAM operator, who was located in the main science lab, that there was an animal inside or outside of the safety radius. If the animal was observed inside the safety radius and a mitigation action was necessary, the PAM operator would relay the message to the seismic technician who sits nearby. Table 1 describes the various mitigation radii applied to cetaceans, sea turtles, sea birds and pinnipeds, as well as what constituted the Level-B harassment radius. The PAM operator was also notified of all marine mammal sightings as soon as possible in order to enable recordings to be made for possible additional analysis later by one of the more experienced acoustic operators. Specifically, the analysis would be performed to determine whether vocalizations had been detected on the PAM system during the sighting.

Table 1. Mitigation Radii/Zones Implemented

Source and Volume	Array Tow Depth (m)	Water Depth (m)	Power/Shut-down radii for Pinnipeds 187 dB (m)	Power/Shut-down radii for Cetaceans and Sea Turtles 177 dB (m)	Level-B Harassment Zone for Sea Turtles 166 dB (m)	Level-B Harassment Zone for Cetaceans 160 dB (m)
Single Bolt Source Element (40 in^3)	4.5	<100	31	109	-	995
4 element subarray (700 in^3)	4.5	<100	151	561	2,229	5,240

When a protected species was observed, range estimations were made using reticle binoculars, the naked eye, and by relating the animal to an object at a known distance, such as the acoustic array located 42 meters from the PSO tower. Specific species identifications were made whenever distance, length of sighting and visual observation conditions allowed. PSOs observed anatomical features of animals sighted with the naked eye and through the big-eyes and reticule binoculars and noted behavior of the animal or group. Photographs were taken during most sightings. Sometimes photographs were not taken due to the brevity of a sighting. The cameras used were a Canon EOS 20D and a Canon 60D with a 300-millimeter telephoto lens. Marine mammal identification manuals were consulted and photos were examined during visual watch breaks to confirm identifications.

During or immediately after each sighting event PSOs recorded the event per the requirements of the IHA and ITS. Each sighting event was linked to an entry on a datasheet such that environmental conditions were available for each sighting event.

3.2. PASSIVE ACOUSTIC MONITORING SURVEY METHODOLOGY

PAM was used to augment visual monitoring effort, by helping to detect, identify, and locate marine mammals within the area, including during periods of low visibility and darkness when visual monitoring might not be applicable or effective. The PAM system was monitored to the maximum extent possible, 24-hours a day during seismic operations, and the times when monitoring was possible while the acoustic source was not in operation. PAM was not used exclusively to execute any mitigation actions without a concurrent visual sighting of the marine mammal.

High levels of background noise on the hydrophone cable were experienced when the cable was deployed while the vessel was traveling at transit speeds (greater than 6 knots), which made it impractical to conduct monitoring for baseline acoustic data collection during those periods. Additionally, in order to minimize the risk of entanglement of the hydrophone cable with other seismic equipment, the hydrophone cable needed to be deployed after all seismic gear had already been deployed, and retrieved prior to the retrieval of the seismic equipment. This prevented baseline acoustic data from being collected on the survey site while visual monitoring was ongoing for baseline data collection purposes. As such, the majority of passive acoustic monitoring undertaken occurred while the

seismic source was active and very little acoustic effort data was accumulated while the source was silent.

Three of the five PSOs were trained and experienced with the use of PAM, one of which was designated as the PAM operator to oversee and conduct the PAM operations. All PSOs completed a PAM training session provided by the PAM Operator in the initial days of the hydrophone deployment during which basic PAM system operation was covered. To achieve 24-hours of monitoring, the PSOs and the PAM operator rotated through acoustic monitoring shifts with a trained PAM operator monitoring many of the night time hours when PSOs were not making visual observations and the PAM was the only system in use for detecting cetaceans. Monitoring shifts lasted one to six hours. During daylight hours, acoustic operators were in communication with visual PSOs in the tower relaying sighting and seismic activity information. The PAM system was located in the main science lab to provide adequate space for the system, allow a quick exchange of communications with the visual PSOs on watch and seismic technicians, and to provide access to the vessel's instrumentation. The vessel's position, water depth, heading and speed, vessel and acoustic source activity were recorded every hour.

Acoustic monitoring for marine mammals was conducted aurally with *Sennheiser* headphones and visually with *Pamguard Beta 1.12.05*. Delphinid whistles, clicks, and burst pulses as well as sperm whale and baleen whale vocalizations may be viewed on a spectrogram display within *Pamguard*. Sperm whale, beaked whale, *Kogia* species, and delphinid echolocation clicks may be viewed on low and high frequency click detector displays. The Spectrogram's amplitude range and appearance were adjusted as needed to suit the operator's preference to maximize the vocalizations appearance above the pictured background noise.

3.2.1. Passive Acoustic Monitoring Parameters

Acoustic monitoring was carried out using a PAM system developed by Seiche Measurements Limited. (PAM system specifications can be found in APPENDIX C.) The PAM system during the cruise consisted of seven main components: a 20m hydrophone cable, a 230m hydrophone tow cable, a 100m deck cable, a data processing unit, a rack-mounted computer with two monitoring screens, an acoustic analysis software package, and headphones for aural monitoring.

The hydrophone cable contained four hydrophone elements and a depth gauge molded into a 20m section of the cable. The first two hydrophones were designated as the low frequency channels; these were broadband elements (200Hz to 200kHz). The third and fourth hydrophones were considered the standard elements, and sample high frequencies (2kHz to 200kHz). The four-element linear hydrophone array permitted a large range for sampling marine mammal vocalizations.

The electronic processing unit contained a buffer processing unit with USB output, and an *RME Fireface 800 ADC* processing unit with firewire output. The electronic processing unit and a rack-mounted computer with two monitors were set-up in the main lab. One of the computer's monitors displayed a high frequency range (hereafter referred to as the HF system), using the signal from two hydrophones, and the low frequency range was displayed on the other computer's monitor (LF system), receiving signal from all four hydrophones. A GPS feed of INGGA strings was supplied from the ship's Seapath

navigation system and connected to the computer and routed to the LF system, reading data every 10 seconds.

The HF system was used to detect and localize ultrasonic pulses produced by some dolphins, beaked whales and *Kogia* species. The signal from two hydrophones was digitized using an analogue-digital National Instruments data acquisition (DAQ) soundcard at a sampling rate of 500 kilohertz, then processed and displayed on a monitor using the program *Pamguard Beta 1.12.05* via USB connection. The amplitude of clicks detected at the front hydrophone was measured at 5th order Butterworth band-pass filters ranging from 35 kilohertz to 120 kilohertz with a high pass digital pre-filter set at 35 kilohertz (Butterworth 2nd order). (*Pamguard* can use the difference between the time that a sound signal arrived at each of the two hydrophones to calculate and display the bearing to the source of the sound. A scrolling bearing time display in *Pamguard* also can display the detected clicks within the HF envelope band pass filter in real time, which allows the identification and directional mapping of detected animal click trains.)

The LF system was used to detect sounds produced by marine mammals in the human audible band between approximately four kilohertz and 24 kilohertz. The LF system used four hydrophones; the signal was interfaced via a firewire cable to a laptop computer, where it was digitized at 48 kilohertz per channel. The LF hydrophone signal was further processed within the *Pamguard* monitoring software by applying Engine Noise Fast Fourier Transform (FFT) filters including click suppression and spectral noise removal filters (median filter, average subtraction, Gaussian kernel smoothing and thresholding). In addition to the Spectrogram available for each of the four hydrophones, modules for Click Detector, Mapping, Sound Recording and Radar displays for bearings of whistles and moans were configured. The bearings and distance to detected whistles and moans were calculated using a Time-of-Arrival-Distance (TOAD) method (the signal time delay between the arrival of a signal on each hydrophone is compared), and presented on a radar display along with amplitude information for the detected signal as a proxy for range. The vessel's GPS connected to the LF laptop via serial USB and allowed delphinid whistles and other cetacean vocalizations to be plotted onto a map module where bearing and range to the vocalizing animal's actual position could be obtained. A mixer unit enabled the operator to adjust stereo signal levels from each of the four hydrophones. The PAM Operator monitored the hydrophone signals aurally using headphones.

3.2.2. Hydrophone Deployment

The vessel had a winch installed on the port stern decklead of the gun deck for deployment of the PAM hydrophone cable. Two deck cables, the main cable and a spare, were installed along the gun deck decklead running from the winch to the science lab. Due to a risk of entanglement with the streamer lead-in off the port side, the hydrophone cable was routed to the starboard side.

Figure 3 shows the position of the PAM hydrophone deployed in relation to the vessel and seismic equipment. Photos of the hydrophone deployment methods and equipment discussed above can be found in APPENDIX D.

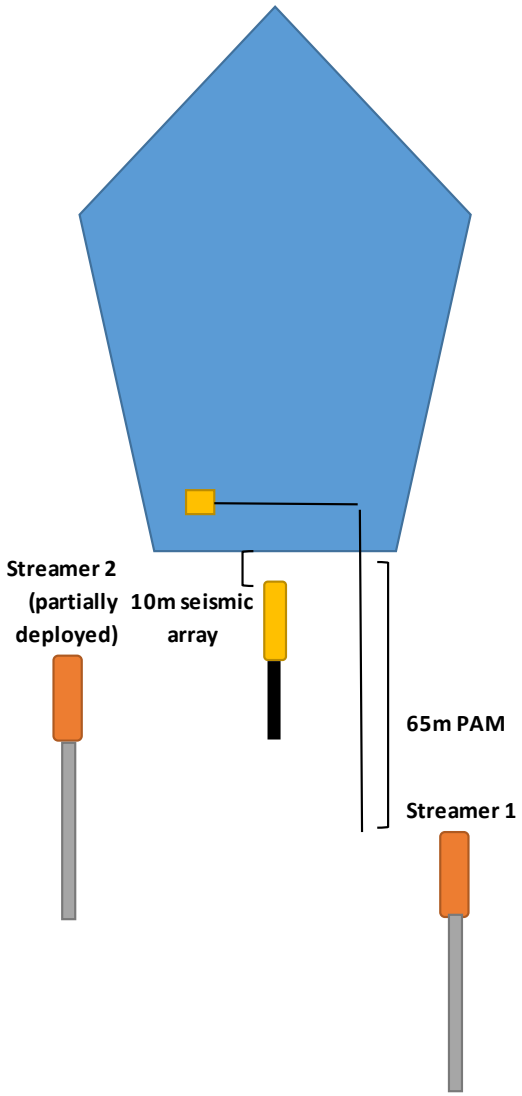

Figure 3. Location of the PAM cable in relation to the seismic gear

4. SURVEY DATA

4.1. SURVEY OPERATIONS AND SOURCE ACTIVITY SUMMARY

The R/V *Langseth* departed SUNY Maritime College at 10:02 Coordinated Universal Time (UTC) on 1 July 2014 to anchor in the Upper Bay and test vessel operations after an obstruction was identified with the ship propeller. The *Langseth* remained at anchor from 12:37 to 19:56 UTC; after all authorizations were received, the NSF environmental compliance process was completed, and the NSF decision was made to authorized the project to move forward, the vessel began its transit to the survey area off New Jersey. The seismic gear was partially deployed and use of the acoustic source commenced at 9:51 UTC on 3 July 2014. The seismic gear was not completely deployed due to the approach of a severe weather system (Hurricane Arthur). The PAM hydrophone equipment was not deployed at this time due to the risk of entanglement with partially deployed seismic equipment. The acoustic source was disabled and retrieved at 15:04 UTC on 4 July 2014. When the weather system passed, deployment continued but a problem was discovered with the winch used to control the towing geometry of the port streamer and deployment halted again for troubleshooting and repairs. The acoustic source was enabled at 23:33 on 7 July 2014, while troubleshooting continued on the port tow winch and a limited streamer deployment was attempted. On 8 July 2014 at 22:39 UTC the acoustic source was disabled in order to retrieve all equipment to return to port to repair the winch. The R/V *Langseth* arrived back in port at the Brooklyn Port Authority at 16:10 UTC on 10 July 2014. The delays in the survey were also a result of federal litigation filed by the State of New Jersey.

Upon completion of repairs to the winch, the R/V *Langseth* departed Brooklyn Port Authority at 21:15 UTC on 19 July 2014. When all the seismic gear was nearly deployed the acoustic source was deployed and the mitigation gun enabled at 00:14 UTC on 22 July 2014 with the intent of beginning acquisition shortly thereafter. However, the R/V *Langseth* experienced mechanical issues with the starboard shaft electrical generator and the mitigation source was disabled at 3:44 UTC. The seismic gear was retrieved on 22 July 2014 and the *R/V* Langseth transited back to port and arrived at the Brooklyn Port Authority at Red Hook at 12:06 UTC on 23 July 2014.

The acoustic source was inactive for most of the survey program due to mechanical problems with vessel equipment. The survey lines that were acquired during this portion of the program are shown in Figure 4. There was a total of 61 hours 08 minutes of source activity. This includes ramp-up of the acoustic source, full power operation both online and during line changes, and operation of a single 40 in^3 mitigation source (Figure 5). The mitigation source was used during mechanical/technical issues, and was active for 9 hours 13 minutes during the survey. Full power source operations, while online, accounted for 71% (43 hours 11 minutes) of total acoustic source activity during the project. Line changes were relatively short (between 45 minutes and 1.5 hours) and were mostly undertaken with the source operating at full power, totaling 7 hours 48 minutes of array activity. The dates and times of acquisition for each survey line can be found in APPENDIX E.

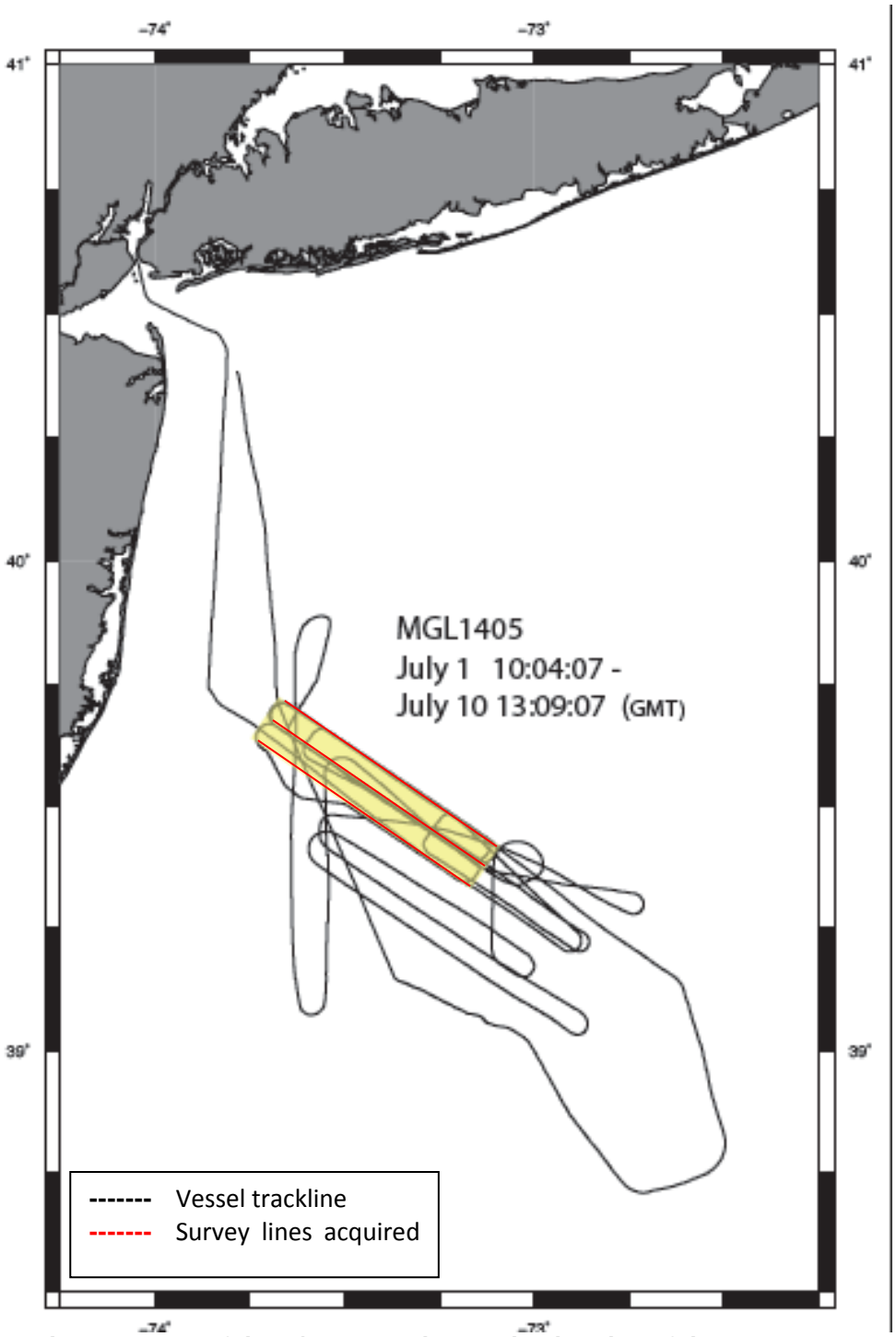

Figure 4. Vessel movements of the R/V Langseth over the duration of the survey program. Vessel movements of the R/V Langseth over the duration of the survey program.
Note that most of the vessel tracks were outside the survey area while vessel was not surveying and was making attempts to repair equipment, avoid a hurricane, or other inclement weather.

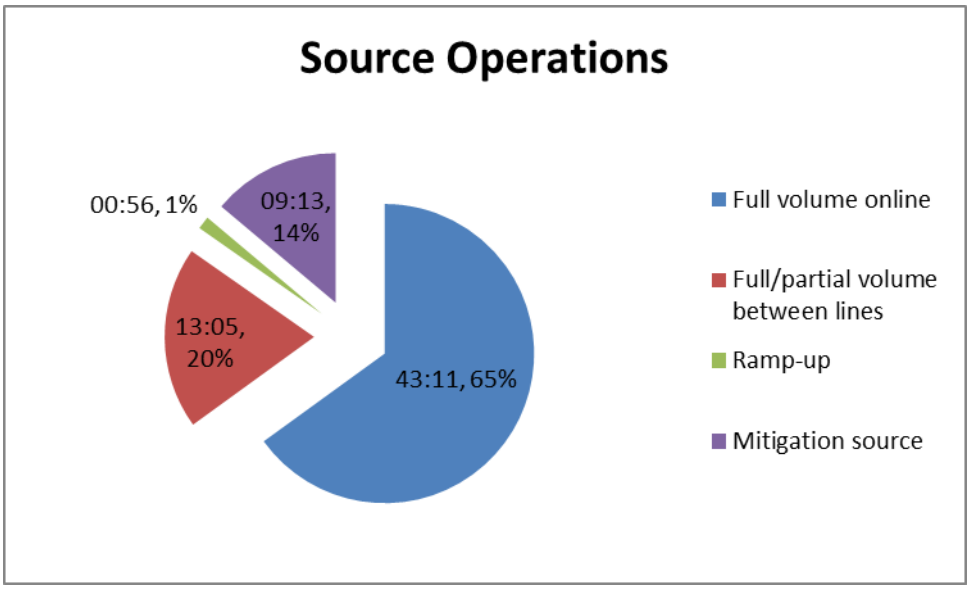

Figure 5. Total acoustic source operations

The acoustic source was ramped up four times over the course of the survey in order to commence full power survey operations (Table 2). With only 4 source elements, the ramp-ups occurred over a duration ranging from 13 minutes to 15 minutes. They were conducted using the gun controller program, DigiShot, which adds guns sequentially to achieve the full source over the required period of time. The ramp-ups were performed by cycling each gun 20 times at a shot point interval of 10 seconds, adding an additional source after each cycle, resulting in an approximately 15 minute ramp-up when all four source elements were active.

Table 2. Total acoustic source operations during the New Jersey 3-D seismic survey

Acoustic Source Operations	Number	Duration (hh:mm)
Source Tests		**00:00**
Ramp-up	**4**	**00:56**
Day time ramp-ups from silence	**1**	
Day time ramp-ups from mitigation source	**3**	
Night time ramp-ups from mitigation source	**0**	
Full power survey acquisition		**43:11**
Full power line changes		**13:05**
Single source element (40 in³)		**7:48**
Total time acoustic source was active		**61:08**

4.2. VISUAL MONITORING EFFORT SUMMARY

The PSOs began visual observations immediately upon departure from port and while in transit to the survey site during both transits to and from New York. These observations were undertaken to collect baseline data about protected species abundance and behavior in the area and during periods of source silence. Visual monitoring began at 10:02 UTC on 1 July 2014 and continued until 12:37 UTC when the R/V *Langseth* dropped anchor in the Upper Bay. Visual monitoring resumed at 19:56 UTC the same day when the R/V *Langseth* lifted anchor and continued to transit to the survey area. Visual observations were suspended once again at 15:46 UTC on 4 July 2014 while the vessel waited for a storm system to pass and were resumed the next morning on 5 July 2014 at 9:12 UTC. When the vessel returned to port for repairs on 10 July 2014 observations ended at 16:10 UTC when the vessel tied up in port. Visual observations resumed at 21:15 UTC on 19 July 2014 when the R/V *Langseth* began transiting back to the survey area to continue the project. Visual monitoring ended at 12:06 UTC on 23 July 2014 when the vessel tied up in Brooklyn for maintenance. Visual monitoring was conducted over a period of 13 days. Monitoring was conducted by two PSOs each day between just before dawn until just after dusk (civil dawn/dusk), when it was too dark for the entire safety radius to be visible, averaging approximately 15 hours 30 minutes of visual observations per day.

Visual watches were held by two PSOs except during the scheduled meal hours for lunch and dinner when a single PSO continued visual monitoring, in addition to acoustic monitoring conducted by the PAM operator on duty while each PSO rotated for a meal break. Single PSO visual observations during these periods lasted a maximum of 45 minutes. In the event of a sighting event during a single PSO watch a second PSO would be notified and would immediately return to assist with observations.

The majority of visual observations were performed while the acoustic source was silent. The source was active during 22% of visual observations undertaken (Figure 6). Total visual monitoring effort during source activity and during source silence is listed in Table 3.

Visual observations were conducted primarily from the PSO tower, which provided the PSOs with a 360° view of the water around the vessel and the acoustic source. Visual watches could be conducted from the catwalk or bridge should the tower not be accessible for any reason. As Figure 7 demonstrates, approximately 99% of visual monitoring was conducted from the PSO tower during the New Jersey 3D seismic survey.

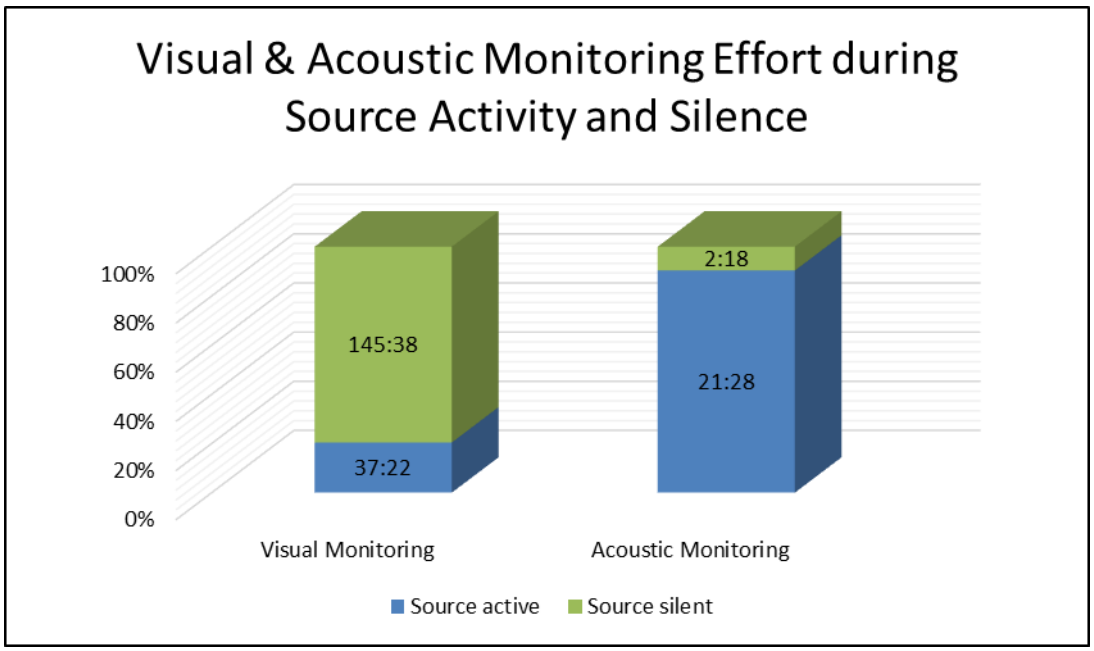

Figure 6. Duration of visual and acoustic monitoring effort during source activity and source silence

Table 3. Total visual monitoring effort

Visual Monitoring Effort	Duration (hh:mm)
Total monitoring while acoustic source active	37:22
Total monitoring while acoustic source silent	145:38
Total monitoring effort	**183:00**

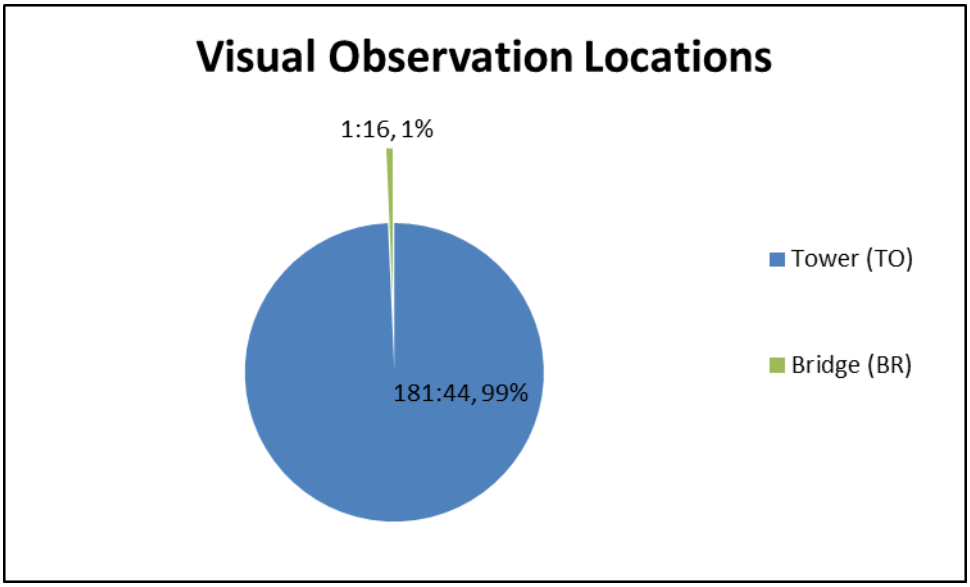

Figure 7. Total visual effort from observation locations

4.3. PASSIVE ACOUSTIC MONITORING EFFORT SUMMARY

The hydrophone cable was deployed for the first time near midnight on 7 July following the complete deployment of the seismic equipment. The hydrophone cable was not deployed while the equipment was only partially deployed due to the increased risk of entanglement with seismic gear and damage to the cable. Acoustic monitoring began at 00:35 UTC on 8 July. Acoustic monitoring for the project ended at 00:21 UTC on 9 July when the hydrophone cable was retrieved due to inclement weather. The vessel also retrieved seismic equipment in preparation for severe weather and then on 10 July the vessel went into port, where it remained until 19 July. The hydrophone cable remained on board while the seismic equipment was being deployed from the 20 through 22 July to reduce the risk of entanglement with the seismic gear and damage to the cable. Before the hydrophone cable could be deployed on 22 July, the decision was made to terminate the survey program and the vessel began retrieving the seismic equipment again.

Over the course of the project, PSOs conducted 23 hours 46 minutes of acoustic monitoring. Slightly more monitoring was conducted during daytime than during nighttime (Table 4). The majority of acoustic monitoring (over 90%) was conducted while the source was active (Figure 6).

Table 4. Total passive acoustic monitoring (PAM) effort

Passive Acoustic Monitoring Effort	Duration (hh:mm)
Total night time monitoring	**08:19**
Total day time monitoring	**15:27**
Total monitoring while acoustic source active	**21:28**
Total monitoring while acoustic source silent	**02:18**
Total acoustic monitoring	**23:46**

4.4. SIMULTANEOUS VISUAL AND PASSIVE ACOUSTIC MONITORING SUMMARY

Due to the limited amount of acoustic monitoring undertaken during the survey, very little of the overall monitoring effort consisted of simultaneous visual and acoustic monitoring: approximately 7% (15 hours and 27 minutes) of total effort (Figure 8).

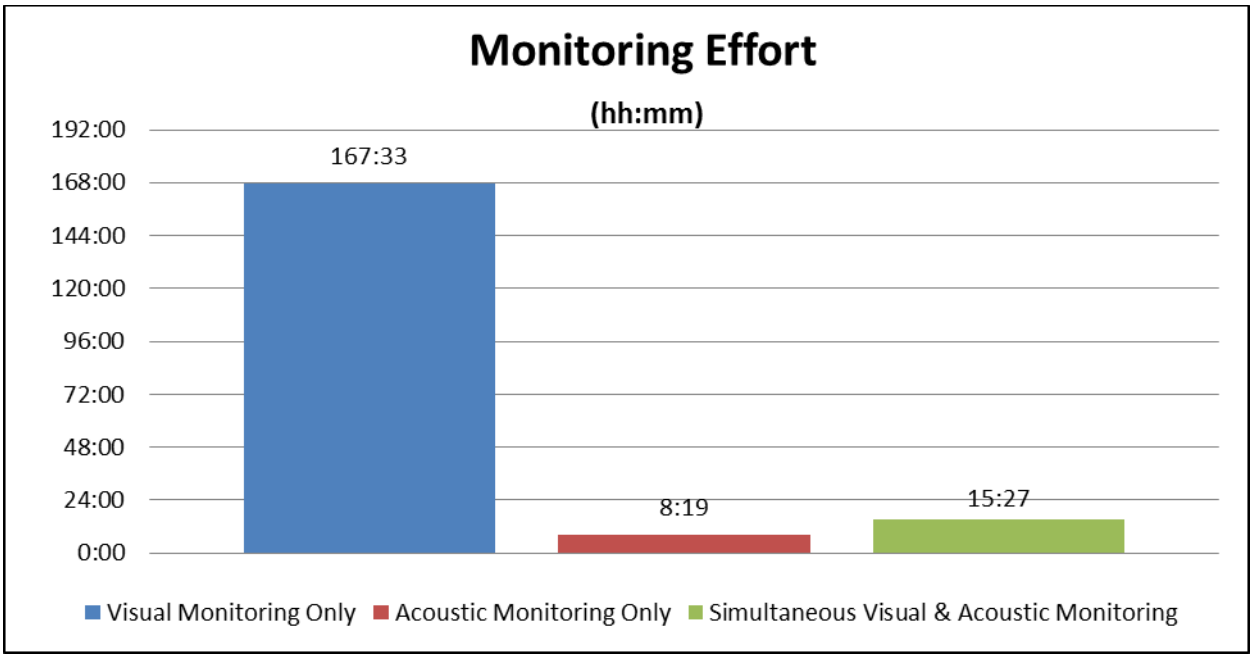

Figure 8. Total acoustic and visual monitoring effort

4.5. ENVIRONMENTAL CONDITIONS

The environmental conditions experienced during visual observations varied over the three weeks of the survey program.

Visibility was considered to be excellent if PSOs could monitor out to 10 kilometers. More than half (93 hours and 10 minutes) of all visual monitoring was conducted while visibility extended to 10 kilometers or greater. Of the visual effort undertaken while visibility extended to less than 10 kilometers, only 2 hours of monitoring was undertaken while visibility was less than two kilometers. Periods of fog and light to heavy rain were intermittently present throughout the survey and at times affected visual observations. A total of 15 hours 30 minutes of precipitation during monitoring periods were recorded in addition to 9 hours 45 minutes of fog.

The Beaufort Sea State ranged from levels 0 through 8 during the survey visual monitoring effort however more visual observations were undertaken at Beaufort Sea State Levels of 4 or 5 than at any other sea state level (93 hours and 40 minutes). A large percentage of monitoring effort was also undertaken at sea state levels of 3 or less (66 hours and 31 minutes), while only 22 hours and 49 minutes of monitoring were conducted while the sea state was of a Beaufort level 6 or greater.

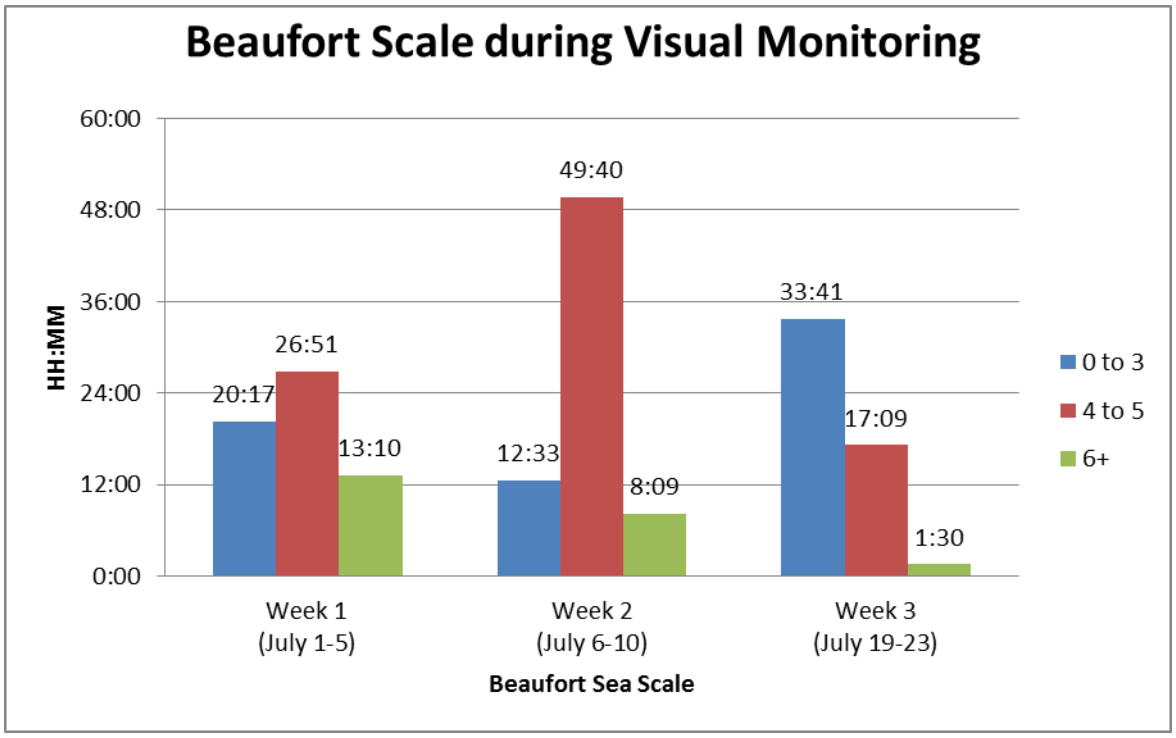

Figure 9. Beaufort sea scale during visual monitoring over the survey program

Wind forces present during visual monitoring were predominantly between 11 and 21 knots (58.5% of all visual effort, 107 hours and 13 minutes). Wind force of less than 10 knots was present for a total of 45 hours 30 minutes of visual observation, and wind forces from 11 to 21 knots were present for 43 hours and 22 minutes. Winds greater than 22 knots were present during 32 hours and 25 minutes of observations undertaken (Figure 10).

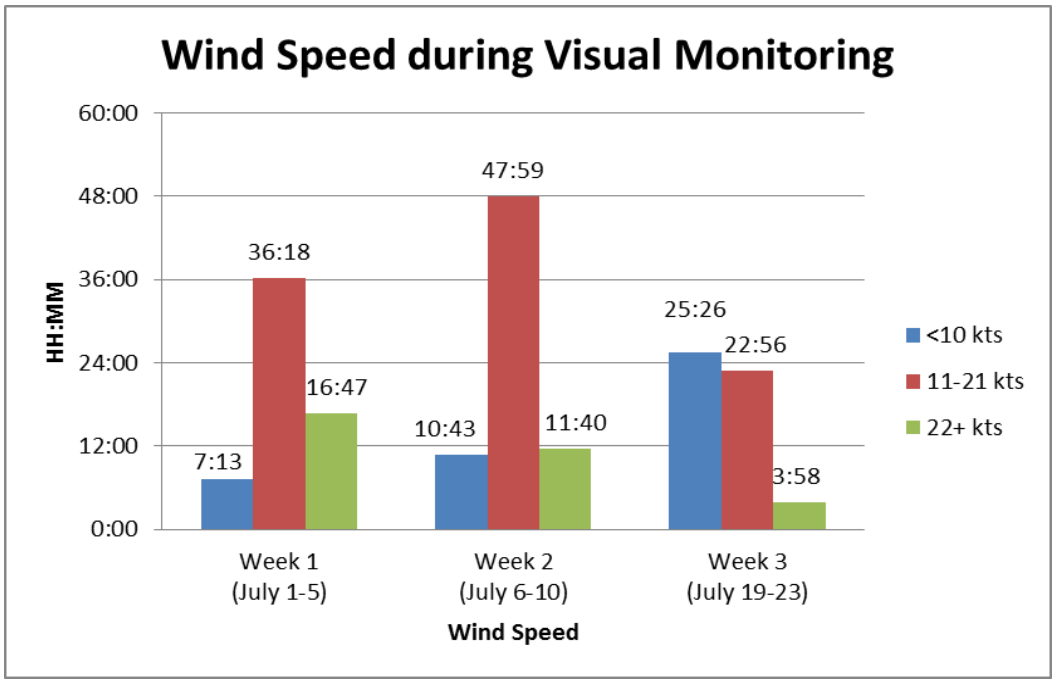

Figure 10. Average wind speed each week during visual monitoring

Swell heights remained relatively low throughout visual monitoring periods. The majority of visual observations (144 hours 28 minutes) were conducted while swells were less than two meters. Swells of greater than four meters were not recorded at all during any visual observation periods (Figure 11).

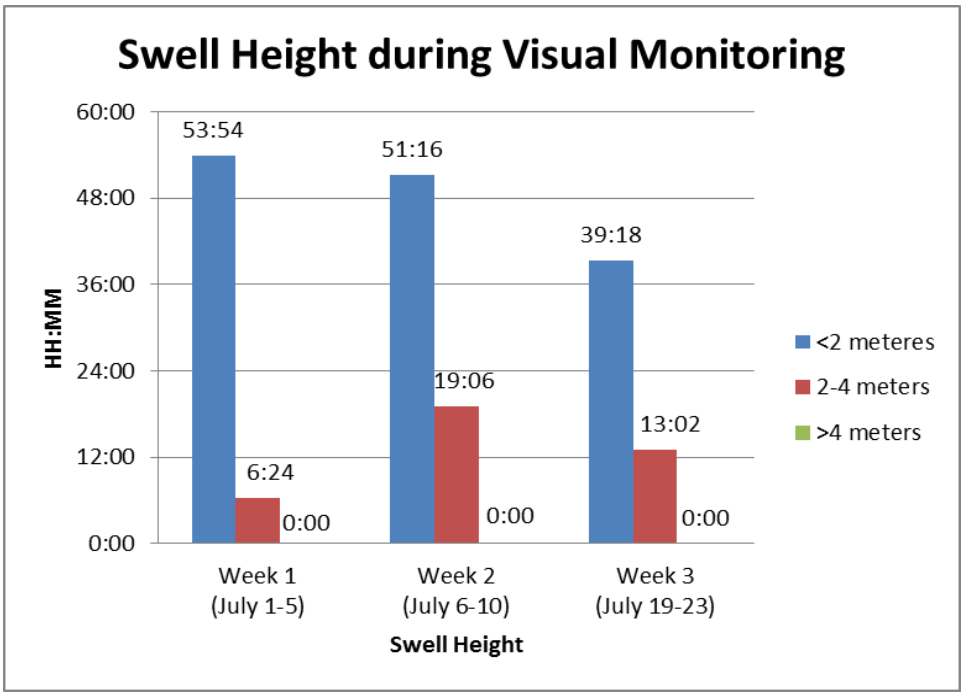

Figure 11. Swell heights during visual monitoring

5. MONITORING AND DETECTION RESULTS

5.1. VISUAL DETECTIONS

Visual monitoring conducted during the New Jersey 3-D seismic survey resulted in the collection of 41 visual records of detection for protected species by observers on the R/V *Langseth* (summarized in APPENDIX F). The spatial distribution of marine mammal detections on the R/V *Langseth* during transit between the survey site and port and on the survey site can be seen in Figure 12 and
Figure 13 (One detection of a sea turtle observed shortly after the vessel left port in New York is not shown).

Five species of marine mammals were positively identified and observations were also made of unidentifiable baleen whales and unidentifiable dolphins. One species of sea turtle was positively identified and additional observations were made of unidentifiable shelled sea turtles. The total number of detection events and total number of animals recorded by species is described in Table 5.

A complete list of birds and marine animals observed and identified in addition to the approximate number of individuals observed and the number of days on which they were observed can be found in APPENDIX G.

Table 5. Number of visual detection records collected for each protected species

	Total Number of Detection Records	Total Number of Animals Recorded
Sea Turtles		
Loggerhead sea turtle	16	16
Unidentifiable shelled sea turtle	13	13
Mysticetes		
Humpback whale	1	1
Unidentified baleen whale	1	1
Odontocetes		
Risso's dolphin	1	1
Atlantic spotted dolphin	1	12
Short-beaked common dolphin	4	45
Common bottlenose dolphin	1	10
Unidentifiable dolphin	3	9
TOTAL	**41**	**108**

There were multiple protected species sightings on most days of the survey (Figure 14). Most of the detections occurred on 5 July 2014 when there were eight detections: two detections of delphinids and six detections of shelled sea turtles. These detections occurred while seismic surveying was suspended due to weather until mid-day and during gear deployment in the afternoon when the acoustic source was still silent.

Of the 41 protected species detection events during the New Jersey 3-D seismic survey, 13 detections (32%) occurred while the acoustic source was active and 28 detections (68%) occurred while the

acoustic source was silent. Figure 15 demonstrates the species detected compared to acoustic source activity.

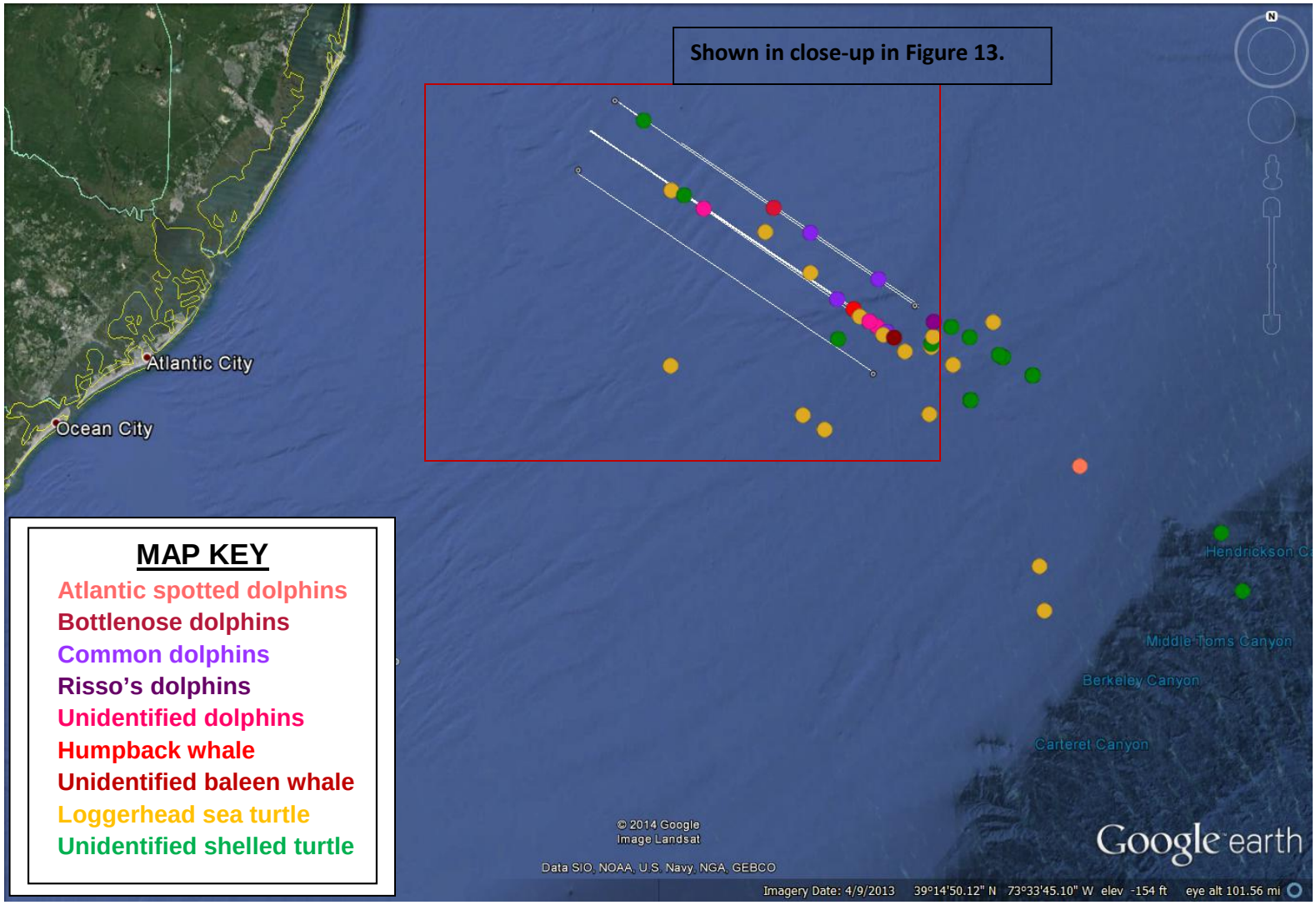

Figure 12. Protected species detections observed from the R/V *Langseth* in and around the survey area and location of survey lines acquired

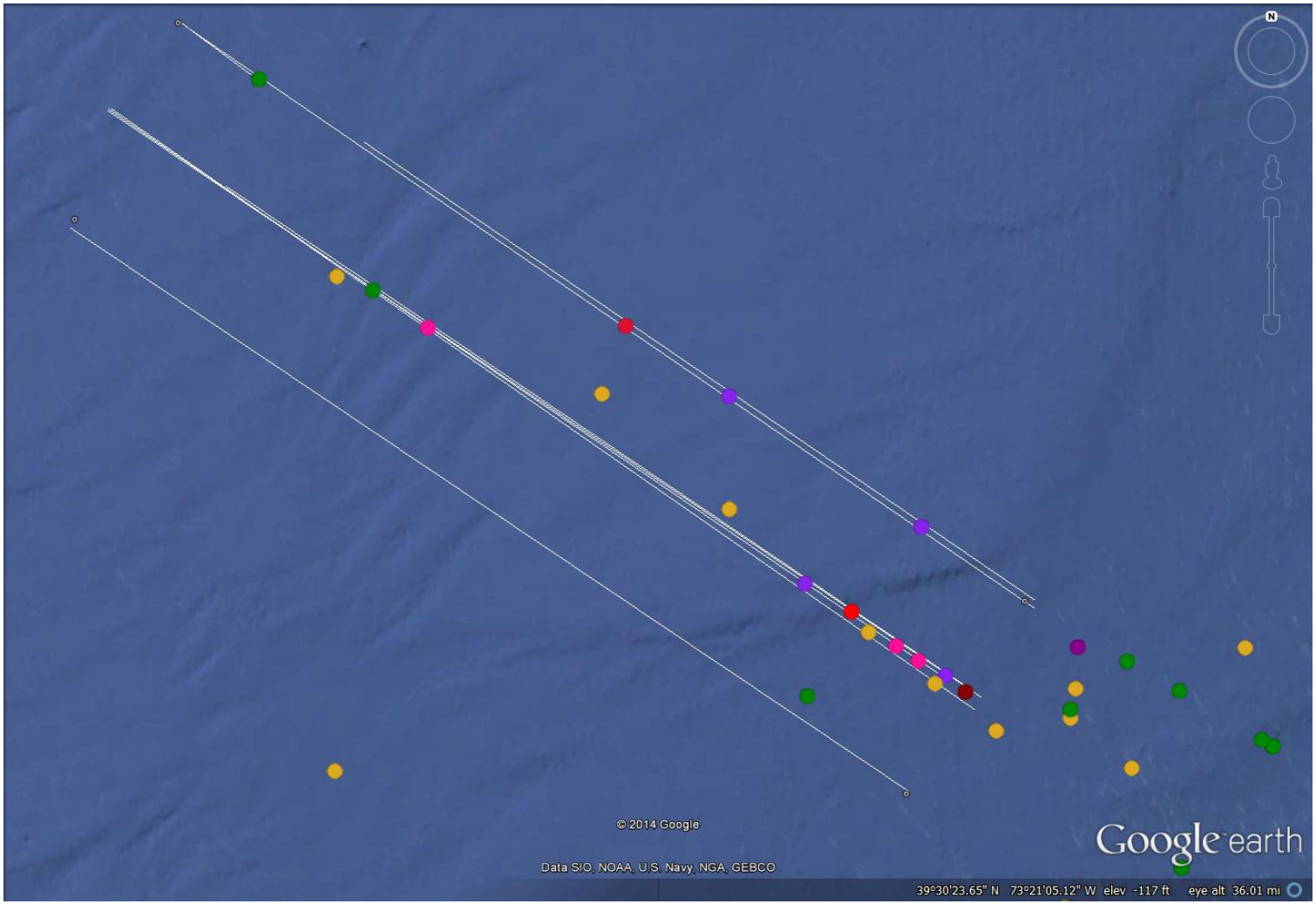

Figure 13. Protected species detections occurring inside the survey area

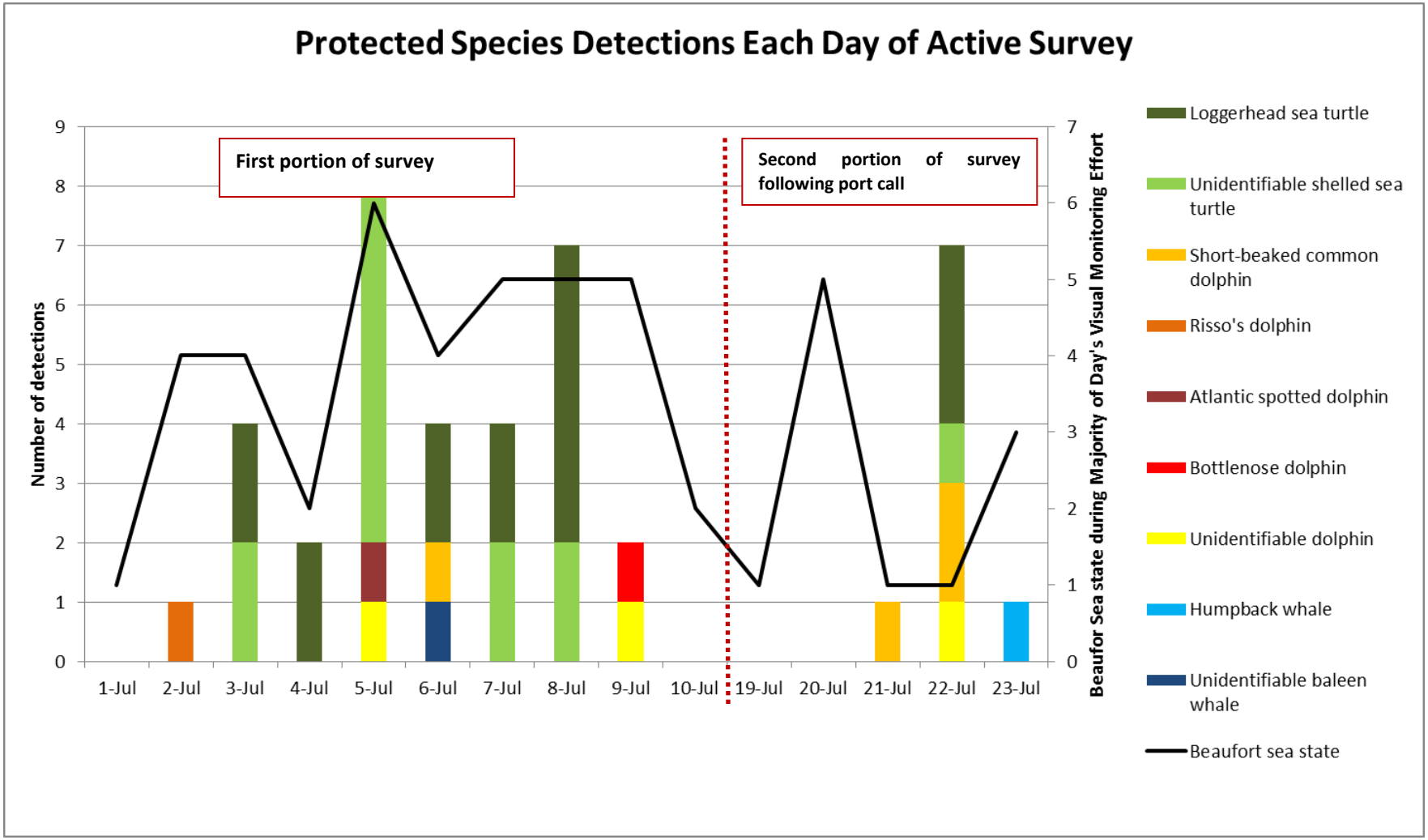

Figure 14. Number of protected species detections each day of active survey and Beaufort sea state during visual monitoring effort that day. The two portions of cruise were separated by ~9-day port period where the vessel was in port.

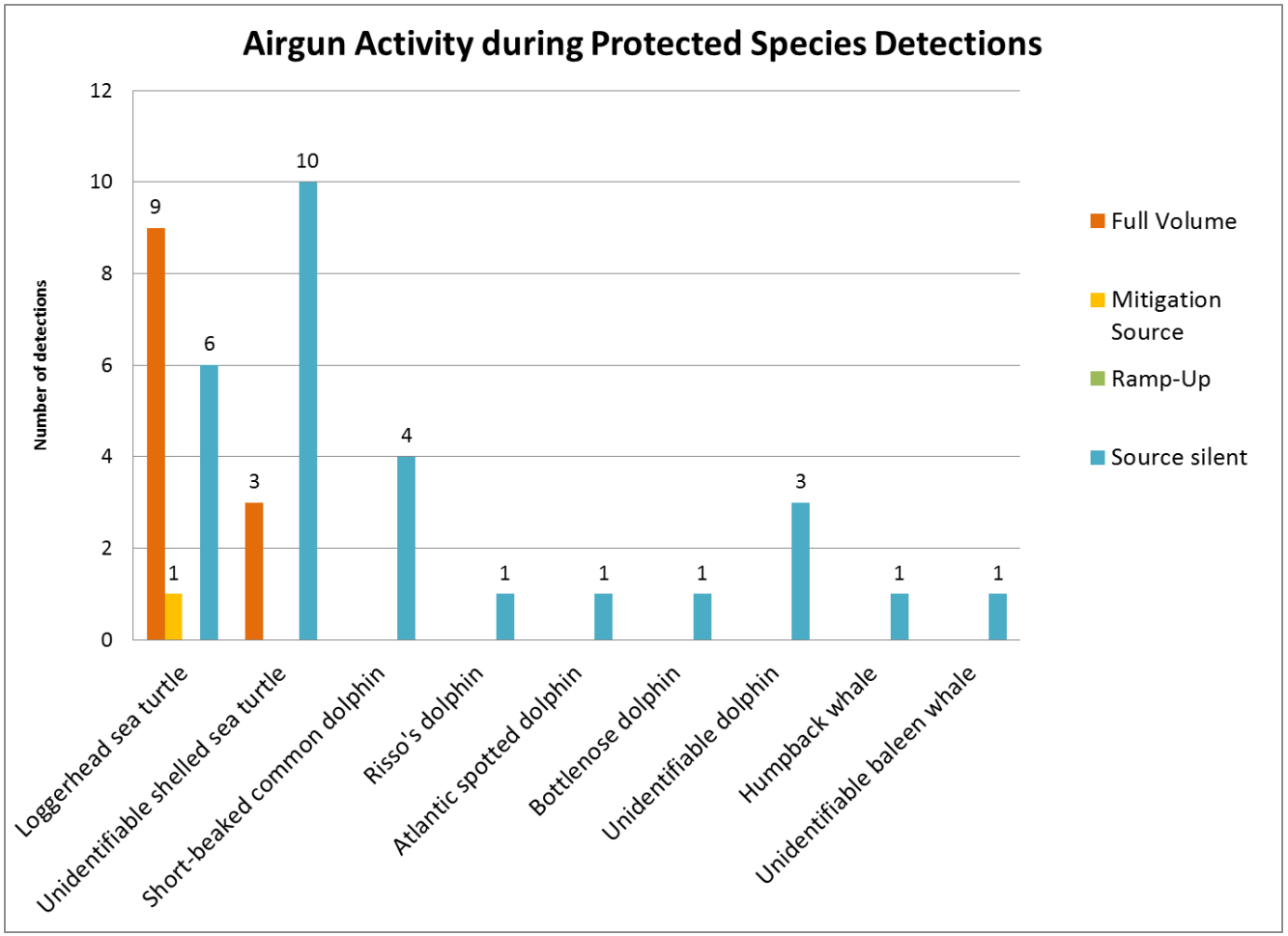

Figure 15. Acoustic source activity during all protected species detection records collected during monitoring effort

The average closest approach of protected species to the source at full volume and silent was calculated (Table 6). No detections occurred while the source was in ramp-up. Only one detection (loggerhead sea turtle at a distance of 360 meters to the source) occurred while the mitigation source was active so the average distance of protected species to the source at these volumes is not provided. Only shelled sea turtles were observed while the acoustic source was active; no cetaceans were observed while the source was active.

Table 6. Average closest approach of protected species to the acoustic source at full volume and silent

Species Detected	Full Volume Active (700 in³)		Silent	
	Number of detections	Average closest approach to source array (meters)	Number of detections	Average closest approach to source array/ array position (meters)
Loggerhead sea turtle	9	49	8	58
Unidentifiable shelled sea turtle	3	57	8	57
Humpback whale	0	-	1	500
Unidentified baleen whale	0	-	1	1200
Risso's dolphin	0	-	1	5
Atlantic spotted dolphin	0	-	1	30
Short-beaked common dolphin	0	-	4	364
Common bottlenose dolphin	0	-	1	50
Unidentifiable dolphin	0	-	3	497

Figure 16 demonstrates the total number of animals observed, per species, during all of the detection events (during the active survey and while the vessel was in transit or conducting other operations). The most detection records collected for a species was 16 records for loggerhead sea turtles, totaling 16 animals. Additionally, there were 13 detections of unidentified shelled sea turtles, totaling 13 animals.

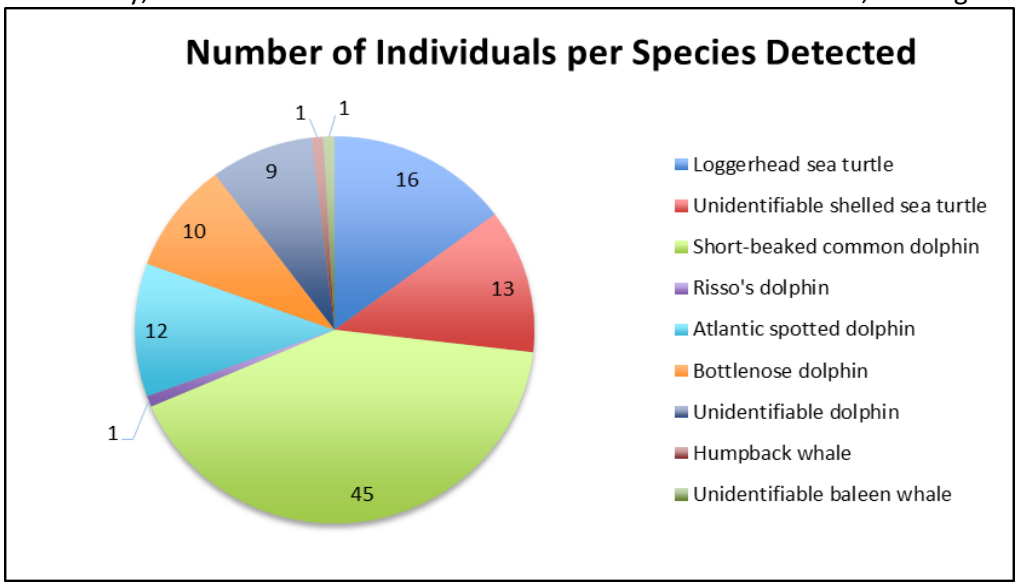

Figure 16. Number of individuals per species detected during all detection events

5.1.1. Cetacean Detections

The source was silent during all cetacean detections described below.

5.1.1.1. Risso's dolphin

There was a single visual sighting of an adult Risso's dolphin (*Grampus griseus*) on 2 July 2014. A tail buoy and streamers had been deployed, but the sound source was onboard throughout the detection. The animal travelled behind the vessel for 12 minutes, wake-riding and occasionally breaching. The dolphin's closest approach to the vessel was 15 meters and the water depth was 76 meters. No mitigation actions were necessary.

5.1.1.2. Atlantic spotted dolphin (*Stenella frontalis*)

A pod of 12 Atlantic spotted dolphins was detected on 5 July 2014 travelling in the same direction as the vessel. The pod appeared off the port side of the vessel, porpoising, tail slapping, and breaching; the behavior continued until they changed direction and swam away from the vessel. The dolphins approached to within 5 meters of the vessel, and water depth during the sighting was 40 meters. The animals remained within the 109 meter mitigation zone for seven minutes, but the acoustic source was onboard due to rough weather conditions, so no mitigation action was required.

5.1.1.3. Bottlenose dolphin (*Tursiops truncatus*)

A single sighting of bottlenose dolphins was made on 9 July 2014. The pod was detected off the port bow travelling parallel to and in the opposite direction of the vessel and included 10 adults. The detection lasted two minutes and the closest an animal was observed to the vessel was 20 meters. The sound source was onboard and no mitigation action was required.

5.1.1.4. Short-beaked common dolphin (*Delphinus delphis*)

Throughout the course of the survey program, there were four detections of short-beaked common dolphins, none of which led to mitigation actions because the acoustic source was on board the vessel during each encounter. One sighting consisted of 10 adults; one sighting consisted of 15 adults and one juvenile; one consisted of 10 adults and five juveniles; and the last sighting consisted of four adults. Water depth during sightings ranged from 57 meters to 83 meters. The closest approach to the vessel by any pod was 3 meters during detection on 21 July.

5.1.1.5. Humpback whale (Megaptera novaeangliae)

There was one sighting event of a single humpback whale during the project, on 23 July at 10:21 UTC, as the vessel was steaming to port with the source on board. The blow was first observed off the port bow at a distance of approximately 700 meters. Water depth was 20 meters and the closest distance of the animal to the vessel was 500 meters. The last sighting was at 10:32 UTC at about 2600 meters off the stern. The vessel was in transit and the acoustic source was on board; no mitigation action was required.

5.1.1.6. Unidentifiable baleen whale

There was a single sighting of a baleen whale, identified as either a fin or sei whale, on 6 July 2014 while the acoustic source was inactive. A blow was detected at about 2.2 kilometers off the starboard side of the vessel and moving toward the vessel. During the 47 minute detection, the unidentified baleen whale

travelled behind the stern of the vessel and then away from the port side. Water depth was 80 meters and the animal's closest approach to the vessel was about 1.2 kilometers. No mitigation was required.

5.1.1.7. Unidentifiable dolphin

Three detections of unidentified dolphins were made during the survey totaling nine individuals. The first sighting on 5 July consisted of four adults; the next sighting consisted of two adults; and the final sighting included two adults and one juvenile. The closest approach of the unidentified dolphins occurred at 400 meters, at which time the sound source was onboard. Water depth at the time of sightings ranged from 48 meters to 57 meters. The sound source was onboard during each of these sightings, so no mitigation actions were required.

5.1.2. Sea Turtle Detections

5.1.2.1. Loggerhead sea turtle (*Caretta caretta*)

There were 16 sightings of loggerhead sea turtles during the survey, each sighting event consisting of a single animal. The source was active during ten (full volume operations for nine detections and operation on mitigation volume during one detection) of the 16 detection events and silent during six of the events. Eight of these observations resulted in shut-downs of the acoustic source, resulting in a total of 37 minutes of mitigation downtime. The sea turtles were noted to be in depths ranging from 21 to 65 meters.

5.1.2.2. Unidentified shelled sea turtle

There were 13 sightings of unidentifiable shelled sea turtles during the survey, each sighting event consisting of a single animal. The source was silent during ten of the 13 sightings and active on full volume for three sightings, where a shut-down of the acoustic source was implemented each time. The turtles were noted to be in depths ranging from 26 to 70 meters.

5.1.3. Other Wildlife

Observations were carried out for other wildlife species, including bird and fish species, throughout the survey program. A complete list of seabirds and other marine animals observed and identified in addition to the approximate number of individuals observed and the number of days on which they were observed can be found in Appendix H. No impacts as a result of survey activities were detected during this program to any of the other wildlife species observed.

5.2. ACOUSTIC DETECTIONS

There were no acoustic detections made during this survey program.

5.3. CORRELATED VISUAL AND ACOUSTIC DETECTIONS

There were no visual and acoustic correlated detections made during this survey program.

6. MITIGATION ACTION SUMMARY

Operational mitigation measures were defined in the PEIS, NSF Final EA and FONSI for the project and the NMFS issued IHA and ITS, including: ramp-ups, power-downs, and shut-downs of the acoustic source, and vessel speed and course alterations.

There were 11 mitigation actions implemented during the New Jersey 3-D seismic survey due to protected species being observed within the mitigation-triggering radii of the sound source. All mitigation actions implemented consisted of shutdowns of the acoustic source for shelled sea turtles. The total duration of downtime caused by mitigation actions (including ramp-up to resume operations, if required) was 50 minutes over the course of the entire survey program. The number and duration of mitigation actions is summarized in Table 7.

Eight mitigation actions were implemented for loggerhead sea turtles and three mitigation actions were implemented for unidentified shelled sea turtles. During all detections of sea turtles that resulted in the implementation of mitigation actions, the sea turtles were first observed within the 177 dB mitigation radius for a single source element. This resulted in the acoustic source being shut-down long enough for the vessel to travel a great enough distance to leave the sea turtle outside of the 177 dB mitigation radius for the full acoustic source array. Depending on the speed of the vessel, the acoustic source was silenced for four or five minutes.

There was one detection event during the program where a mitigation action should have been implemented but a problem with the communication system resulted in an inability to implement the mitigation. On 3 July 2014 a loggerhead sea turtle observed was observed within the 177 dB mitigation radius while the acoustic source was active; and a shutdown of the source would normally have been implemented. The primary contact phone number to seismic personnel was not functioning and the PSOs on visual watch were unaware that there was a secondary number that could be used. These secondary phone numbers were provided following this incident and a two-way radio was placed in the observation tower as another back-up to the phone system. No observable impact to the sea turtle was detected as a result of the survey activities and lack of shutdown; as noted in APPENDIX F the sea turtle was observed to be demonstrating slow travel and dive behavior.

Table 7. Number and duration of mitigation actions implemented during the NJ 3D program

Mitigation Action	Cetaceans	
	Number	Duration (hh:mm)
Delayed Ramp-up	0	00:00
Power-down	0	00:00
Shut-down	11	00:50
Total	**11**	**00:50**

Mitigation actions and total duration of downtime are listed in Table 8 and Figure 17 by species. Each mitigation action that was implemented during the survey is summarized in Table 9. The total duration of the mitigation event includes the ramp-up to return to full power, if the acoustic source had been silent for longer than eight minutes per the IHA and ITS.

Table 8. Mitigation actions and downtime duration by species

Species	Number of Shut-downs	Duration of Downtime (hh:mm)	Percentage of Total Mitigation Downtime
Loggerhead sea turtle	8	00:37	**74%**
Unidentifiable shelled sea turtles	3	00:13	**26%**

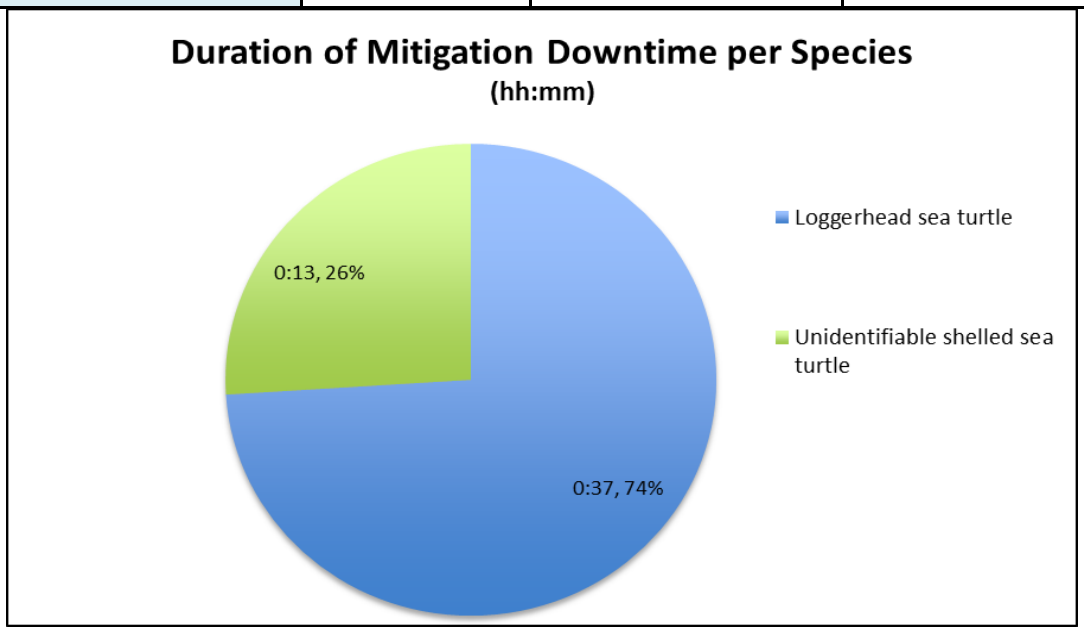

Figure 17. Duration of mitigation downtime per species

Table 9. Summary of each mitigation action implemented during the New Jersey 3-D seismic survey

Date	Visual Detection Number	Species	Group Size	Source Activity (initial detection)	Closest Approach to Full Volume Source (m)	Mitigation Action	Total Duration of Mitigation Event
3-Jul	3	Loggerhead sea turtle	1	Full volume	40	Shut-down	0:04
3-Jul	4	Unidentified shelled sea turtle	1	Full volume	70	Shut-down	0:04
3-Jul	5	Unidentified shelled sea turtle	1	Full volume	40	Shut-down	0:04
4-Jul	6	Loggerhead sea turtle	1	Full volume	40	Shut-down	0:04
4-Jul	7	Loggerhead sea turtle	1	Full volume	30	Shut-down	0:04
8-Jul	24	Unidentified shelled sea turtle	1	Full volume	60	Shut-down	0:05
8-Jul	25	Loggerhead sea turtle	1	Full volume	70	Shut-down	0:05
8-Jul	26	Loggerhead sea turtle	1	Full volume	75	Shut-down	0:05
8-Jul	27	Loggerhead sea turtle	1	Full volume	60	Shut-down	0:05

8-Jul	28	Loggerhead sea turtle	1	Full volume	30	Shut-down	0:05
8-Jul	29	Loggerhead sea turtle	1	Full volume	60	Shut-down	0:05

6.1. MARINE MAMMALS AND SEA TURTLES OBSERVED WITHIN THE PREDICTED 160/166 DB ZONE DURING ACTIVE SEISMIC OPERATIONS

NMFS granted an IHA and ITS for a marine seismic survey allowing Level B harassment takes (exposure to sound pressure levels greater than or equal to 160 dB re: 1 µPa (rms)) for 33 marine mammal species and 166 dB re: 1 µPa (rms) for 271 sea turtles: six mysticetes, 24 odontocetes, three pinniped species, 30 green, 130 hawksbill, 77 Kemps ridley, and 34 leatherback sea turtles. Direct visual observations recorded by PSOs of no species of marine mammals for which Level B harassment takes were granted in the IHA and ITS provide a minimum estimate of the actual number of cetaceans exposed to received sound levels of 177 dB and 160 dB. Although Level B harassment may be expected to occur in sea turtles at the 166dB zone, PSOs monitored to the 160dB zone for convenience. Only shelled sea turtles were observed within the predicted 160 dB zone. Level B harassment takes were granted for sea turtles in the ITS and mitigation actions were implemented if the sea turtles were observed within the 177 dB mitigation zone.

During the New Jersey 3D seismic survey loggerhead sea turtles and unidentifiable shelled sea turtles were observed within the predicted 160 dB zone while the acoustic source was active (Table 10). The first detection of the majority of these animals occurred while they were already within the predicted 177 dB mitigation radius around the acoustic source.

The observed number of potential takes may be an underestimate and, therefore, may be a minimum number of animals actually exposed. It is possible that estimated numbers of animals recorded during each sighting event, particularly during dolphin detections, were underestimates due to some animals not being seen or having moved away before they were observed.

Environmental conditions, particularly the Beaufort sea state, during visual monitoring periods also influence sighting rates, predominantly of sea turtles or smaller cetaceans with less obtrusive behavior (such as beaked whales). While 63% of visual observations were undertaken while the Beaufort sea state was rated as level four or above, many of the days where the largest number of protected species sighting events occurred (including multiple sea turtle sightings) also took place during high Beaufort sea states. For example, on 5 July and 8 July, eight and seven detection events were accumulated respectively, each taking place while the sea state was a level five or higher (Figure 14). This suggests that the Beaufort sea state did not greatly hinder the ability of PSOs to identify the presence of protected species.

Recent analysis of R/V *Langseth* source received levels collected via hydrophone streamers in shallow waters (Crone 2013 and 2014), including off of NJ (Crone 2015, *pers. comm.*), demonstrated that the predicted mitigation zones, both the 180 and 160, were substantially smaller than those predicted. Therefore, animals observed within the predicted mitigation zones in shallow water for this survey may not have experienced received levels at those predicted levels. Furthermore, as described in the PEIS, Lloyd's mirror and surface release effects ameliorate the effects for animals at or near the sea surface.

Table 11 describes the behaviour of all sea turtles, including unidentified species, which were observed with the predicted 166 dB zone for the duration they were observed. No marine mammals were observed while the acoustic source was active

Table 10. Level B Harassment Takes authorized by NMFS IHA and ITS for the New Jersey 3D seismic survey and number of known individuals observed within the 160 dB (marine mammals) /166 dB (sea turtles) and 177/187 dB through visual observations

Species	IHA Authorized Takes	Number of animals observed within the predicted 177/187 dB zone	Number of animals observed within the predicted 160 dB /166 dB zone
Mysticetes			
North Atlantic right whale	3	0	0
Humpback whale	2	0	0
Common minke whale	2	0	0
Sei whale	2	0	0
Fin whale	2	0	0
Blue whale	17	0	0
Odontocetes			
Sperm whale	18	0	0
Dwarf sperm whale	3	0	0
Pygmy sperm whale	3	0	0
Cuvier's beaked whale	4	0	0
Gervais' beaked whale	4	0	0
Sowerby's beaked whale	4	0	0
Unidentified *Mesoplodon.*or *Ziphid*	4	0	0
Rough-toothed dolphin	0	0	0
Bottlenose dolphin (coastal&pelagic)	349	0	0
Pantropical spotted dolphin	0	0	0
Atlantic spotted dolphin	113	0	0
Spinner dolphin	0	0	0
Striped dolphin	59	0	0
Short-beaked common dolphin	23	0	0
White-beaked dolphin	0	0	0
Atlantic white-sided dolphin	19	0	0
Risso's dolphin	44	0	0
False killer whale	0	0	0
Pygmy killer whale	0	0	0
Killer whale	0	0	0
Long-finned pilot whale	12	0	0
Short-finned pilot whale	12	0	0
Harbor porpoise	3	0	0
Pinnipeds			
Gray seal	15	0	0
Harbor seal	140	0	0
Harp seal	5	0	0
Sea Turtles			
Loggerhead sea turtle	166	9	10
Unidentifiable shelled sea turtle	n/a	3	3
Green sea turtle	30	0	0
Hawksbill sea turtle	130	0	0
Kemp's Ridley sea turtle	77	0	0
Leatherback sea turtle	34	0	0

Table 11. Behaviour of species observed within the predicted 166 dB zone (sea turtles)

Species	Detection No.	No. of Animals	Initial behavior	Initial direction in relation to vessel	Subsequent and Final behavior	Subsequent and Final direction in relation to vessel
Loggerhead sea turtle	2	1	Traveling below surface	Parallel, opposite direction	Diving	Parallel, opposite direction
	3	1	Surfacing	Parallel, same direction	Breathing, diving	Away from vessel
	6	1	Surfacing	Milling	Breathing	Milling
	7	1	Traveling	Parallel, same direction	Traveling	Parallel, same direction
	23	1	Traveling at surface	Parallel, opposite direction	Breathing	Parallel, opposite direction
	25	1	Traveling at surface	Towards vessel	Breathing	Towards vessel
	26	1	Traveling at surface	Parallel, same direction	Breathing	Parallel, same direction
	27	1	Breathing	Away from vessel	Diving	Away from vessel
	28	1	Traveling at surface	Away from vessel	Diving	Parallel, same direction
	29	1	Traveling at surface	Parallel, same direction	Breathing	Parallel, same direction
Unidentifiable shelled sea turtle	4	1	Surfacing	Away from vessel	Breathing	Away from vessel
	5	1	Traveling submerged	Away from vessel	Traveling submerged	Away from vessel
	24	1	Milling submerged	Milling	Milling submerged	Milling

6.2. IMPLEMENTATION AND EFFECTIVENESS OF THE BIOLOGICAL OPINION'S ITS AND IHA

In order to minimize potential impacts to marine mammals and sea turtles during the New Jersey 3-D seismic survey in 2014, mitigation measures were implemented whenever these protected species were seen near or within the safety radii designated in the IHA and ITS. Multiple mitigation actions were implemented during this survey for shelled sea turtles. Only shut-downs of the acoustic source were implemented; there were no power-downs or significant delays due to ramp-ups during this survey. No mitigation actions were implemented for cetaceans or pinnipeds. There were no detections of pinnipeds during the survey and all detections of cetaceans occurred while the acoustic source was silent. The implementation of each Term and Condition of the Biological Opinion's Incidental Take Statement are described within this report.

Additional mitigation measures specific to the New Jersey 3-D seismic survey required that if a North Atlantic right whale (*Eubalaena glacialis*) was sighted, the acoustic source would be shut-down regardless of the distance of the animal(s) to the sound source and that the array would remain inactive until 30 minutes after the last documented sighting of the whale (s). No North Atlantic right whales were observed during the New Jersey 3-D seismic survey and therefore no special mitigation measures were implemented.

Passive acoustic monitoring was undertaken throughout the survey program and the majority of acoustic monitoring was undertaken while the source was active. High levels of background noise on the hydrophone cable are experienced when the vessel was traveling at higher speed (greater than 6 knots), which made it impractical to conduct monitoring for baseline acoustic data collection while the vessel was in transit to and from the survey site. Additionally, in order to minimize the risk of entanglement of the hydrophone cable with other seismic equipment, the hydrophone cable was deployed after all seismic gear had already been deployed, and retrieved prior to the retrieval of the seismic equipment. This prevented baseline acoustic data from being collected on the survey site while visual monitoring was ongoing for baseline data collection purposes. No acoustic detections were made during this cruise.

The monitoring and mitigation measures required by the IHA and ITS appear to have been an effective means to protect the few marine species encountered during this survey.

7. LITERATURE CITED

Crone, T. J., Tolstoy, M., & Carton, H. D. (2013). *Calibration of the R/V Marcus G. Langseth Seismic Array in shallow Cascadia waters using the Multi-Channel Streamer.* Paper presented at the AGU Fall Meeting Abstracts 2013.

Crone, T.J., M. Tolstoy, and H. Carton. 2014. Estimating shallow water sound power levels and mitigation radii for the R/V *Marcus G. Langseth* using an 8 km long MCS streamer. **Geochem. Geophys. Geosyst.** 15, doi:10.1002/2014GC005420.

Crone, T.J. 2015. Personal communication.

APPENDIX A. INCIDENTAL HARASSMENT AUTHORIZATION FOR THE NEW JERSEY 3-D MARINE GEOPHYSICAL SURVEY.

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

DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE

INCIDENTAL HARASSMENT AUTHORIZATION

We hereby authorize the Lamont-Doherty Earth Observatory (Observatory), Columbia University, P.O. Box 1000, 61 Route 9W, Palisades, New York 10964-8000, under section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA) (16 U.S.C. 1371(a)(5)(D)) and 50 CFR 216.107, to incidentally harass small numbers of marine mammals incidental to a marine geophysical survey conducted by the R/V *Marcus G. Langseth* (*Langseth*) marine geophysical survey in the Atlantic Ocean, July through August, 2014.

1. EFFECTIVE DATES

This Authorization is valid from July 1, 2014 through August 17, 2014.

2. SPECIFIED GEOGRAPHIC REGION

This Authorization is valid only for specified activities associated with the R/V *Marcus G. Langseth*'s (*Langseth*) seismic operations as specified in the Observatory's Incidental Harassment Authorization (Authorization) application and the National Science Foundation's Environmental Assessment (EA) in the following specified geographic area:

(a) In the Atlantic Ocean, approximately 25 to 85 kilometers (km) off the coast of New Jersey. The area is within the following coordinates: between approximately 39.3° – 39.7° North and approximately 73.2° - 7.38° West, as specified in the Observatory's application and the National Science Foundation's EA.

3. SPECIES AUTHORIZED AND LEVEL OF TAKES

(a) This Authorization limits the incidental taking of marine mammals, by Level B harassment only, to the following species in the area described in Condition 2(a):

(i) Mysticetes – see Table 1 (attached) for authorized species and take numbers.

(ii) Odontocetes – see Table 1 (attached) for authorized species and take numbers.

(iii) Pinnipeds – see Table 1 (attached) for authorized species and take numbers.

(b) During the seismic activities, if the Holder of this Authorization encounters any marine mammal species not listed in Table 1 (attached) for authorized taking and may expose that species to sound pressure levels greater than or equal to 160 decibels (dB) re: 1 µPa, then the Holder must alter the *Langseth's* speed or course or shut-down the airguns to avoid take.

(c) This Authorization prohibits the taking by injury (Level A harassment), serious injury, or death of any of the species listed in Condition 3(a) or the taking of any kind of any other

species of marine mammal. Thus, it may result in the modification, suspension or revocation of this Authorization.

(d) This Authorization limits the methods authorized for taking by Level B harassment to the following acoustic sources:

(i) A single airgun with a total discharge capacity of 40 cubic inches (in^3);

(ii) A 4-airgun subarray with a total discharge capacity of 700 in^3;

(iii) An 8-airgun subarray with a total discharge capacity of 1,400 in^3;

(iv) A multibeam echosounder (MBES);

(v) A sub-bottom profiler (SBP); and

(vi) A 75-kHz acoustic current Doppler profiler (ADCP).

4. Prohibited Take

The Holder of this Authorization must immediately report the taking of any marine mammal in a manner prohibited under this Authorization to the Office of Protected Resources, National Marine Fisheries Service, at 301-427-8401 and/or by email to Jolie.Harrison@noaa.gov and Jeannine.Cody@noaa.gov.

5. Cooperation

We require the Holder of this Authorization to cooperate with the Office of Protected Resources, National Marine Fisheries Service and any other Federal, state or local agency monitoring the impacts of the activity on marine mammals.

6. Mitigation and Monitoring Requirements

We require the Holder of this Authorization to implement the following mitigation and monitoring requirements when conducting the specified activities to achieve the least practicable adverse impact on affected marine mammal species or stocks:

Visual Observers

(a) Utilize two, National Marine Fisheries Service-qualified, vessel-based Protected Species Visual Observers (visual observers) to watch for and monitor marine mammals near the seismic source vessel during daytime airgun operations (from civil twilight-dawn to civil twilight-dusk) and before and during start-ups of airguns day or night.

(i) At least one visual observer will be on watch during meal times and restroom breaks.

(ii) Visual observer shifts will last no longer than four hours at a time.

(iii) Visual observers will have access to reticle binoculars (7x50 Fujinon), and big-eye binoculars (25x150).

(iv) Visual observers will also conduct monitoring while the *Langseth* crew deploys and recovers the airgun array and streamers from the water.

(v) When feasible, visual observers will conduct observations during daytime periods when the researchers are not operating the seismic system. This monitoring will

help in the comparison of sighting rates and behavioral reactions during, between, and after airgun operations.

(vi) The *Langseth*'s crew will also assist in detecting marine mammals, when practicable.

Exclusion Zones

(b) Establish a 177-dB or 187-dB exclusion zone for cetaceans and pinnipeds, respectively, before starting either the 4-airgun (700 in^3); the 8-airgun (1,400 in^3) subarray; or the single airgun (40 in^3). Observers will use the predicted radius distance for the 177-dB and 187-dB exclusion zones for cetaceans and pinnipeds, respectively.

(c) See Table 2 (attached) for the distances of the exclusion zones.

Visual Monitoring at the Start of Airgun Operations

(d) Monitor the entire extent of the exclusion zones listed in Table 2 (attached) for at least 30 minutes (day or night) prior to the ramp-up of airgun operations after a shutdown.

(e) If a visual observer sees a marine mammal within the 177-dB or 187-dB exclusion zone for cetaceans or pinnipeds, respectively, the Holder of this Authorization must delay the start of airgun operations until the marine mammal(s) has left the area.

(i) If the visual observer sees a marine mammal that surfaces, then dives below the surface, the visual observer shall wait 30 minutes. If the observer sees no marine mammals during that time, he/she should assume that the animal has moved beyond the 177-dB or 187-dB exclusion zones for cetaceans and pinnipeds, respectively.

(ii) If for any reason the visual observer cannot see the full 177-dB or 187-dB exclusion zone for cetaceans or pinnipeds, respectively, for the entire 30 minutes (*i.e.*, rough seas, fog, darkness), or if marine mammals are near, approaching, or within the exclusion zone, the Holder of the Authorization may not resume airgun operations.

(iii) If one airgun is already running at a source level of at least 177 dB re: 1 μPa, the Holder of the Authorization may start the second gun–and subsequent airguns–without observing relevant exclusion zones for 30 minutes, provided that the observers have not seen any marine mammals near the relevant exclusion zones (in accordance with Condition 6(b)).

Passive Acoustic Monitoring

(f) Utilize the passive acoustic monitoring (PAM) system, to the maximum extent practicable, to detect and allow some localization of marine mammals around the *Langseth* during all airgun operations and during most periods when airguns are not operating. One visual observer and/or bioacoustician will monitor the PAM at all times in shifts no longer than 6 hours. A bioacoustician shall design and set up the PAM system and be present to operate or oversee PAM, and available when technical issues occur during the survey.

(g) Do and record the following when an animal is detected by the PAM:

(i) Notify the visual observer immediately of a vocalizing marine mammal so that the Holder of the Authorization can initiate a power-down or shut-down, if required; and

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

Ramp-Up Procedures

(h) Implement a "ramp-up" procedure when starting the airguns at the beginning of seismic operations or anytime after the entire array has been shutdown, which means start the smallest gun first and add airguns in a sequence such that the source level of the array will increase in steps not exceeding approximately 6 dB per 5-minute period. During ramp-up, the visual observers will monitor the exclusion zone, and if they sight marine mammals, the *Langseth* will implement a course/speed alteration, power-down, or shutdown as though the full array were operational.

Recording Visual Detections

(i) Visual observers must record the following information when they have sighted a marine mammal:

(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 6(g)(ii) at the start and end of each observation watch and during a watch whenever there is a change in one or more of the variables.

Speed or Course Alteration

(j) 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, the Holder of this Authorization will implement further mitigation measures, such as a shutdown.

Power-Down Procedures

(k) Power down the airguns if a visual observer detects a marine mammal within, approaching, or entering the relevant exclusion zones (as defined in Table 2, attached). A power-down

means reducing the number of operating airguns to a single operating 40 in^3 airgun. This would reduce the exclusion zone to the degree that the animal(s) is outside of it.

Resuming Airgun Operations After a Power-Down

(l) Following a power-down, if the marine mammal approaches the smaller designated exclusion zone, the Holder of this Authorization must shutdown the airguns completely. Airgun activity will not resume until the visual observer sees the marine mammal(s) exiting the relevant exclusion zone and it is not likely to return, or the visual observer has not seen it within the relevant exclusion zone for 15 minutes for species with shorter dive durations (*i.e.,* small odontocetes) or 30 minutes for species with longer dive durations (*i.e.,* mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, killer, and beaked whales).

(m) Following a power-down and subsequent animal departure, the Holder of this Authorization may resume airgun operations at full power. Initiation requires that the visual observers can effectively monitor the full exclusion zones described in Condition 6(b). If the visual observer sees a marine mammal within or about to enter the relevant exclusion zone, then the *Langseth* will implement a course/speed alteration, power-down, or shutdown.

Shutdown Procedures

(n) Shutdown the airgun(s) if a visual observer detects a marine mammal within, approaching, or entering the relevant exclusion zone (as defined in Table 2, attached). A shutdown means that the *Langseth* turns off all operating airguns.

(o) If a visual observer sees a north Atlantic right whale (*Eubalaena glacialis*) at any distance from the *Langseth*, the Holder of this Authorization will shut down the airgun array regardless of the distance of the animal(s) to the sound source. The array will not resume firing until 30 minutes after the last documented visual sighting of a north Atlantic whale.

Resuming Airgun Operations After a Shutdown

(p) Following a shutdown, if the visual observer has confirmed that the animal has departed the 177-dB or 187-dB exclusion zone within a period of less than or equal to 8 minutes after the shutdown, then the Holder of this Authorization may resume airgun operations at full power.

(q) Else, if the visual observer has not seen the animal depart the 177-dB or 187-dB exclusion zone, then the Holder of this Authorization shall not resume airgun activity until 15 minutes has passed for species with shorter dive times (*i.e.,* small odontocetes and pinnipeds) or 30 minutes has passed for species with longer dive durations (*i.e.,* mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, killer, and beaked whales). The Holder of this Authorization will follow the ramp-up procedures described in Conditions 6(h).

Survey Operations at Night

(r) The *Langseth* may continue marine geophysical surveys into night and low-light hours if the Holder of the Authorization initiates these segment(s) of the survey when the observers can view and effectively monitor the full relevant exclusion zones.

(s) This Authorization does not permit the Holder of this Authorization to initiate airgun array operations from a shut-down position at night or during low-light hours (such as in dense fog or heavy rain) when the visual observers cannot view and effectively monitor the full relevant exclusion zones.

(t) To the maximum extent practicable, the Holder of this Authorization should schedule seismic operations (*i.e.*, shooting the airguns) during daylight hours.

Mitigation Airgun

(u) The *Langseth* may operate a small-volume airgun (*i.e.*, mitigation airgun) during turns and maintenance at approximately one shot per minute. During turns or brief transits between seismic tracklines, one airgun would continue to operate.

7. Reporting Requirements

This Authorization requires the Holder of this Authorization to:

(a) Submit a draft report on all activities and monitoring results to the Office of Protected Resources, National Marine Fisheries Service, within 90 days of the completion of the seismic survey. This report must contain and summarize the following information:

(i) Dates, times, locations, heading, speed, weather, sea conditions (including Beaufort sea state and wind force), and associated activities during all seismic operations and marine mammal sightings;

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

(iii) An estimate of the number (by species) of marine mammals with known exposures to the seismic activity (based on visual observation) at received levels greater than or equal to 160 dB re: 1 μPa and/or 177 and 187 dB re: 1 μPa for cetaceans and pinnipeds, respectively, and a discussion of any specific behaviors those individuals exhibited.

(iv) An estimate of the number (by species) of marine mammals with estimated exposures (based on modeling results) to the seismic activity at received levels greater than or equal to 160 dB re: 1 μPa and/or 177 and 187 dB re: 1 μPa for cetaceans and pinnipeds respectively, with a discussion of the nature of the probable consequences of that exposure on the individuals.

(v) A description of the implementation and effectiveness of the: (A) terms and conditions of the Biological Opinion's Incidental Take Statement (attached); and (B) mitigation measures of the Incidental Harassment Authorization. For the Biological Opinion, the report will confirm the implementation of each Term and Condition, as well as any conservation recommendations, and describe their effectiveness, for minimizing the adverse effects of the action on Endangered Species Act listed marine mammals.

(b) Submit a final report to the Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, within 30 days after receiving comments from us on the draft report. If the agency decides that the draft report is sufficient, we will consider the draft report to be the final report.

8. Reporting Prohibited Take

In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by this Authorization, such as an injury (Level A harassment), serious injury or mortality (*e.g.*, ship-strike, gear interaction, and/or entanglement), the Observatory 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 ITP.Cody@noaa.gov and the Northeast Regional Stranding Coordinator at (978) 281-9300.

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 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 all marine mammal observations in the 24 hours preceding the incident;
- Species identification or description of the animal(s) involved;
- Fate of the animal(s); and
- Photographs or video footage of the animal(s) (if equipment is available).

The Observatory will not resume their activities until we are able to review the circumstances of the prohibited take. We will work with the Observatory to determine what is necessary to minimize the likelihood of further prohibited take and ensure Marine Mammal Protection Act compliance. The Observatory may not resume their activities until we notify them by letter, email, or telephone.

9. Reporting an Injured or Dead Marine Mammal with an Unknown Cause of Death

In the event that the Observatory discovers an injured or dead marine mammal, and the lead visual observer determines that the cause of the injury or death is unknown and the death is relatively recent (*i.e.*, in less than a moderate state of decomposition as described in the next paragraph), the Observatory 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 ITP.Cody@noaa.gov and the Northeast Regional Stranding Coordinator at (978) 281-9300.

The report must include the same information identified in Condition 8. Activities may continue while we review the circumstances of the incident. We will work with the Observatory to determine whether modifications in the activities are appropriate.

10. Reporting an Injured or Dead Marine Mammal not Related to the Activities

In the event that the Observatory discovers an injured or dead marine mammal, and the lead visual observer determines that the injury or death is not associated with or related to the activities authorized in the Authorization (*e.g.*, previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), the Observatory will 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 Jeannine.Cody@noaa.gov and the Northeast Regional Stranding Coordinator at (978) 281-9300 within 24 hours of the discovery. Activities may continue while NMFS reviews the circumstances of the incident. The Observatory will provide photographs or video footage (if available) or other documentation of the stranded animal sighting to us.

11. ENDANGERED SPECIES ACT BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The Observatory is required to comply with the Terms and Conditions of the Incidental Take Statement corresponding to the Endangered Species Act Biological Opinion issued to both the National Science Foundation and the National Marine Fisheries Service's Office of Protected Resources, Permits and Conservation Division.

A copy of this Authorization and the Incidental Take Statement must be in the possession of all contractors and protected species observers operating under the authority of this Incidental Harassment Authorization.

Perry Gayaldo

JUL - 1 2014

for Donna S. Wieting
Director,
Office of Protected Resources
National Marine Fisheries Service

Date

Attachments

Attachment

Table 1 – Authorized Level B harassment take levels.

Species	Proposed Take Authorization[2]
North Atlantic right whale	3
Humpback whale	2
Common minke whale	2
Sei whale	2
Fin whale	2
Blue whale	17
Sperm whale	18
Dwarf sperm whale	3
Pygmy sperm whale	3
Cuvier's beaked whale	4
Gervais' beaked whale	4
Sowerby's beaked whale	4
Unidentified Mesoplodon or Ziphid: True's, Blainville, Northern bottlenose whale	4
Rough-toothed dolphin	0
Bottlenose dolphin (pelagic)	349
Bottlenose dolphin (coastal)	
Pantropical spotted dolphin	0
Atlantic spotted dolphin	113
Spinner dolphin	0
Striped dolphin	59
Short-beaked common dolphin	23
White-beaked dolphin	0
Atlantic white-sided dolphin	19
Risso's dolphin	44
False killer whale	0
Pygmy killer whale	0
Killer whale	0
Long-finned pilot whale	12
Short-finned pilot whale	12
Harbor porpoise	3
Gray seal	15
Harbor seal	140
Harp seal	5

Table 2 –Exclusion zones (EZ) for marine mammals in the survey area.

Source and Volume (in^3)	Tow Depth (m)	Water Depth (m)	Predicted RMS Distances[1] (m)		
			187 dB	177 dB	160 dB
Single Bolt airgun (40 in^3)	6	< 100	31	109	995
4-Airgun subarray (700 in^3)	4.5	< 100	151	561	5,240
4-Airgun subarray (700 in^3)	6	< 100	175	651	6,100
8-Airgun subarray (1,400 in^3)	4.5	< 100	190	709	6,670
8-Airgun subarray (1,400 in^3)	6	< 100	234	886	8,150

APPENDIX B. BASIC DATA SUMMARY FORM.

BASIC DATA FORM				
LDEO Project Number		MGL1405		
Seismic Contractor		Lamont-Doherty Earth Observatory of Columbia University		
Area Surveyed During Reporting Period		Atlantic Ocean off the coast of New Jersey		
		Approximately between 39.3 to 39.7°N and 73.2 to 73.8°W		
Survey Type		3D surface seismic		
Vessel and/or Rig Name		R/V *Marcus G. Langseth*		
Permit Number		IHA and ITS granted by NMFS on 1 July 2014		
Location / Distance of Acoustic Source Deployment		42 meters aft of PSO tower		
Water Depth	**Min**	~22 meters		
	Max	~50 meters		
Dates of project		1 July 2014	THROUGH	23 July 2014
Total time acoustic source operating – all power levels:		61 hours 08 minutes		
Time acoustic source operating at full power on survey lines:		43 hours 11 minutes		
Time acoustic source operating at full power on line changes:		7 hours 48 minutes		
Amount of time mitigation source (40 in³) operations:		9 hours 13 minutes		
Amount of time in ramp-up:		56 minutes		
Number daytime ramp-ups:		4		
Number of night time ramp-ups:		0		
Number of ramp-ups from mitigation source:		3		
Amount of time conducted in source testing:		0		
Duration of visual observations:		182 hours 10 minutes		
Duration of observations while acoustic source active:		40 hours 34 minutes		
Duration of observation while acoustic source silent:		141 hours 36 minutes		
Duration of acoustic monitoring:		23 hours 46 minutes		
Duration of acoustic monitoring while acoustic source active:		21 hours 28 minutes		
Duration of acoustic monitoring whil acoustic source silent:		2 hours 18 minutes		
Duration of simultaneous acoustic and visual monitoring:		15 hours 27 minutes		
Lead Protected Species Observer:		Heidi Ingram		
Protected Species Observers:		Leslie Curran		
		Cassandra Frey		
		Laurie Dugan		
Acoustic Observer:		Laura Marcella		
Number of Marine Mammals Visually Detected:		12		
Number of Marine Mammals Acoustically Detected:		0		
Number of acoustic detections confirmed by visual sighting:		0		
Number of visual sighting confirmed by acoustic detection:		0		
Number of Sea Turtles detected:		29		
List Mitigation Actions (eg. Power-downs, shut-downs, ramp-up delays)		11 shut-downs		
Duration of operational downtime due to mitigation:		50 minutes		

APPENDIX C. PASSIVE ACOUSTIC MONITORING SYSTEM SPECIFICATIONS.

Main cable and spare cable:

1.1 Outline Array
Array serial number SM.4961
Mechanical Information
Length 20m
Diameter 14mm over cable 32mm over mouldings 45mm over connectors
Weight 10kg
Connector Seiche 36 pin

Hydrophone elements
Hydrophone 1 Sphere 1 Broad band 200Hz to 200kHz (3dB points)
Hydrophone 2 Sphere 2 Broad band 200Hz to 200 kHz (3dB points)
Hydrophone 3 Sphere 3 Standard 2 kHz to 200 kHz (3dB points)
Hydrophone 4 Sphere 4 Standard 2 kHz to 200 kHz

Depth Capability 100m
Spacing between elements 1 & 2 (for HF / LF detection) 2.0m 1.28mSecs
Spacing between elements 2 & 3 (for HF / LF detection) 13.0m 8.32mSecs
Spacing between elements 3 & 4 (for HF detection) 0.25m 0.16mSecs

Interface unit Array 1 outputs

Broad band channel sensitivity -166dB re 1V/uPa
Standard channel sensitivity -166dB re 1V/uPa

1.2 Heavy tow cable
Tow serial number SM.4635
Mechanical Information
Length 230m
Diameter 17mm over cable 32mm over mouldings
Connector Tail end Seiche 36 pin 45mm over connectors
Head end ITT 19 pin 65mm over connectors
Weight 100kg

1.3 Deck cable
Deck serial number SM.1035
Mechanical Information
Length 100m
Diameter 14mm
Connectors ITT 19 pin 65mm over connectors
Weight 25kg

APPENDIX D. PAM HYDROPHONE DEPLOYMENT ON THE R/V MARCUS LANGSETH.

The hydrophone deployment procedure is generally described below and may be altered as needed during operations. The deployment requires the PAM operator and one additional person to complete.

Overview

A 20-meter hydrophone array cable and a 230-meter hydrophone tow cable are supplied for the survey. The linear hydrophone array contains two broadband (200Hz to 200kHz), two low frequency hydrophone elements (2kHz to 200kHz) and a depth gauge (100m capacity) potted directly into the cable. The four hydrophones and their positions on the array cable are shown in Figure 1. A 100-meter deck cable connects the hydrophone tow cable from a winch on the port gun deck to the data processing unit located in the science lab.

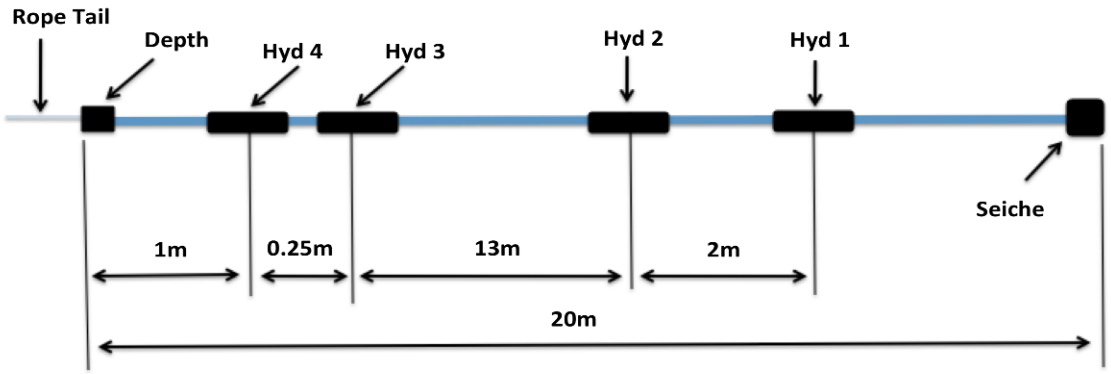

Figure 1. Diagram of the hydrophone array cable indicating the position and separation of the individual hydrophone elements.

The hydrophone array cable, connected to the tow cable, is spooled onto a port hydrolytic winch (Figure 2). The adjoined cables are deployed directly off the stern of the vessel, just aft of the winch. The hydrophone tow cable, with a looped rope attached via Chinese-fingers bound by tape, connects to a tow rope with shackle and this is the towing point of the PAM cable system (Figure 3; Left). The towrope is secured to a bitt aft of the winch and run through a chalk (Figure 3; Right) where it connects to the PAM cable.

To ensure a lower placement of the PAM cable in the water column then the adjacent gun cables, 2.5kg of weight is added to the cable.

Figure 2. PAM tow cable spooled onto the winch and running aft.

Figure 3. On the left is the PAM tow cable connecting to the towrope via shackle. Right shows PAM going over the stern bulkhead, the towrope tied off to the bitt and threaded through the chalk.

When deployed 65 meters of the PAM cable system is dispensed, (45 meters of tow cable and the 20 meter hydrophone cable). The gun array is placed 10 meters astern of the vessel, this places the separation between the end of the PAM hydrophone cable and the seismic array at 55 meters. The PAM cable is off set to port due to the deployment location.

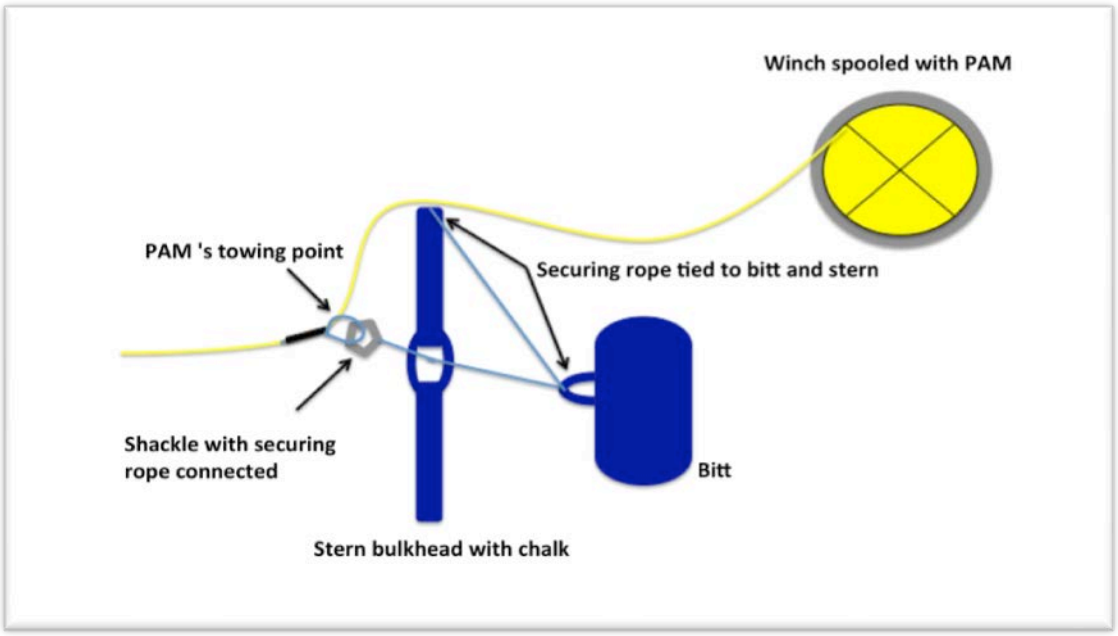

Figure 4. Diagram of PAM deployed off stern.

Pre-Deployment Tasks

The PAM data processing unit and monitors are setup and secured for rough weather in the main science lab (Figure 5). A GPS feed (GPGGA string) is supplied by the ships navigation system Seapath 200.

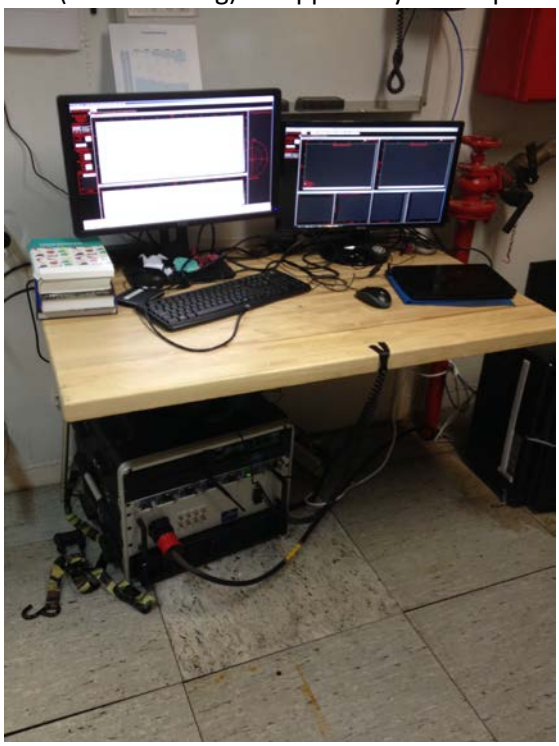

Figure 5. Passive acoustic monitoring station located in the instrument room.

The hydrophone tow cable is measured and marked in 5-meter increments for the first 75 meters from the hydrophone array-tow cables' connection point.

Prior to deployment a tap test is performed to the hydrophones and the depth gauge calibrated.

Deployment

- Ensure that the PAM electronics unit is powered down.
- Alert the bridge of pending hydrophone deployment.
- Ensure the deck cable is disconnected from the hydrophone tow cable.
- Power on winch.
- Payout 65m of the hydrophone cable from the winch, dispensing the cable into the water.
- Add a Zip-tie to secure the shackle from coming undone.
- Power off winch.
- Connect the deck cable to the hydrophone cable.
- Power up electronics in the instrument room.

Retrieval

- Power down electronics in the instrument room.
- Alert the bridge of pending hydrophone retrieval.
- Ensure the deck cable is disconnected from the hydrophone cable (tape both connectors to prevent corrosion).
- Disconnect cable from towing point shackle.
- Retrieve the hydrophone cable and wind evenly on winch, paying special attention to weighted sections.

Always ensure the deck cable is disconnected from the tow cable before operating the winch.

HSE

Normal working deck Personal Protective Equipment (PPE) is required (hard hat, boots, gloves, eye protection, and coveralls). A life vest is required for any work involving items going over the side.

The operation carries a relatively low risk. Hazards include working close to the side of the vessel, trip hazards, and pinch points at the winch, shackles, and collar.

A Job Safety Analysis (JSA) has been completed for this task. The JSA will also require further review upon any additional modifications.

APPENDIX E. SURVEY LINES ACQUIRED.

Survey Line	Date Acquisition Commenced	Time Acquisition Commenced	Date Acquisition Completed	Time Acquisition Completed
MGL14052860OL Seq001	03-Jul-14	11:13	03-Jul-14	16:22
MGL14051948OL Seq002	03-Jul-14	17:35	04-Jul-14	00:17
MGL14051012OL Seq003	04-Jul-14	01:40	04-Jul-14	08:11
MGL14051972OL Seq004	04-Jul-14	09:26	04-Jul-14	15:04
MGL14051870OL Seq005	07-Jul-14	23:15	08-Jul-14	06:13
MGL14052860OM Seq006	08-Jul-14	07:23	08-Jul-14	13:32
MGL14051948OM Seq007	08-Jul-14	14:47	08-Jul-14	21:07
MGL14052836OL Seq008	08-Jul-14	22:10	08-Jul-14	22:39

APPENDIX F. SUMMARY OF VISUAL DETECTIONS OF PROTECTED SPECIES DURING THE NEW JERSEY 3-D SEISMIC SURVEY.

Movement Codes: **TV**: towards vessel; **AV**: away from vessel; **PV/SD**: parallel vessel, same direction; **PV/OD**: parallel vessel, opposite direction; **PE (AH/BH):** perpendicular (crossing ahead or behind); **MI**: milling ; **SA**: stationary; **V:** variable, **UN**: unknown**; OM**: other movement

Behavioural Codes: **NS**: normal swimming; **FT**: fast travel; **ST**: slow travel; **PO**: porpoising; **SS**: swimming below surface; **MI**: milling: **BR**: bow/wake riding; **BA**: resting/basking at surface; **FL:** floating; **SA** :surface active (lob tailing/pectoral slapping, full/partial breaching)**; R:** rolling; **DI**: dive; **DF**: dive with fluke; **FF**: feeding/foraging; **SB**: social behaviour; **MT**: mating behaviour; **BV**: blow visible (whale); **SV**: only splashes visible (dolphins); **DV**: dorsal fin visible; **OB**: other behaviour

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
1	2-Jul	23:22	Risso's dolphin	1	39.23028°N 072.85693°W	Silent	PV/SD	MI NS	5 m / Silent	None	Deploying gear, acoustic source on board
2	3-Jul	13:10	Loggerhead sea turtle	1	39.56463°N 073.37078°W	Full volume	PV/OD	ST DI	40 m / Full volume	None	PSO error, mitigation shut down should have been implemented
3	3-Jul	13:57	Loggerhead sea turtle	1	39.53250°N 073.30917°W	Full volume	PV/SD	DI AV	35 m / Silent	Shut down	Acoustic source shut down to allow turtle to pass through safety radius
4	3-Jul	15:28	Unidentified shelled sea turtle	1	39.47262°N 073.19465°W	Full volume	AV	ST	70 m / Silent	Shut down	Acoustic source shut down to allow turtle to pass through safety radius
5	3-Jul	18:38	Unidentified shelled sea turtle	1	39.44658°N 073.26395°W	Full volume	AV	ST	40 m / Silent	Shut down	Acoustic source shut down to allow turtle to pass through safety radius
6	4-Jul	9:36	Loggerhead sea turtle	1	39.40433°N 073.18033°W	Full volume	MI	MI	40 m / Silent	Shut down	Acoustic source shut down to allow turtle to pass through safety radius
7	4-Jul	10:19	Loggerhead sea turtle	1	39.43372°N 073.23623°W	Full volume	PV/SD	ST	30 m / Silent	Shut down	Acoustic source shut down to allow turtle to pass through safety radius
8	5-Jul	10:31	Atlantic spotted dolphin	12	39.35985°N 073.54295°W	Silent	PV/SD	PO SA	30 m / Silent	None	Down for weather, acoustic source on board

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
9	5-Jul	13:51	Unidentified shelled sea turtle	1	39.58693°N 073.54302°W	Silent	AV	ST	90 m / Silent	None	Down for weather, acoustic source on board
10	5-Jul	15:45	Unidentified shelled sea turtle	1	39.53348°N 073.38490°W	Silent	SA	BA	80 m / Silent	None	Down for weather, acoustic source on board
11	5-Jul	16:56	Unidentified shelled sea turtle	1	39.48072°N 073.30898°W	Silent	PV/SD	SS	30 m / Silent	None	Deploying gear, acoustic source on board
12	5-Jul	18:13	Unidentified shelled sea turtle	1	39.42432°N 073.22610°W	Silent	AV	ST	40 m / Silent	None	Deploying gear, acoustic source on board
13	5-Jul	18:48	Unidentified shelled sea turtle	1	39.40075°N 073.18663°W	Silent	PV/SD	ST	55 m / Silent	None	Deploying gear, acoustic source on board
14	5-Jul	19:20	Unidentified shelled sea turtle	1	39.37907°N 073.15020°W	Silent	PV/OD	SS	40 m / Silent	None	Deploying gear, acoustic source on board
15	5-Jul	20:20	Unidentifiable dolphin	4	39.36183°N 073.06960°W	Silent	PV/OD	PO FT	690 m / Silent	None	Deploying gear, acoustic source on board
16	7-Jul	14:08	Loggerhead sea turtle	1	39.29652°N 073.32123°W	Silent	TV	BA	10 m / Silent	None	Deploying gear, acoustic source on board
17	7-Jul	14:41	Loggerhead sea turtle	1	39.27783°N 073.28483°W	Silent	PV/OD	ST	50 m / Silent	None	Deploying gear, acoustic source on board
18	7-Jul	19:25	Short-beaked common dolphin	10	39.10075°N 072.92503°W	Silent	PE/AH	PO FT	1000 m / Silent	None	Deploying gear, acoustic source on board
19	7-Jul	21:24	Unidentified baleen whale	1	39.04317°N 072.91683°W	Silent	PE/BH	BV DV	1200 m / Silent	None	Either fin or sei whale. Acoustic source on board
20	8-Jul	17:43	Loggerhead sea turtle	1	39.29782°N 073.10935°W	Silent	PV/SD	ST DI	65 m / Silent	None	Acoustic source on board

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
21	8-Jul	18:46	Unidentified shelled sea turtle	1	39.38490°N 073.10603°W	Silent	TV	ST DI	85 m / Silent	None	Acoustic source on board
22	8-Jul	18:57	Unidentified shelled sea turtle	1	39.39838°N 073.10293°W	Silent	MI	MI	35 m / Silent	None	Acoustic source on board
23	8-Jul	19:58	Loggerhead sea turtle	1	39.41705°N 073.00200°W	Mitigation source	PV/OD	ST	360 m / Mitigation source	None	Animal observed within the predicted 166 dB zone
24	8-Jul	13:50	Unidentified shelled sea turtle	1	39.41742°N 073.10160°W	Full volume	MI	SS	60 m / Silent	Shut down	Animal within the predicted 177 dB zone
25	8-Jul	14:49	Loggerhead sea turtle	1	39.39692°N 073.16845°W	Full volume	TV	ST	60 m / Silent	Shut down	Animal within the predicted 177 dB zone
26	8-Jul	15:12	Loggerhead sea turtle	1	39.41120°N 073.19648°W	Full volume	PV/SD	ST	50 m / Silent	Shut down	Animal within the predicted 177 dB zone
27	8-Jul	15:23	Loggerhead sea turtle	1	39.41797°N 073.20970°W	Full volume	AV	DI	60 m / Silent	Shut down	Animal within the predicted 177 dB zone
28	8-Jul	18:48	Loggerhead sea turtle	1	39.56350°N 073.48853°W	Full volume	AV	DI	20 m / Silent	Shut down	Animal within the predicted 177 dB zone
29	8-Jul	19:11	Loggerhead sea turtle	1	39.58063°N 073.52145°W	Full volume	PV/SD	SS ST	50 m / Silent	Shut down	Animal within the predicted 177 dB zone
30	8-Jul	22:40	Unidentified shelled sea turtle	1	39.67733°N 073.59000°W	Silent	TV	DI PV/OD	50 m / Silent	None	Retrieving acoustic source
31	9-Jul	09:51	Unidentified dolphin	2	39.14283°N 072.61950°W	Silent	PE/BH	FT	400 m / Silent	None	Acoustic source on board
32	9-Jul	10:46	Common bottlenose dolphin	10	39.06717°N 072.58417°W	Silent	V	FT	50 m / Silent	None	Acoustic source on board

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
33	21-Jul	11:13	Short-beaked common dolphin	16	39.38885°N 073.10592°W	Silent	TV	NS, SA	30 m / Silent	None	Deploying gear, acoustic source on board
34	22-Jul	09:35	Unidentifiable dolphin	3	39.39498°N 073.26237°W	Silent	PV/OD	ST	400 m / Silent	None	Deploying gear, acoustic source on board
35	22-Jul	12:34	Unidentifiable shelled sea turtle	1	39.41083°N 073.07220°W	Silent	PV/SD	BA	70 m / Silent	None	Deploying gear, acoustic source on board
36	22-Jul	13:02	Loggerhead sea turtle	1	39.39733°N 073.04117°W	Silent	PV/OD	MI	50 m / Silent	None	Deploying gear, acoustic source on board
37	22-Jul	13:45	Loggerhead sea turtle	1	39.37467°N 072.99217°W	Silent	PV/SD	ST	60 m / Silent	None	Retrieving gear, acoustic source on board
38	22-Jul	13:50	Short-beaked common dolphin	15	39.37177°N 072.98558°W	Silent	TV	NS	5 m / Silent	None	Retrieving gear, acoustic source on board
39	22-Jul	14:33	Short-beaked common dolphin	4	39.34800°N 072.93550°W	Silent	PV/OD	PO FT	400 m / Silent	None	Retrieving gear, acoustic source on board
40	22-Jul	20:39	Loggerhead sea turtle	1	39.31600°N 073.03985°W	Silent	AV	ST	110 m / Silent	None	Retrieving gear, acoustic source on board
41	23-Jul	10:21	Humpback whale	1	40.51358°N 073.97370°W	Silent	TV	BV DV	500 m / Silent	None	Vessel in transit

APPENDIX G. SPECIES OF BIRDS AND OTHER WILDLIFE OBSERVED DURING THE NEW JERSEY 3-D SEISMIC SURVEY.

Common Name	Family	Genus	Species	Approximate Number of Individuals Observed	Approximate Number of Days Species Was Observed
Barn Swallow	Hirundinidae	*Hirundo*	*rustica*	2	1
Greater Shearwater	Procellariidae	*Puffinus*	*gravis*	27	10
Laughing Gull	Laridae	*Larus*	*atricilla*	24	8
Herring Gull	Laridae	*Larus*	*argentatus*	31	5
Brown-headed Cowbird	Isteridae	*Molothrus*	*ater*	3	6
Double-crested Cormorant	Phalacrocoracidae	*Phalacrocorax*	*auritus*	57	3
Royal Tern	Sternidae	*Thallaseus*	*maximus*	4	3
Common Tern	Sternidae	*Sterna*	*hirundo*	2	1
UID Cormorant	Phalacrocoracidae	-	-	30+	1
UID Gull	Laridae	-	-	51+	4
UID Tern	Sternidae	-	-	2	2
Sunfish	Centrarchidae	*Mola*	*mola*	9	5
Flying Fish	Exocoetidae	-	-	29	5
UID Shark	-	-	-	2	2