Protected Species Mitigation and Monitoring Report

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

01 June 2015 –06 July 2015.

R/V *Marcus G. Langseth*

Prepared for

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for submission to

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1. EXECUTIVE SUMMARY

The U.S. National Science Foundation (NSF) owned research vessel (R/V) *Marcus G. Langseth* (*Langseth*), operated under an existing Cooperative agreement by Columbia University's Lamont-Doherty Earth Observatory (L-DEO), conducted a 3-D seismic survey in the Atlantic Ocean approximately 25 to 85 kilometers (13.5 to 35.9 nautical miles) off the coast of New Jersey (NJ). The operational activities were in support of a research survey led by the State University of NJ at Rutgers (Rutgers) with funding from NSF. The purpose of the survey was to collect and analyze data on the arrangement of sediments beneath the NJ coast, which contain a long record of shoreline response to the sea-level changes as far back as 60 million years ago. The three dimensional (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 survey had previously been attempted in July 2014; however, mechanical issues with the R/V *Langseth* caused the project to be suspended. This second attempt on the survey began on 1 June 2015, and was completed on 6 July 2015.

This report serves to comply with the reporting obligations required pursuant to the Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA) for the survey. 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 small numbers of marine mammals during the marine geophysical survey. On 7 May 2015 an IHA and Incidental Take Statement (ITS) were issued by NMFS. In addition, NMFS issued its Final EA and Finding of No Significant Impact (FONSI) for this project. U.S. Fish and Wildlife Service (USFWS) issued a Letter of concurrence (LOC) that confirmed the proposed actions may affect, but were not likely to adversely affect, the roseate tern or piping plover. Mitigation measures were implemented to minimize potential impacts to marine mammals, endangered or threatened sea turtles and sea birds during 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, the establishment of safety radii, and the implementation of ramp-up, power-down and shut-down procedures.

Continuous protected species observation coverage during the survey was provided by RPS, the environmental consulting agency contracted by L-DEO for the project. Pursuant to the contract, PSOs monitored and reported on the presence and behavior of marine species, and directed the implementation of the mitigation measures as described in the NSF Final Amended Environmental Assessment (EA) 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 Amended EA tiered. Four PSOs and one Passive Acoustic Monitoring (PAM) operator were present on board the R/V *Langseth* throughout the survey.

Over the course of the survey, PSOs conducted visual observations for a total of 553 hours 34 minutes and acoustic monitoring for 676 hours and 18 minutes. The acoustic source was active for a total of 701 hours 24 minutes during the survey. A total of 436 hours 37 minutes (79%) of visual monitoring occurred

while the acoustic source was active (Table 3) and a total of 663 hours 27 minutes (98%) of acoustic monitoring occurred while the acoustic source was active (Table 4).

There were a total of 107 protected species detection events during the survey, including 96 resulting from visual observation efforts, seven resulting from acoustic monitoring efforts, and four resulting from simultaneous visual and acoustic efforts. Visually there were 34 detections of whales, nine detections of dolphins and 53 detections of sea turtles. Thirteen of the whale detections were positively identified as fin whales (*Balaenoptera physalus*), three were positively identified as humpback whales (*Megaptera novaeangliae*), and 18 were unidentified. Two of the dolphin detections were positively identified as short-beaked common dolphins (*Delphinus delphis*) and seven were unidentified. Thirty-seven of the turtle detections were identified as loggerhead sea turtles (*Caretta caretta*) and 16 were unidentified. Two of the visual detections were comprised of multiple species, including one consisting of fin whales and unidentified whales, and one consisting of fin whales and unidentified dolphins. All of the acoustic detections consisted of unidentified dolphins. One of the simultaneous visual and acoustic detections consisted of short-beaked common dolphins, while the other three were of unidentified dolphins.

Protected species detections resulted in the implementation of 53 mitigation actions throughout the survey. This included 48 power-downs, four shut-downs and one delayed ramp-up. Overall, there was eight hours 33 minutes of downtime attributed to protected species mitigation actions.

A total of 20,926 animals, 20,686 marine mammals (including 79 whales listed as endangered species) and 240 endangered sea turtles, were authorized for takes in the IHA and ITS issued by NMFS. During the survey, a total of 246 protected species were observed to be exposed to source levels greater than or equal to 160 decibels. This included 18 unidentified whales, 13 fin whales, two humpback whales, 108 unidentified dolphins, 50 short-beaked common dolphins, 15 unidentified sea turtles and 40 loggerhead sea turtles. Of these species, fin whales, humpback whales and loggerhead sea turtles are listed as endangered species.

On 11 June 2014, protected species takes for both fin whales and short-beaked common dolphins had reached the total number of takes allowed by the IHA issued on 7 May 2015 (three takes and 36 takes respectively). In response, additional mitigation measures were implemented for those two species, including powering down the source anytime either species was positively identified near or within the predicted 160 decibels (dB) re 1 µPa zone for the full volume source (5,240 meters) and then shutting down the source if the whales or dolphins then came near or within the predicted 160 dB re 1 µPa zone for the mitigation source (955 meters). If the individuals were initially observed within the smaller 160 dB re 1 µPa zone, the source would be immediately shut down. Though these additional mitigation measures were implemented several times from 12 June through the 23 June 2015, an additional six fin whales and 15 short-beaked common dolphins were observed to be within the predicted 160 dB re 1 µPa zone around the sound source and therefore potentially exposed to received sound levels equal to or greater than 160 dB re 1 µPa.

On 23 June 2015, a modified IHA was issued to NSF and L-DEO which authorized an additional 33 takes of fin whales (36 takes total), and an additional 2,077 takes of short-beaked common dolphins (2,113 takes total). . Upon the issuance of the modified IHA, the additional mitigation measures described above, that had been put into place for these two species when initial take numbers had been reached, were discontinued.

A project summary sheet of observation, detection, and operational totals for the *Langseth* can be found in Appendix B.

2. INTRODUCTION

The following report details protected species monitoring and mitigation measures as well as seismic survey operations undertaken as part of the 3-D marine geophysical survey on board the R/V *Langseth* from 1 June to 6 July 2014 in the Atlantic Ocean off the coast of NJ (referred to herein as "NJ survey" or "survey"). This document serves to meet the reporting requirements dictated in the IHA and ITS issued to L-DEO by NMFS on 7 May 2015. The IHA authorized "takes", in the form of Level B harassment, of specific marine mammals, incidental to a marine seismic survey. NMFS has stated that seismic source received sound levels greater than 160 dB re 1 µPa (root mean square (rms)) could potentially disturb marine mammals, temporarily disrupting behavior, such that they could be considered 'takes'. Potential consequences of Level B harassment could include effects such as temporary hearing threshold shifts, behavior modification and other reactions. To avoid exposing cetaceans and sea turtles to higher sound levels, where permanent hearing threshold shifts might occur, a safety or exclusion zone (EZ) 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. It is unknown to what extent cetaceans exposed to seismic noise of either 160 or 180 dB re 1 µPa (rms) level would express these effects, and in order to take a precautionary approach, NMFS required that provisions such as EZ, power-downs and shut-downs be implemented to mitigate for these potentially adverse effects. Although the ITS did not define reporting requirements for sea turtles, monitoring and mitigation information for sea turtles has been included in this report.

USFWS issued a Letter of Concurrence 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

The survey was conducted in the northwest Atlantic Ocean between 39.3° to 39.7° North and 73.2° to 73.8° West, approximately 25 to 85 kilometers (15.5 to 52.8 miles) off the coast of NJ (Figure 1). The location of the survey is outside of NJ state waters, but within the United States (U.S.) Exclusive Economic Zone (EEZ) in federal waters. Water depths in this area range from approximately 25 to 75 meters (m) (98.4 to 246 feet).

The purpose of this 3-D study 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 present, illuminating features such as river valleys cut into coastal plain sediments, now buried under a kilometer of younger sediment and flooded by todays ocean, which cannot be resolved using two dimension (2-D) seismic data. To achieve these goals, the lead Principal Investigators (PI), Dr. G. Mountain, and Co-PIs Drs. M. Nedimovic, J. Austin and C. Fulthorpe proposed to (1) map sequences around existing International Ocean Drilling Program (IODP) Expedition 313 drill sites using 3-D 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; 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* deployed one array of four airguns towed at a depth of 4.5 meters as an energy source during the survey. The receiving system consisted of one 3000 meter long Sentry Solid Streamer conventional hydrophone streamer and 24 P-cable hydrophone streamers, each with a length of 50 meters and separated by 12.5 meters. As the airgun array was towed along the survey lines, the hydrophone streamers received the returning acoustic signals and transferred the data to the onboard processing system. The dual receiving system allowed for the collection of both two dimensional (2-D) and 3-D data simultaneously.

Seventy-eight transect lines totaling approximately 4,900 kilometers (2,646 nautical miles) were surveyed during the project. The distance between lines was 150 meters (492 feet). The R/V *Langseth*'s cruising speed was about 10 to 12 knots during transits and varied between 3 and 5 knots during the seismic survey. Seismic acquisition began on 1 June 2015 and was completed on 6 July 2015.

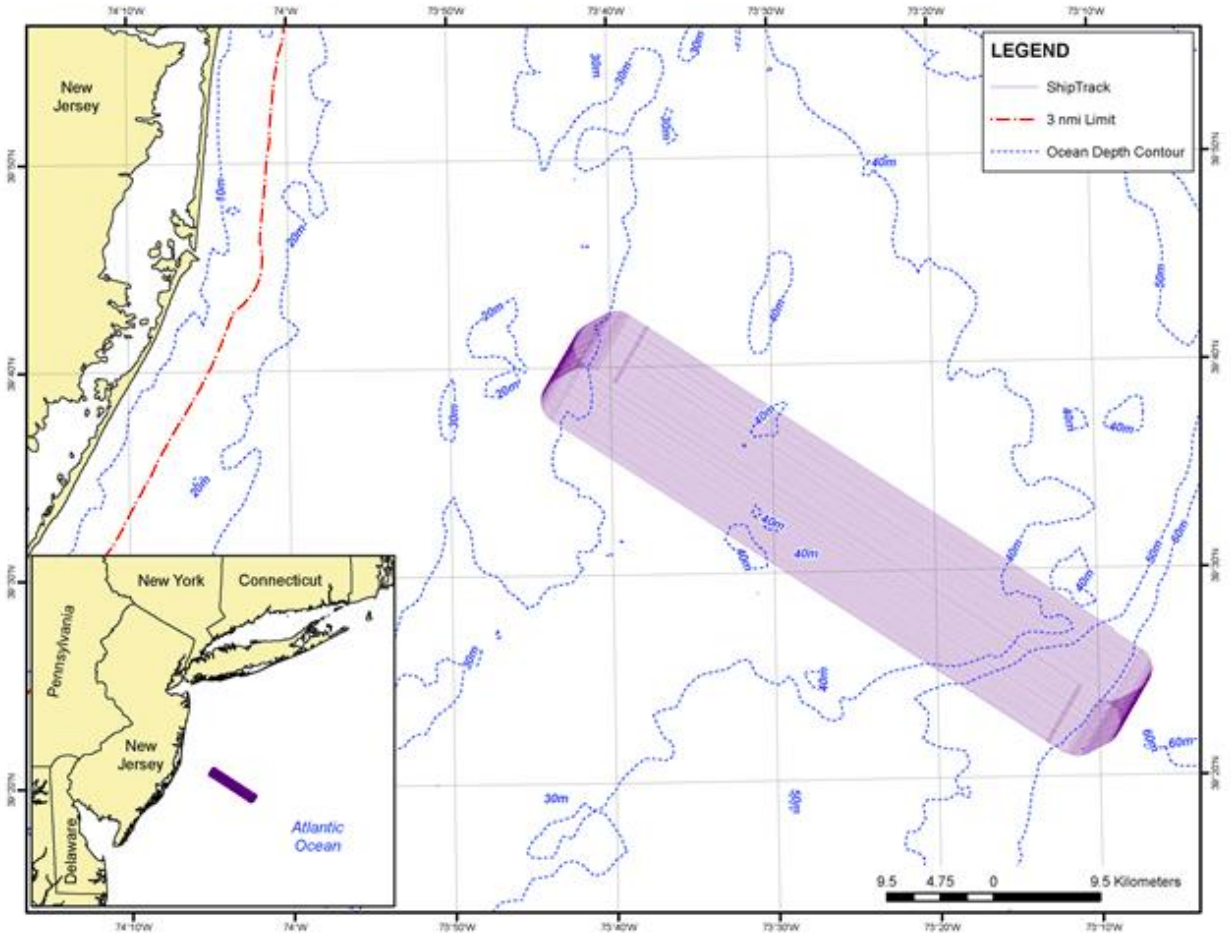

Figure 1. Location and survey lines of the NJ Survey in the Atlantic Ocean

2.1.1. Energy Source

The energy source consisted of one towed airgun sub-array with four airgun elements deployed just aft of the vessel. The airguns were towed at a depth of 4.5 meters (14.8 feet) and were situated 300 meters from the Navigational Reference Point (NRP), which was located on the PSO observation tower.

The source array utilized a mixture of Bolt 1500LL and Bolt 1900LLX airguns ranging in size from 40 to 220 cubic inches (in^3), with an operating pressure of 1,950 pounds per square inch. The dominant frequency components ranged from zero to 188 Hertz (Hz) and nominal source levels of the airgun sub-array ranged from 246 to 253 dB re: 1 µPa (peak-to-peak). The total volume of the sub-array was 700 cubic inches. In this configuration, the source volume would not exceed 700 in^3 (*i.e.*, the four-string sub-array) at any time during acquisition.

The shot point interval for the survey was approximately 5.4 seconds (12.5 meters; 41 feet). During acquisition the airguns would emit a brief (approximately 0.1 second) pulse of sound. During the intervening periods of operations, the airguns would be silent. The receiving system consisted of a single 3,000 meter (1.9 mile) hydrophone streamer and a P-cable system. The Geometrics GeoEel P-cable system consisted of 24, 50 meter long hydrophone cables that were spaced 12.5 meters apart. As the airgun sub-array was towed along the survey lines, the hydrophone streamers received the returning acoustic signals and transferred the data to an on board processing system. Due to the length and placement of the cables, the maneuverability of the vessel was limited to turns of an average of five degrees per minute while the gear was being towed. On 29 June 2015, the single hydrophone streamer was brought on board and the remainder of the survey was conducted with the P-cable system only.

During times when the source array was brought on board for maintenance or repair, a single mitigation gun with a total volume of 40 in^3 was lowered and operated off the stern of the vessel approximately one meter aft via a boom on the gun deck and towed at a depth of 4.5 meters.

Additional sound sources included a Kongsberg EM 122 multibeam echosounder (MBES) which was in use throughout most of the survey operations, to map characteristics of the ocean floor. The hull-mounted echosounder emitted brief pulses of sound (also called pings) (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* did not operate the multibeam echosounder during transits to and from the survey area (*i.e.*, when the airguns were not operating).

The R/V *Langseth* also operated a Knudsen Chirp 3260 sub-bottom profiler (SBP) concurrently during airgun and echosounder operations to provide information about 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 Amended 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 is designed to minimize potential impacts of the R/V *Langseth*'s seismic program on marine turtles, marine mammals, and other protected species of interest. The following monitoring protocols were followed to meet these objectives.

- Visual observations were conducted 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 sea 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 Amended EA, USFWS LOC, and the 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 Amended EA, USFWS LOC, and the IHA and ITS. The PSOs on board were NMFS approved and held certifications from a recognized Bureau of Ocean Energy Management (BOEM) course and/or approved Joint Nature Conservation Committee (JNCC) 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° viewpoint around the acoustic source.

Figure 2. Protected Species Observer observation tower with mounted big-eye binoculars, as seen from the

stern of the vessel

The PSO tower was equipped with Fujinon 7x50 binoculars as well as two mounted 25x150 Big-eye binoculars. A D-300 Night Vision Monocular was also available during this survey for ramp-ups conducted during the night. Inside the tarpaulin 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. Environmental conditions along with vessel and acoustic source activity were recorded at least once an hour, and every time there was a change of one or more of the variables. Most observations were held from the tower; however, during severe weather or when the ships exhaust was blowing on the tower, observations would be performed from the bridge (approximately 12.8 meters above sea level) or the catwalk (approximately 12.3 meters above sea level) in front of the bridge.

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 during daylight periods while airguns operated and whenever the vessel was underway when the airguns were 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 09:00 to 09:30 Coordinated Universal Time (UTC) (05:00 to 05:30 local time), while end of observation times ranged from 00:30 to 01:00 UTC (20:30 to 21:00 local time).

A visual monitoring schedule was established by the PSOs where each person completed visual watches of varying lengths between one to four hours, two to four times a day, for a total of four to eight 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 maintain a solo watch so that the entire team could eat while maintaining both visual and acoustic monitoring. Solo watches lasted less than 50 minutes and occurred each day at meal times. As noted previously, two PSOs were always on watch during ramp-ups of the source.

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 animals range to the acoustic source while identifying the observed animal (cetacean, pinniped, or sea turtle) to determine which predicted safety radius applied to the animal. 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 300 meters astern of the PSO tower. The 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 predicted safety radius. If the animal was observed inside the predicted safety radius and a mitigation

action was necessary, the PAM operator would relay the message to the seismic technician who was stationed nearby.

Power-downs of the source were implemented whenever an animal was observed inside the predicted safety radius of the full volume or partial volume source where-by the number of operating airguns was reduced to a single operating 40 cubic inch airgun. This would reduce the predicted safety radius such that the animal(s) was now outside of that zone. If the animal was then observed entering or approaching the smaller predicted safety radius for the single airgun, that airgun would then be turned off. This mitigation action is hereafter referred to as a shut-down of the source.

Table 1 describes the various predicted safety radii applied to cetaceans/sea turtles and pinnipeds, as well as what constituted the Level B harassment zone. The PAM operator was also notified of all marine mammal sightings as soon as possible in order for recordings to be made for analysis later by one of the more experienced acoustic operators to determine whether vocalizations had been detected on the PAM system during the sighting.

Table 1. Predicted Mitigation radii/Zones Implemented

Source and Volume	Array Tow Depth (m)	Water Depth (m)	Power/Shut-down EZ for Pinnipeds 190 dB (m)	Power/Shut-down EZ for Cetaceans / Sea turtles 180 dB (m)	Level-B Harassment Zone 160 dB (cetaceans) / 166 dB (sea turtles) (m)
Single Source element (40 in^3)	4.5	<100	21	73	995
4-Airgun subarray (700 in^3)	4.5	<100	101	378	5240

PSOs recorded the following information for each protected species detection:

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

II. Time, location, heading, speed, activity of the vessel (including number of source elements operating and whether in state of ramp-up or power-down), Beaufort Sea state and wind speed, visibility, and sun glare.

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 and vessel activity are available for each sighting event.

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, through the big-eyes and reticule binoculars and noted behavior of the animal or group. Photographs were taken during most sightings, although in some cases photographs were not taken due to the brevity of a

sighting. The camera used was a Canon EOS 60D with a 300-millimeter telephoto lens. Marine mammal identification manuals were consulted and photos were examined during observation breaks to confirm identifications.

3.2. PASSIVE ACOUSTIC MONITORING SURVEY METHODOLOGY

PAM was used to augment visual monitoring efforts by helping to detect, identify, and locate marine mammals within the area. PAM was not used as an exclusive method to detect and mitigate for marine mammals; any detections originating from PAM monitoring were confirmed by visual monitoring to prompt a mitigation action. PAM was particularly beneficial during periods of darkness or low visibility when visual monitoring was not as effective. The PAM system was monitored 24-hours per day during seismic operations and when the acoustic source was not in operation, to the maximum extent possible.

Five PSOs were on-board to provide monitoring for protected species. One PSO was designated as the Primary PAM Operator who oversaw PAM operations. Four of the five PSOs, the Primary PAM Operator and three others, were trained and experienced with the use of PAM prior to the survey. The Primary PAM Operator trained the inexperienced PSO in basic PAM system operation at the beginning of the survey.

All five PSOs rotated through acoustic monitoring shifts, which were two to five hours in duration. The Primary PAM Operator monitored most of the night time hours when visual monitoring was not being conducted and PAM was the only system in use for detecting cetaceans. For an acoustic detection during the nighttime, the PAM operator was to notify an on-call PSO to visually monitor for protected species and request mitigation, if necessary. During daylight hours, PAM operators were in communication with visual PSOs to relay sighting and seismic activity information.

The PAM system was located in the main science lab to provide adequate space for the system, allow for quick communication with the visual PSOs and seismic technicians, and provide access to the vessel's instrumentation. The vessel's position, water depth, heading and speed, vessel and acoustic source activity were recorded at least once an hour.

In the event of an acoustic detection of a protected species, the PAM operator was to record the following information: acoustic encounter identification number; whether it was linked with a visual sighting; date; time when first detected, last detected, and when additional information was recorded; position and water depth when first detected; bearing, if determinable; species or species group; types and nature of sounds heard (e. g., clicks, continuous, sporadic, whistles, creaks, burst pulses, strength of signal, etc.); and any other notable information.

Acoustic monitoring for marine mammals was conducted aurally using Sennheiser headphones, listening to lower audible frequencies from the Asio Fireface soundcard, and visually with Pamguard Beta 1.12.05. Delphinid whistles, clicks, and burst pulses as well as sperm whale and baleen whale vocalizations were viewed on a spectrogram display within Pamguard. Sperm whale, beaked whale, Kogia species, and delphinid echolocation clicks were 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.

The map module within Pamguard could be monitored when vocalizations were detected to localize the position and distance to vocalizing marine mammals, when possible. When Pamguard could not determine the distance to a vocalizing animal, the experienced PAM operator could make a distance estimation using the noise or detection score system developed by Gannier et al. (2002). Sound

recordings could be made using the sound recording module when potential marine mammal vocalizations were detected or when the operator noted unknown or unusual sound sources.

3.2.1. Passive Acoustic Monitoring Parameters

A Passive Acoustic Monitoring (PAM) system designed to detect most species of marine mammals was installed on board the R/V *Langseth*. The system was developed by Seiche Measurements Limited and consisted of seven main components: 250 meter hydrophone cable, 100 meter deck cable, data processing unit, two laptop computers, acoustic analysis software package, and headphones for aural monitoring. A spare hydrophone array cable, deck cable, and Data Processing Unit (DPU) were also present on board in the event the main array became damaged or inoperable. PAM system specifications can be found in Appendix C.

The hydrophone cable contained four hydrophone elements and a depth gauge molded into a 20 m section of the cable. The four-element linear hydrophone array allowed the system to sample a large range of marine mammal vocalization frequencies. The first two hydrophones were low frequency channels, with a frequency response of 200 hertz to 200 kilohertz. The third and fourth hydrophones were standard elements, with a frequency response of two kilohertz to 200 kilohertz.

The deck cable interfaced the hydrophone array and the data processing unit. The data processing unit was set up in the main lab, along with two laptop computers. The electronic data processing unit contained a buffer processing unit with Universal Serial Base (USB) output and an RME Fireface 800 ADC processing unit with firewire output. One of the laptops displayed the high frequency range (HF system), using the signal from two hydrophones and the second laptop displayed the low frequency range (LF system), receiving signal from all four hydrophones. A Global Positioning System (GPS) feed of GNGGA strings was supplied from the ship's Seapath navigation system and routed to the LF system, reading data every 20 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 120 kilohertz to 150 kilohertz with a high pass digital pre-filter set at 40 kilohertz (Butterworth 6th order). Pamguard used 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 displayed the detected clicks within the HF system envelope band pass filter in real time, allowing for 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 three kilohertz and 24 kilohertz. The LF system used four hydrophones; the signal was interfaced via a firewire cable to the LF system laptop, where it was digitized at 48 kilohertz per channel. The LF system 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 computer via serial USB 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 also monitored the hydrophone signals aurally using headphones.

3.2.2. Hydrophone Deployment

The PAM hydrophone cable was deployed from a winch on the port stern deckhead of the vessel's gun deck. Two deck cables, a main cable and a spare, were installed along the gun deck deckhead running from the winch to the science lab. The hydrophone array was towed 130 meters from the stern and 141 meters forward of the source array (Figure 3).

Details of the PAM system specifications can be found in Appendix D. A more detailed description of the hydrophone deployment methods and photos of the equipment can be found in Appendix E.

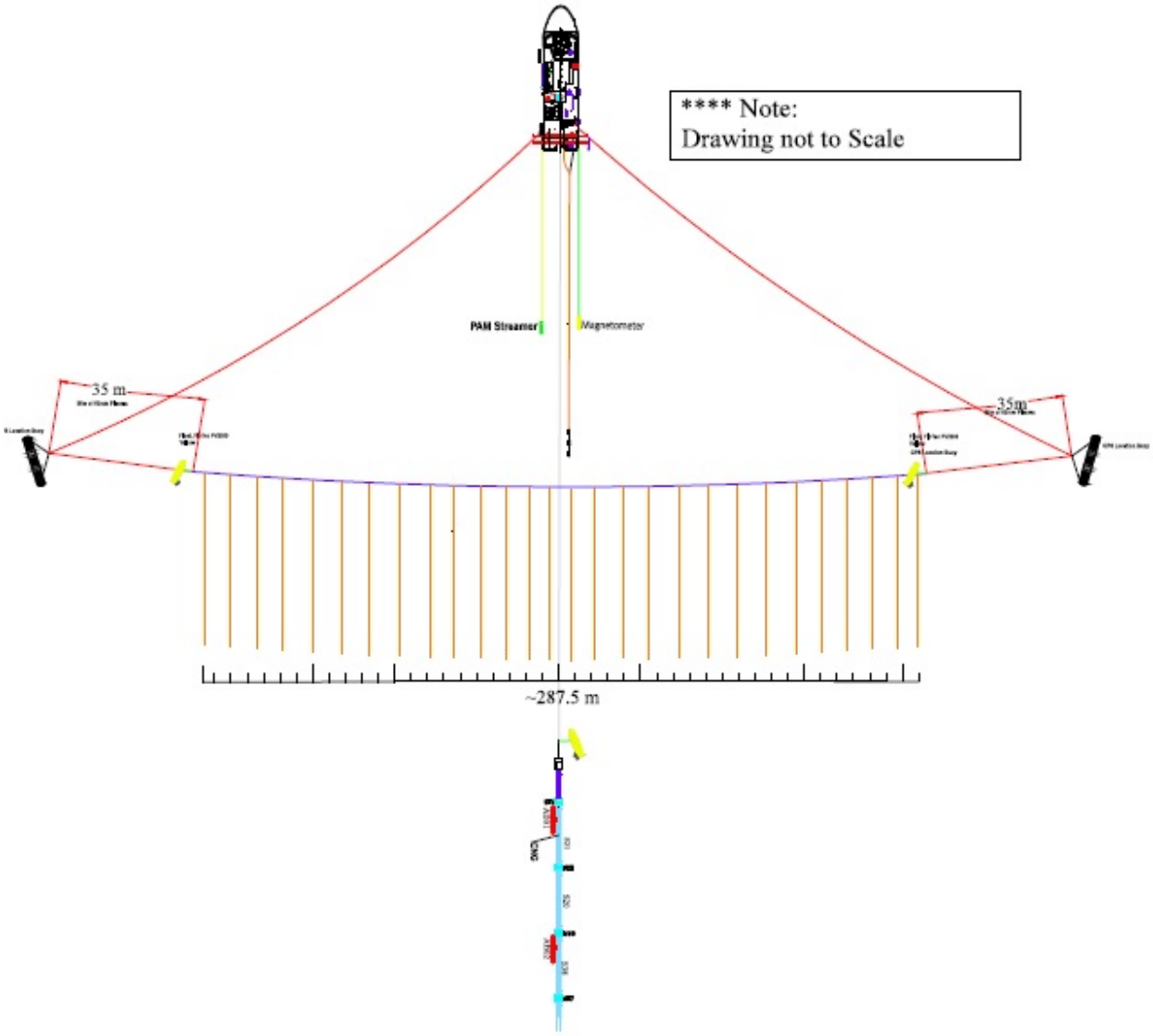

Figure 3. Location of the PAM cable in relation to the seismic gear

4. MONITORING EFFORT SUMMARY

4.1. SURVEY OPERATIONS SUMMARY

The R/V *Langseth* departed the State University of New York (SUNY) Maritime College dock in Throgs Neck, New York at 12:50 UTC on 1 June 2015 and began transit to the survey site. The PSOs began visual monitoring immediately upon departure and while in transit to the survey site to collect baseline data about protected species abundance in the area. Gear deployment began at 07:04 UTC on 2 June 2015 and was completed at 19:40 UTC. A single gun test was performed from 19:40 to 19:44 UTC and the acoustic source was ramped up for the first time from 19:44 to 20:15 UTC. Acquisition of the first survey line began at 20:22 UTC. The dates and times of acquisition for each survey line can be found in Appendix E. After the final survey line was competed at 08:44 UTC on 6 July 2015, the R/V *Langseth* retrieved all gear and transited back to the SUNY Maritime College dock in Throgs Neck, New York, arriving at 22:34 UTC on 6 July 2015.

The acoustic source was active for a total of 701 hours 24 minutes throughout the project. This includes ramp-up of the airguns, full power during both online and line changes, and operation of a single 40 in³ mitigation airgun (Figure 4). The mitigation source was utilized during mechanical/technical maintenance of the acoustic source, as well as during mitigation power downs for protected species, and was active for 31 hours 26 minutes during the survey. Full power source operations, while online, accounted for 80% (563 hours 38 minutes) of airgun activity during the project. Line changes were mostly shot at full power, totaling 99 hours 3 minutes of array activity.

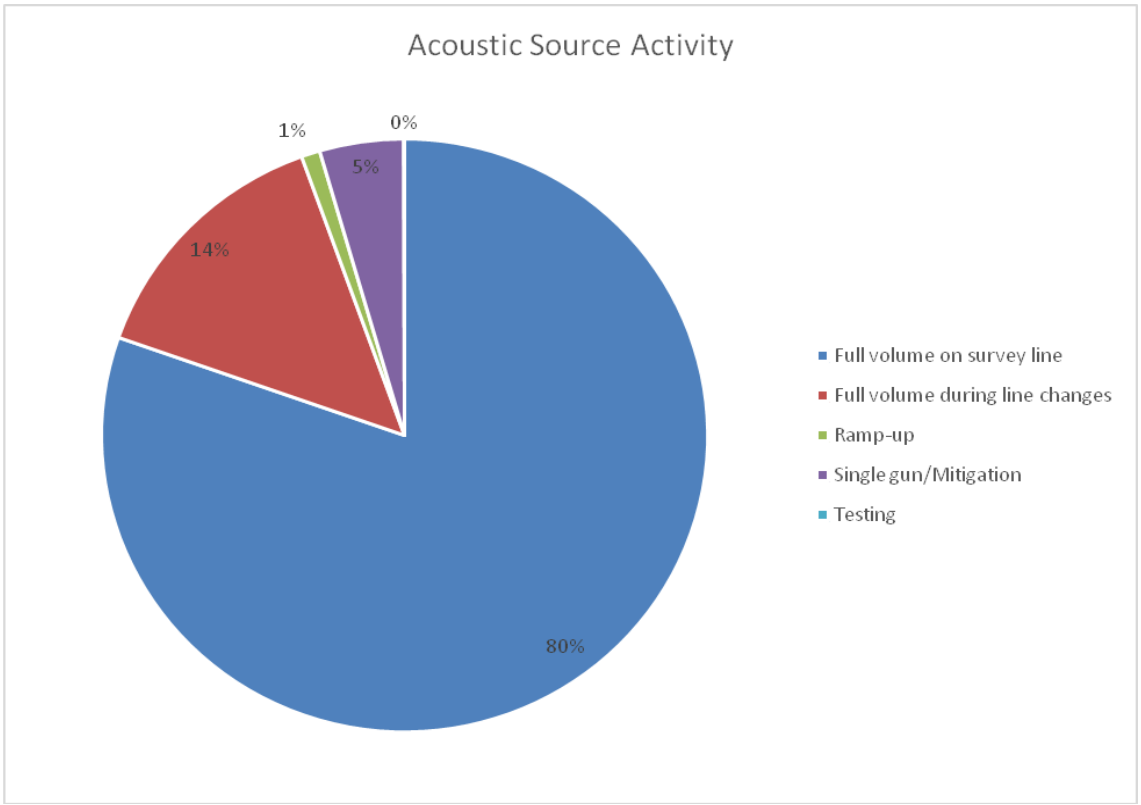

Figure 4. Total acoustic source operations over the course of the NJ survey

The acoustic source was ramped-up 14 times over the course of the survey in order to commence full power survey operations (Table 2). Duration of ramp-ups ranged from 27 minutes to 31 minutes. Ramp-ups were conducted using the NMFS approved automated gun controller program, DigiShot, which added guns sequentially to achieve the full source over the required period of time. The ramp-ups were performed by cycling each gun 23 times at a shot point interval of 20 seconds, adding an additional source after each cycle, resulting in an approximately 30--minute ramp-up when all four sources were active.

Table 2. Total acoustic source operations during the NJ survey

Acoustic Source Operations	Number	Duration (hh:mm)
Source Tests	**4**	**00:18**
Ramp-up	**14**	**06:59**
Day time ramp-ups from source silence	**8**	**03:57**
Day time ramp-ups from mitigation source	**4**	**02:02**
Night time ramp-ups from mitigation source	**2**	**01:00**
Full volume survey acquisition		**563:38**
Full volume line changes		**99:03**
Single source element (40 in³)		**31:26**
Total time acoustic source was active		**701:24**

There was a single instance of source volume reduction during the survey which occurred on 16 June 2015. On this date, the source volume was initially reduced from 700 in^3 to 620 in^3 at 02:33 UTC due to issues with the guns, although four guns remained active. The volume was reduced again from 620 in^3 to 540 in^3 at 02:40 UTC with only three guns active. The mitigation gun was turned on at 02:47 UTC while the source array was brought on board for maintenance and full volume resumed at 04:02 UTC for the remainder of the survey line.

There were several occasions throughout the survey where the source was silenced for gear maintenance or repair. On 3 June 2015 at 10:16 UTC, the source was silenced at the end of the survey line and the majority of the seismic gear and the PAM cable were brought on board so that adjustments could be made to the streamer. On 4 June 2015, the line was stopped early and the source silenced at 04:51 UTC due to GPS failure on the port paravane. On 6 June 2015 the source was silenced at 05:58 UTC during a line change so the source array could be retrieved for maintenance. On 8 June 2015, the source was silenced and the line ended early at 07:52 UTC due to problems with the p-cable. Full volume briefly resumed from 07:54 to 08:12 UTC, but the source was again fully silenced and the array brought on board along with the PAM cable for maintenance of the p-cable. On 11 June 2015, the source was silenced at 09:01 UTC at the end of the line and brought on board along with the PAM cable for maintenance on the p-cable. On 18 June 2015 the survey line was terminated early and the source was silenced at 22:31 UTC and again at 22:52 due to technical issues with the p-cable. On 19 June 2015 the line was ended early and the source was silenced at 22:25 UTC again due to problems with the p-cable.

The mitigation gun was utilized on 12 occasions, during gear maintenance or for technical issues with the compressor an during mitigation power-downs of the source. These times were 11:27 to 12:30 UTC on 7 June 2015, from 22:56 to 22:58 UTC on 9 June and then again from 23:54 UTC to 00:06 UTC on 10 June, from 03:46 to 04:58 UTC, 08:04 to 08:16 UTC, and 12:19 to 13:05 UTC on 12 June 2015, from 22:34 to 22:52 UTC on 18 June 2015, from 00:33 to 02:35 UTC on 19 June 2015, from 00:45 to 03:11 UTC on 20

June, from 20:04 to 21:03 UTC on 21 June 2015, from 09:16 to 10:26 UTC on 24 June 2015 and from 07:33 to 08:35 UTC on 26 June 2015.

In addition to the initial testing of the source on the first day of the project, the array was tested on three more occasions throughout the survey. On each of these occasions, each of the four guns in the sub-array was fired once. These times were from 18:30 to 18:36 UTC on 3 June 2015, from 15:36 to 15:38 on 4 June 2015 and from 18:21 to 18:27 on 8 June 2015. All monitoring and mitigation protocols were adhered to during these test periods.

4.1.1. Vessel Interactions

In addition to visually monitoring for protected species, PSOs also observed and documented interactions with other marine traffic. Over the course of the program, several types of vessels were observed in the survey area in the vicinity of the R/V Langseth: commercial and recreational fishing boats, sailing vessels, cargo vessels, and other personal crafts.

On eight occasions the *R/V Langseth* had to deviate from planned survey operations (diverge from the survey line, reduce speed) as a result of other vessels in the survey area:

- On 06 June 2015, from 16:14 to 18:32 UTC the *Langseth* had to deviate offline two kilometers due to a recreational fishing boat that was too close by to the vessel during operations.

- On 07 June, the *Langseth* deviated offline 500 meters due to a recreational sport fishing vessel that was in the path of the vessel during operations. The acoustic source continued to operate throughout the deviation.

- On two days, 10 June and 11 June 2015, recreational fishing vessels transited very closely to the stern and crossed over the seismic gear, however, no damage to the equipment occurred.

- On 13 June the *Langseth* had to reduce speed while acquiring data on a survey line for a sailing vessel crossing the bow.

- On 26 June 2015, the *Langseth* had to diverge from course to avoid fishing gear in the water.

- On both 4 and 5 July 2015, the *Langseth* altered course due to recreational fishing vessels that were in the path of the vessel during night operations, however, no damage occurred to any gear. The acoustic source continued to operate throughout the deviation from course.

On multiple other occasions (between 7 and 15 times a week), visual PSOs observed vessels coming in very close proximity to the *Langseth*, approaching to within 2 kilometers of the vessel or the seismic gear.

4.2. VISUAL MONITORING SURVEY SUMMARY

The PSOs began conducting visual monitoring as the vessel departed Throggs Neck, New York (NY) at 12:50 UTC on 01 June 2015 and continued observation while the vessel was in transit to the survey site. This was undertaken to collect baseline data about protected species abundance in the area. Visual

monitoring was conducted during all daylight hours during all survey operations throughout the program. Visual monitoring was completed at 22:00 UTC on 6 July 2015 when the vessel returned to Throggs Neck, NY after the completion of the project.

Visual monitoring during the survey was conducted over a period of 36 days for a total of 553 hours 34 minutes. Monitoring was conducted each day from just before dawn to just after dusk (civil dawn/dusk), when the entire safety radius was first and lastly visible. Observations averaged 15 hours 22 minutes each day.

Two PSOs held visual watch at all times except during the scheduled meal hours. During this time a single PSO continued visual monitoring along with the PAM operator acoustically monitoring while each PSO rotated for a meal break. If a sighting occurred during a single PSO watch a second PSO would have been notified to immediately return to assist observations but this situation did not arise during this cruise. Two PSOs were always on watch for at least 30 minutes prior to the initiation of the acoustic source and throughout all ramp-ups. There were 52 hours 18 minutes of visual monitoring with only one PSO during the project.

The majority of visual monitoring was performed while the acoustic source was active (79%, or 436 hours 37 minutes) (Table 3). Visual monitoring during acoustic source silence was mainly conducted during the transit to and from the survey site and during equipment maintenance (117 hours 56 minutes, or 21%). The total visual monitoring effort during both active and silent acoustic source is also provided in Figure 5.

Table 3. Total visual monitoring effort during the survey program

Visual Monitoring Effort	Duration (hh:mm)	% of Overall Visual Monitoring Effort
Total monitoring while acoustic source active	436:37	79
Total monitoring while acoustic source silent	117:56	21
Total monitoring effort	**553:34**	-

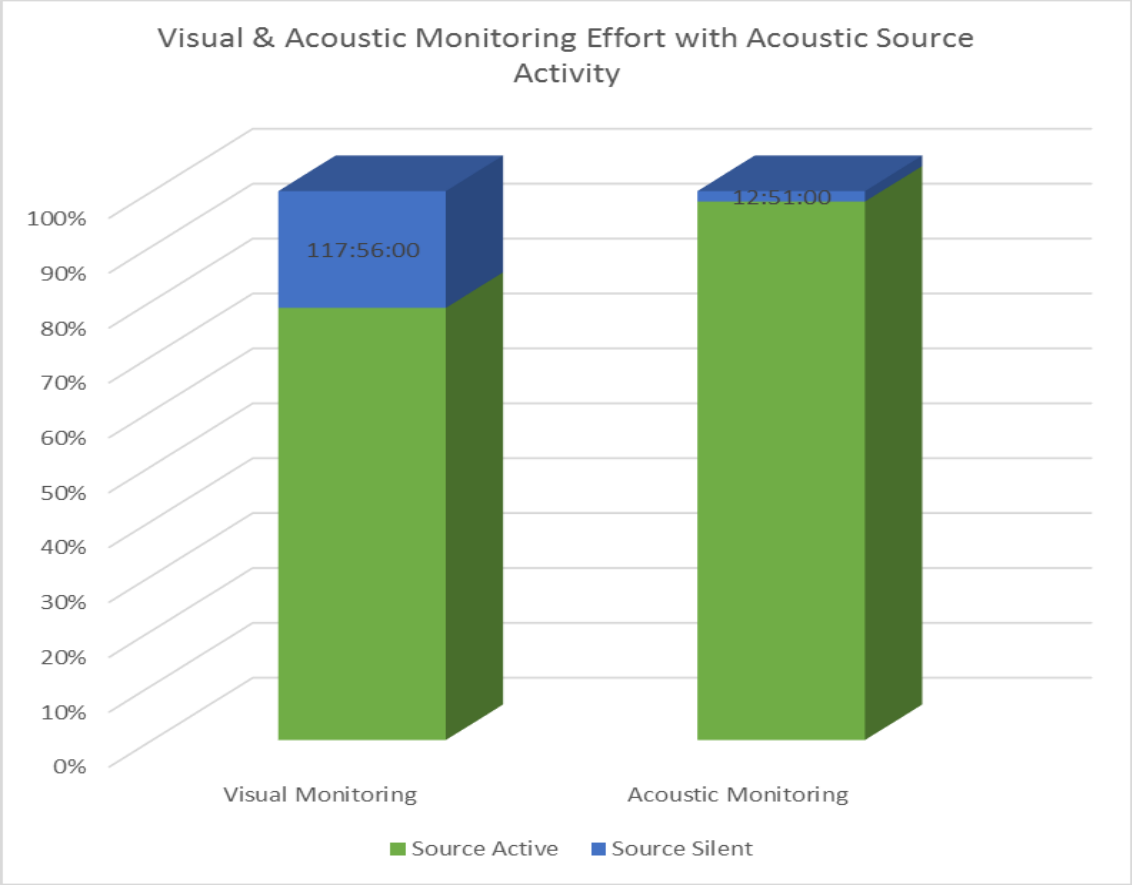

Figure 5. Visual and acoustic monitoring effort while the acoustic source was active and silent

Visual observations were preferentially conducted from the PSO tower, which provided a 360-degree view of the water around the vessel and the acoustic source. Visual watches could also be conducted from other locations including the catwalk or bridge if monitoring conditions could not be undertaken from the tower, such as during rough weather and sea conditions which made the tower unsafe, or when the vessel was heading directly into the wind blowing the engine exhaust right onto the tower. During the survey, PSOs monitored mainly from the tower (91%, 503 hours 14 minutes) and from the bridge (9%, 48 hours 52 minutes) (Figure 6).

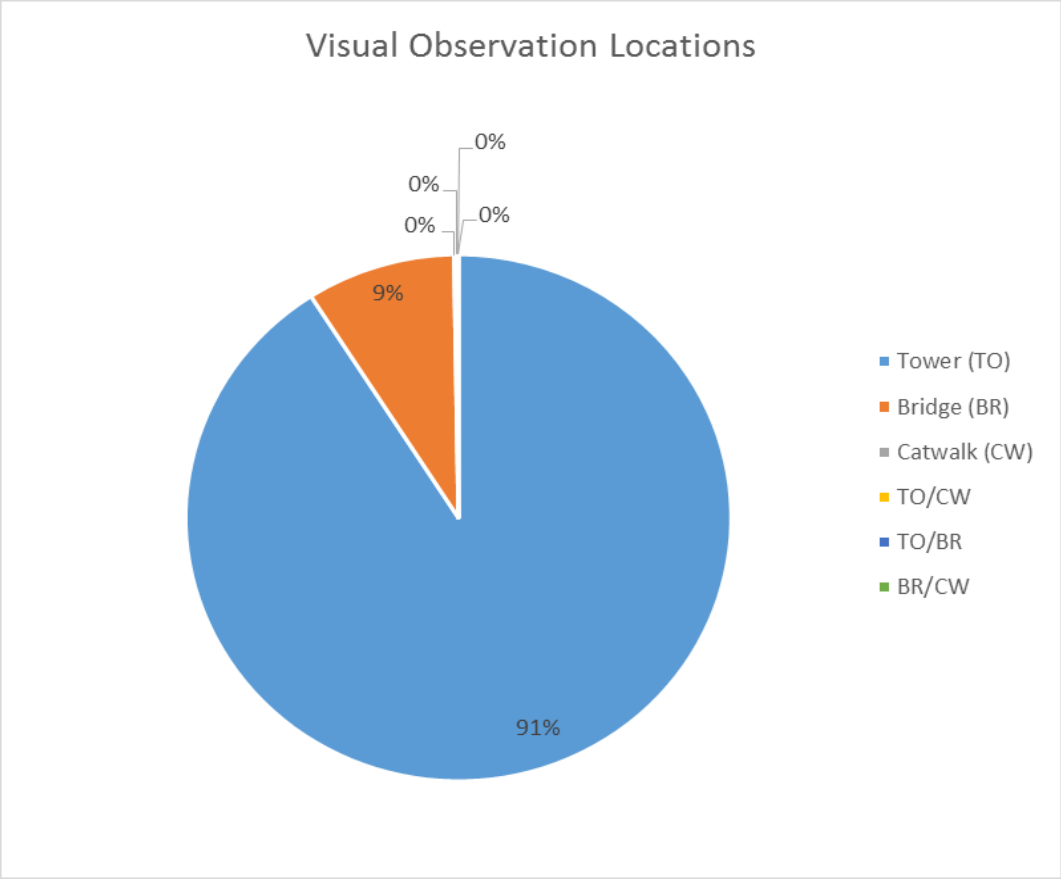

Figure 6. Total visual effort from observation locations during the NJ program

4.3. ACOUSTIC MONITORING SURVEY SUMMARY

The PAM hydrophone cable was deployed for the first time on 02 June 2015 at 18:15 UTC, after the seismic gear had been deployed. Acoustic monitoring began at 18:30 UTC and continued, both day and night, to the maximum extent practicable for the duration of the project. Acoustic monitoring was suspended 12 times due to seismic gear maintenance, detailed below. Acoustic monitoring for the project ended at 08:44 UTC on 06 July 2015, following the completion of the last survey line, and the PAM hydrophone cable was retrieved at 08:50 UTC. During the survey, acoustic monitoring was conducted for a total of 676 hours and 18 minutes; all but 12 hours 51 minutes of acoustic monitoring occurred while the acoustic source was active (Figure 5, Table 4).

Table 4. Total passive acoustic monitoring (PAM) effort during the USGS ECS survey program

Passive Acoustic Monitoring Effort	Duration (hh:mm)
Total night time monitoring	**262:55**
Total day time monitoring	**413:23**
Total monitoring while acoustic source active	**663:27**
Total monitoring while acoustic source silent	**12:51**
Total acoustic monitoring	**676:18**

Acoustic monitoring downtime totaled 129 hours 56 minutes during the survey, including 100 hours 45 minutes for gear maintenance and 29 hours and 11 minutes for PAM operator meals (Table 5).The PAM cable was retrieved and acoustic monitoring was suspended 12 times due to seismic gear maintenance during the survey, including:

PAM monitoring was suspended and the hydrophone cable was retrieved twice during the first week of the survey, both times due to required maintenance of the seismic gear. Acoustic monitoring was suspended from 10:20 to 16:36 UTC on 03 June 2015 and from 04:56 to 14:12 UTC on 04 June 2015, resulting in a total of 15 hours 32 minutes of PAM downtime.

The PAM cable was retrieved and acoustic monitoring was suspended three times during the second week of the survey. On 08 June 2015, the source was silenced and the line ended early at 07:52 UTC due to an issue with the p-cable. The PAM cable was retrieved and acoustic monitoring was suspended at 08:22 UTC so the acoustic array could be brought on board. The acoustic gear and PAM cable were deployed at 13:05 UTC and acoustic monitoring resumed at 13:12 UTC. However, after only five minutes, acoustic monitoring was again suspended at 13:17 UTC and the PAM cable retrieved at 13:18 UTC so that the acoustic gear could be retrieved for further maintenance. The PAM cable was deployed again at 13:55 UTC and acoustic monitoring resumed at 18:00 UTC. On 11 June 2015, acoustic monitoring was suspended at 09:02 UTC and the PAM cable was retrieved at 09:08 UTC so the acoustic array and p-cable could be brought on board for maintenance. The PAM cable was re-deployed at 13:59 UTC and acoustic monitoring resumed at 14:08 UTC.

The PAM cable was retrieved and acoustic monitoring was suspended twice during the third week of the survey. On both 18 June and 19 June 2015, the source was silenced and the line ended early due to an issue with the p-cable. On 18 June, the line ended early at 22:34 UTC, acoustic monitoring was

suspended at 22:36 UTC, and the PAM cable was retrieved at 22:46 UTC. The PAM cable was re-deployed on 19 June at 04:15 UTC and acoustic monitoring resumed at 04:18 UTC. In the evening on 19 June, the line ended early and acoustic monitoring was suspended at 22:21 UTC. The PAM cable was retrieved at 22:33 UTC and re-deployed at 03:50 UTC on 20 June. Acoustic monitoring resumed at 03:58 UTC.

The PAM cable was retrieved and acoustic monitoring was suspended twice during the fourth week of the survey. On both 25 June and 26 June, the source was silenced and the line ended early due to an issue with the p-cable. On 25 June, the line ended early at 14:57 UTC, acoustic monitoring was suspended at 15:02 UTC, and the PAM cable was retrieved at 15:10 UTC. The PAM cable was re-deployed at 23:32 UTC and acoustic monitoring resumed at 23:40 UTC. On 26 June, the line ended early and acoustic monitoring was suspended at 17:33 UTC. The PAM cable was retrieved at 17:44 UTC and re-deployed at 00:13 UTC on 27 June. Acoustic monitoring resumed at 00:24 UTC.

The PAM cable was retrieved and acoustic monitoring was suspended twice during the fifth week of the survey. On 29 June 2015, the source was silenced and the line ended early at 05:44 UTC due to an issue with the p-cable. Acoustic monitoring was suspended at 05:44 UTC and the PAM cable was retrieved so the acoustic array could be brought on board. The gear was re-deployed on 30 June 2015 and acoustic monitoring resumed at 20:36 UTC. On 4 July 2015, the source was silenced and acoustic monitoring was suspended at 11:55 UTC due to an issue with the p-cable. After maintenance was completed, the gear was re-deployed and acoustic monitoring resumed at 16:49 UTC.

Table 5. Passive acoustic monitoring (PAM) downtime during the NJ survey program

Cause of Downtime	Duration (hh:mm)
Debris Removal and Maintenance Hydrophone Cable	**00:00**
Replacement of Damaged PAM Equipment	**00:00**
Rough Seas/Risk of Entanglement	**00:00**
Assessment and Adjustment to PAM Equipment	**00:00**
Seismic Gear Maintenance	**100:45**
PSO Meals	**29:11**
Total Passive Acoustic Monitoring Downtime	**129:56**

4.4. SIMULTANEOUS VISUAL AND ACOUSTIC MONITORING SUMMARY

Acoustic monitoring was undertaken during all day and night hours during the survey when possible. During the day, a total of 413 hours 23 minutes of simultaneous visual and acoustic monitoring were undertaken (Figure 7), with all but 6 hours 52 minutes of simultaneous monitoring occurring while the acoustic source was active. Additional visual monitoring undertaken during transit periods could not be accompanied by acoustic monitoring for operational reasons.

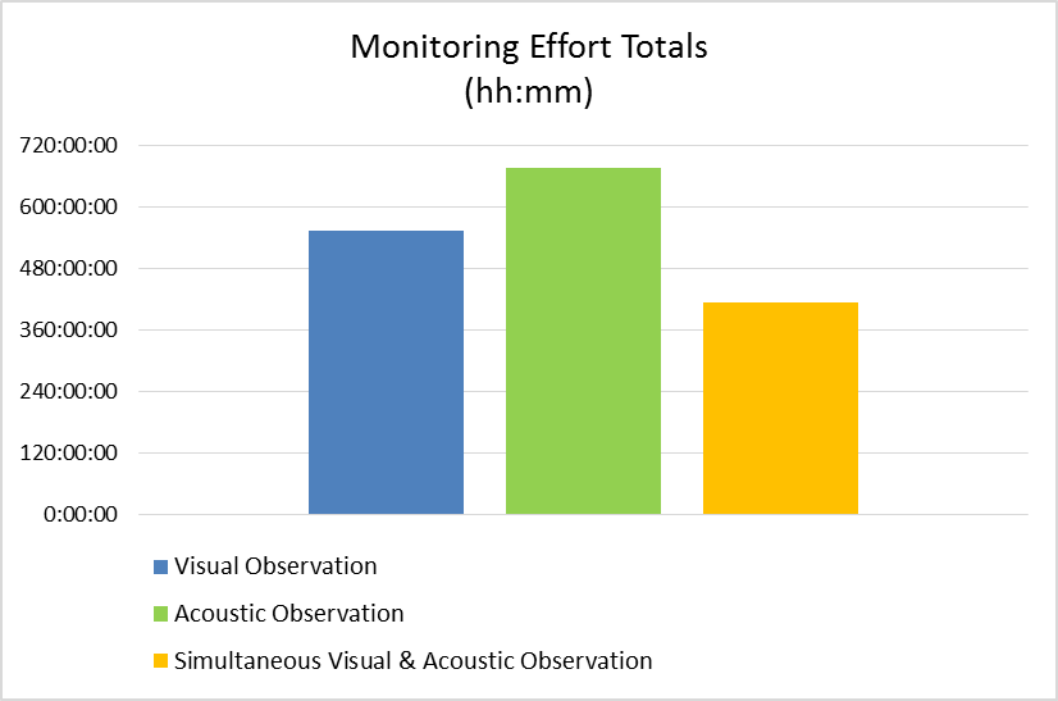

Figure 7. Total acoustic and visual monitoring effort

4.5. ENVIRONMENTAL CONDITIONS

Environmental conditions can have an impact on the probability of detecting protected species in a survey area. The environmental conditions present during visual observations undertaken during this survey program were generally moderate to good.

Visibility was classified as 'excellent' if it extended to 10 kilometres or greater. A total of 274 hours 52 minutes (50% of total effort) of visual monitoring effort was undertaken while visibility extended to 10 kilometres or greater (Figure 8). Periods of fog and light to heavy rain were intermittently present throughout the survey and occasionally resulted in reduced visibility. of Precipitation was observed during a total of 122 hours 17 minutes of visual monitoring (22% of all monitoring effort). Only 25 hours 53 minutes of monitoring was undertaken while visibility extended to less than two kilometres. The entirety of the 180 dB radius was not visible during visual monitoring, while the acoustic source was active, on multiple brief occasions during the survey for a total duration of 25 hours 14 minutes. The entire 160 dB radius was not visible during visual monitoring, while the acoustic source was active, on multiple occasions throughout the survey for a total of 80 hours 40 minutes.

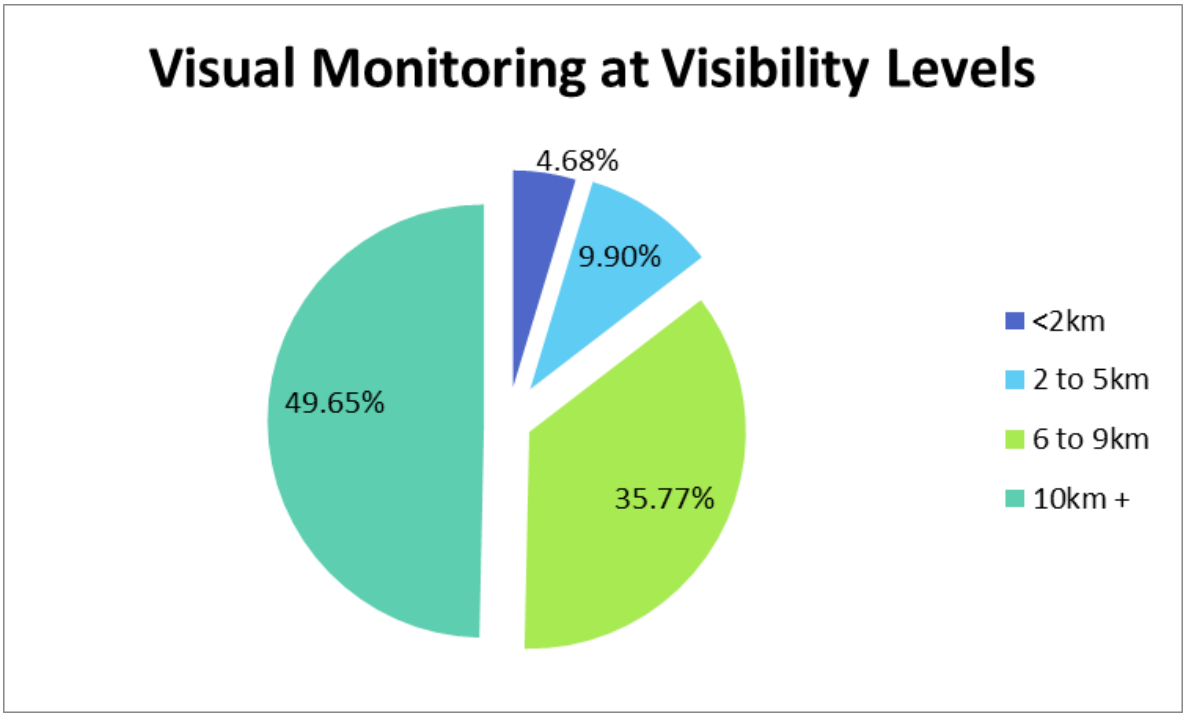

Figure 8. Weekly summary of the Beaufort scale during visual monitoring

The Beaufort Sea state recorded during visual monitoring ranged from level one to level five over the course of the survey. Figure 9 shows a general breakdown of the Beaufort scale during each observation week of the survey. A total of 469 hours 52 minutes (85%) of visual observations were undertaken in conditions where the Beaufort state was rated level three or less, good conditions for the detection of protected species.

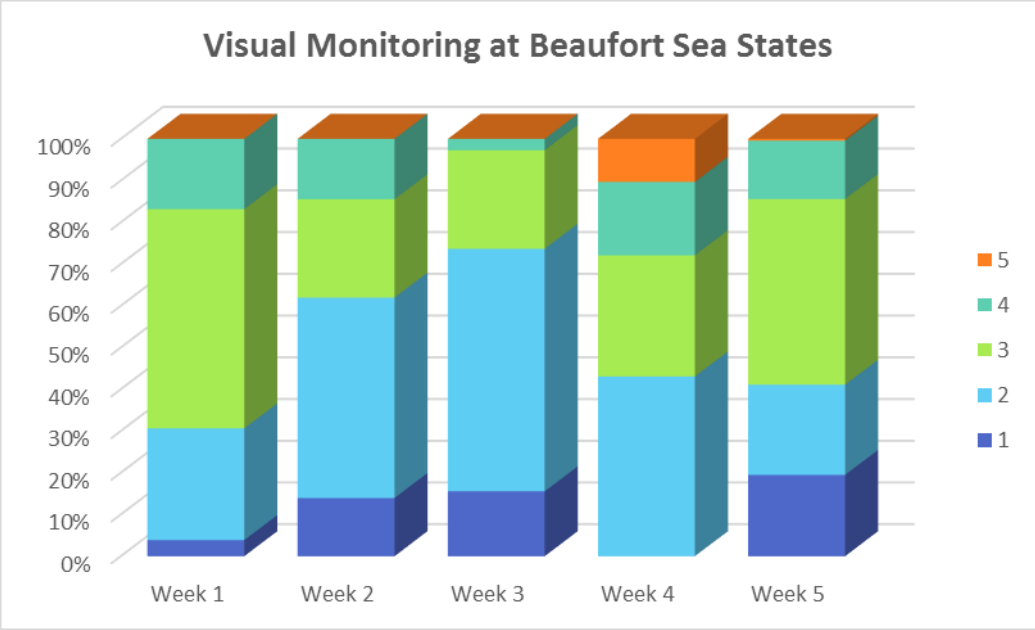

Figure 9. Total hours of observation at each Beaufort scale over the duration of the survey

The majority of visual monitoring was undertaken while wind speeds were measured between 11 and 16 knots (164 hours 29 minutes, 22% of effort) (Figure 10).

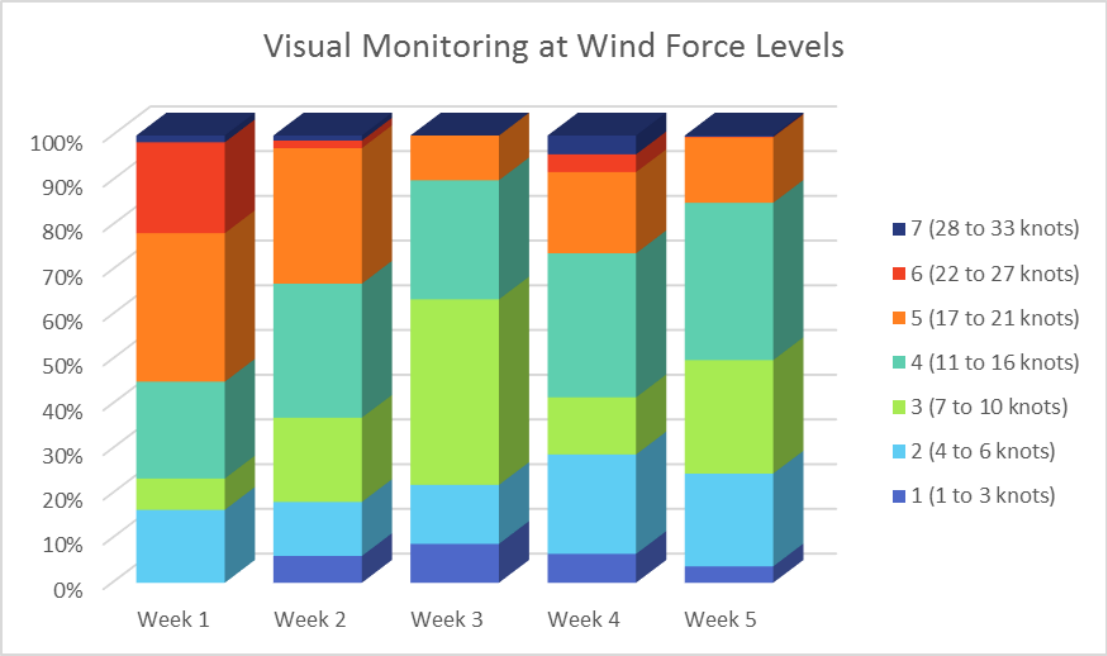

Figure 10. Average wind speed each week during visual monitoring

Swell heights during visual observations were generally low, with swells of less than two meters recorded for over 99% of total visual effort. Only one hour 35 minutes (less than 1%) of visual observations were undertaken while swells were recorded at heights between two and four meters, all of which occurred during week four and five of the survey program (Figure 11).

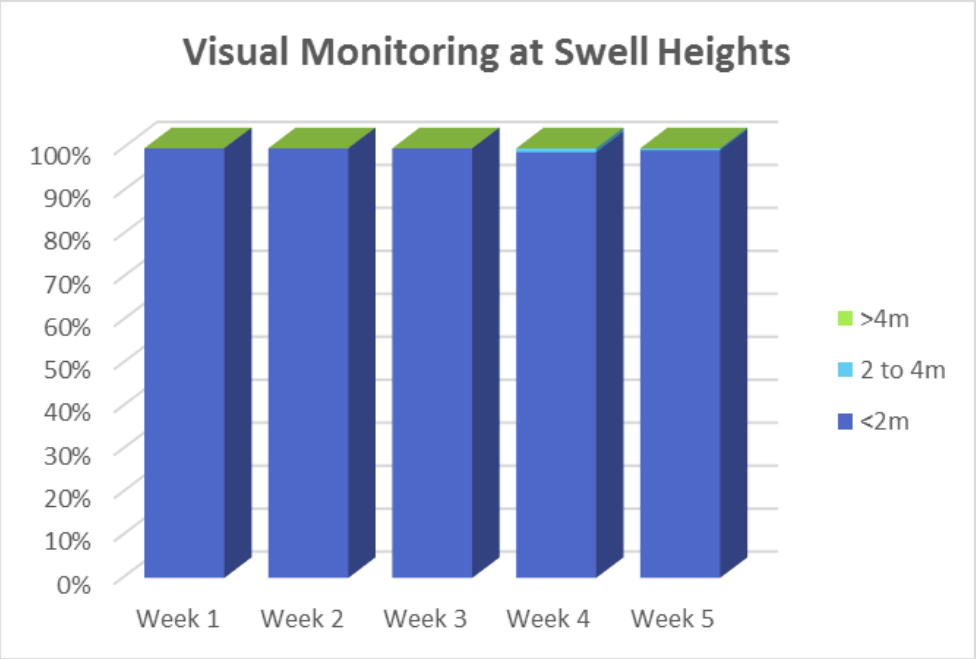

Figure 11. Swell heights while visual monitoring was conducted

Moderate glare was present during 66 hours 17 minutes (12%) and severe glare was present for 103 hours two minutes (18%) of visual monitoring during the survey, possibly hindering the detection of protected species in areas of glare (Figure 12).

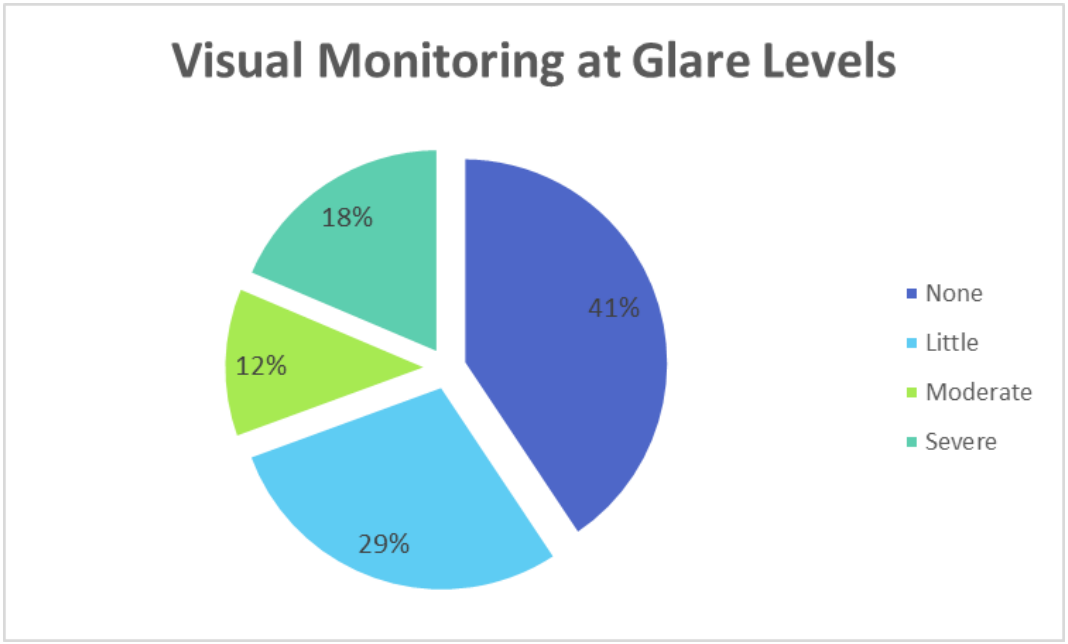

Figure 12. Total hours of glare present throughout visual monitoring

5. MONITORING AND DETECTION RESULTS

5.1. VISUAL DETECTIONS

Visual monitoring conducted during the NJ survey resulted in a total of 100 detections of protected species (summarized in Appendix F). This total included 34 detections of whales, 13 detections of dolphins, and 53 detections of sea turtles. For whales, 13 detections were positively identified as fin whales, three were positively identified as humpback whales, and 18 detections remained unidentified. For dolphins, three detections were positively identified as short-beaked common dolphins and 10 detections remained unidentified. For sea turtles, 37 detections were positively identified as loggerhead sea turtles and 16 detections remained unidentified (Table 6). Two of the visual detections were comprised of multiple species, including one with both fin whales and an unidentified whale, and one with a fin whale and an unidentified dolphin. One of the short-beaked common dolphin detections and three of the unidentified dolphin detections were simultaneous with acoustic detections. Photographs taken of positively identified protected species can be found in Appendix H.

Table 6. 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	37	43
Unidentified shelled sea turtle	16	16
Mysticetes		
Fin whale	13	17
Humpback whale	3	3
Unidentified baleen whale	18	25
Odontocetes		
Short-beaked common dolphin	3	50
Unidentified dolphin	10	115
TOTAL	**100**	**269**

The majority of the protected species detections during the survey occurred within the project area while the vessel was on a survey line (Figure 13), with only a few dolphin detections occurring outside of the survey area (Figure 14). Whales were observed at either end of the survey area with the only positively identified fin whale detections occurring at the north-west end of the project site, and the only positively identified humpback whale detections occurring at the south-east end of the project site (Figure 15). Dolphins sighted during the project were generally more spread out than the whale detections; however, they were still sighted in higher concentrations towards the eastern end of the project area (Figure 16). Sea turtles sighted during the project were more wide-spread than marine mammals (Figure 17). However, there were several days of high concentrations of detections which corresponded to the days with excellent observation conditions. In general, days with higher numbers of visual detections corresponded with days with high visibility and very calm seas (Figure 18).

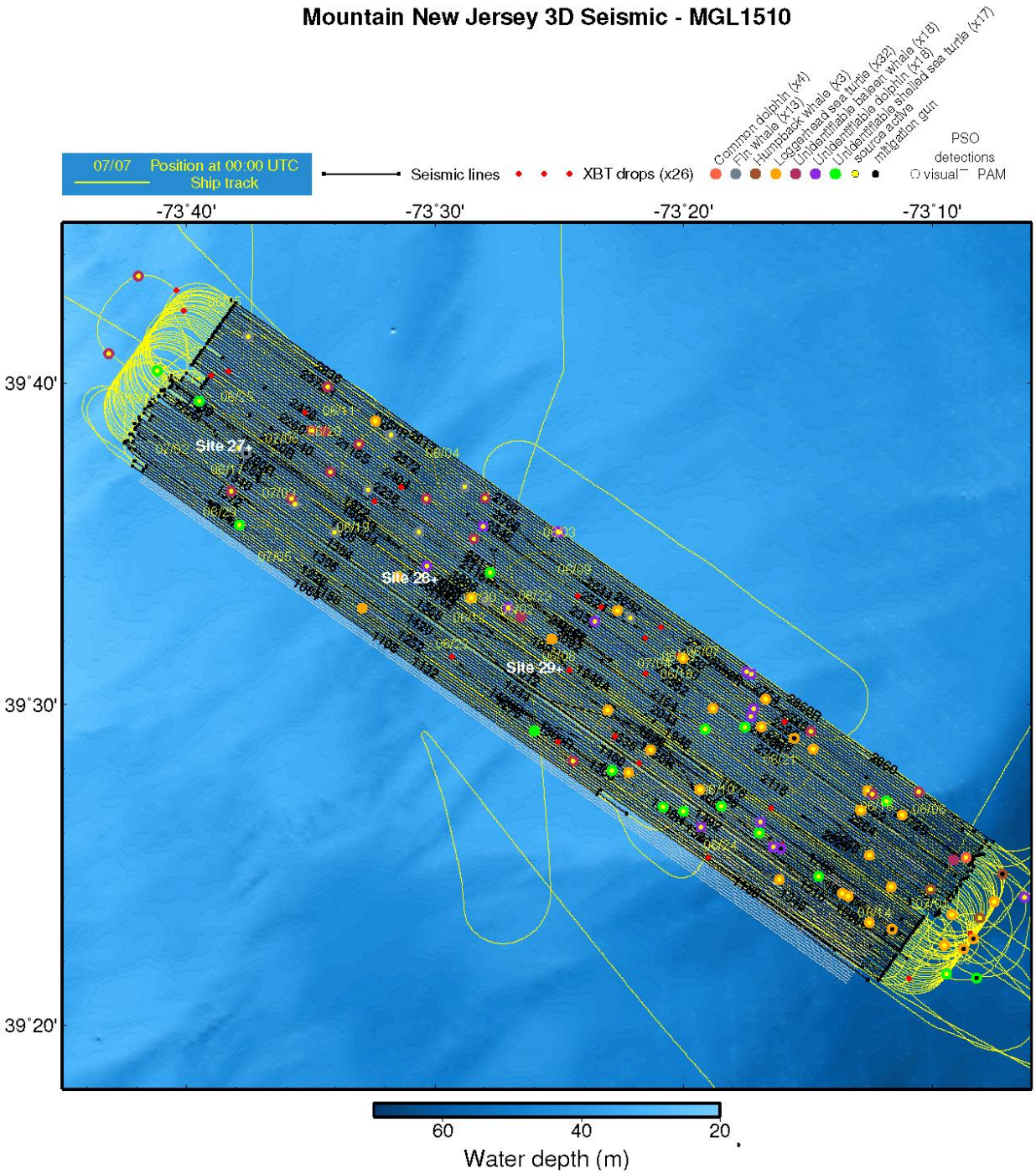

Figure 13: Protected Species detections during the NJ survey and vessel track lines

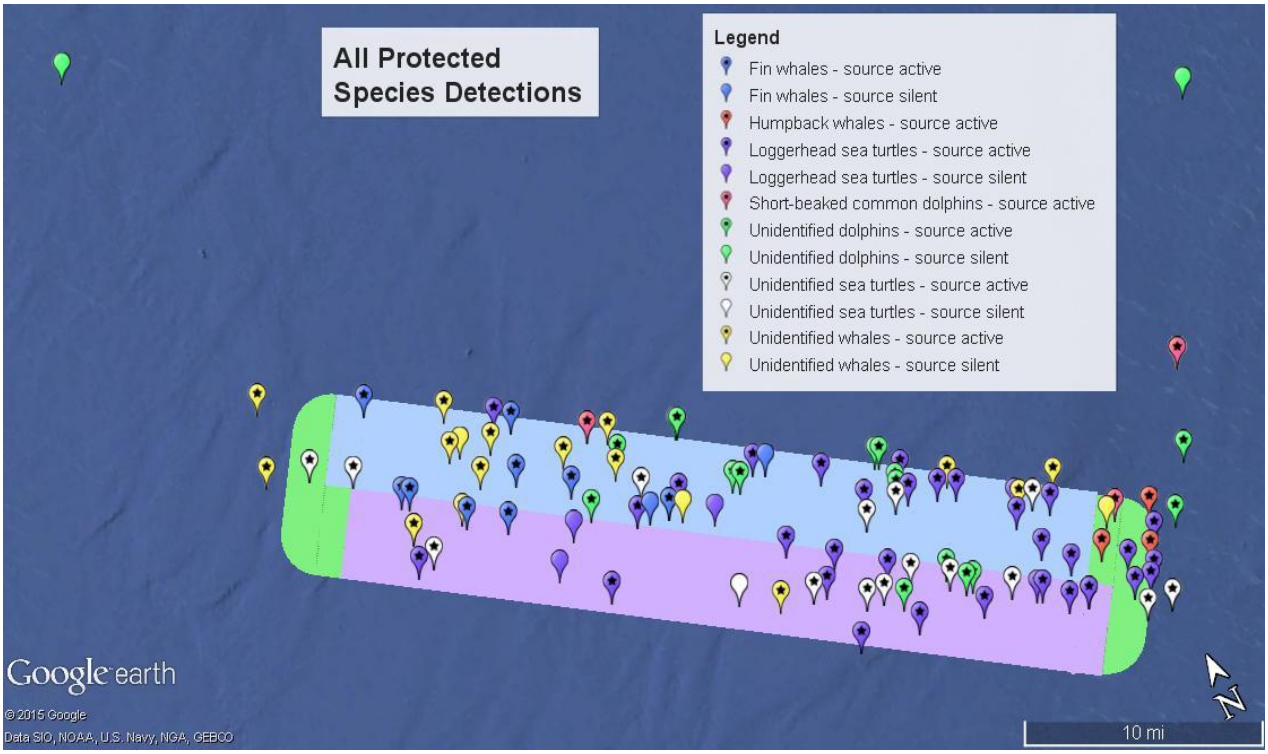

Figure 14: All protected species observed during the NJ survey

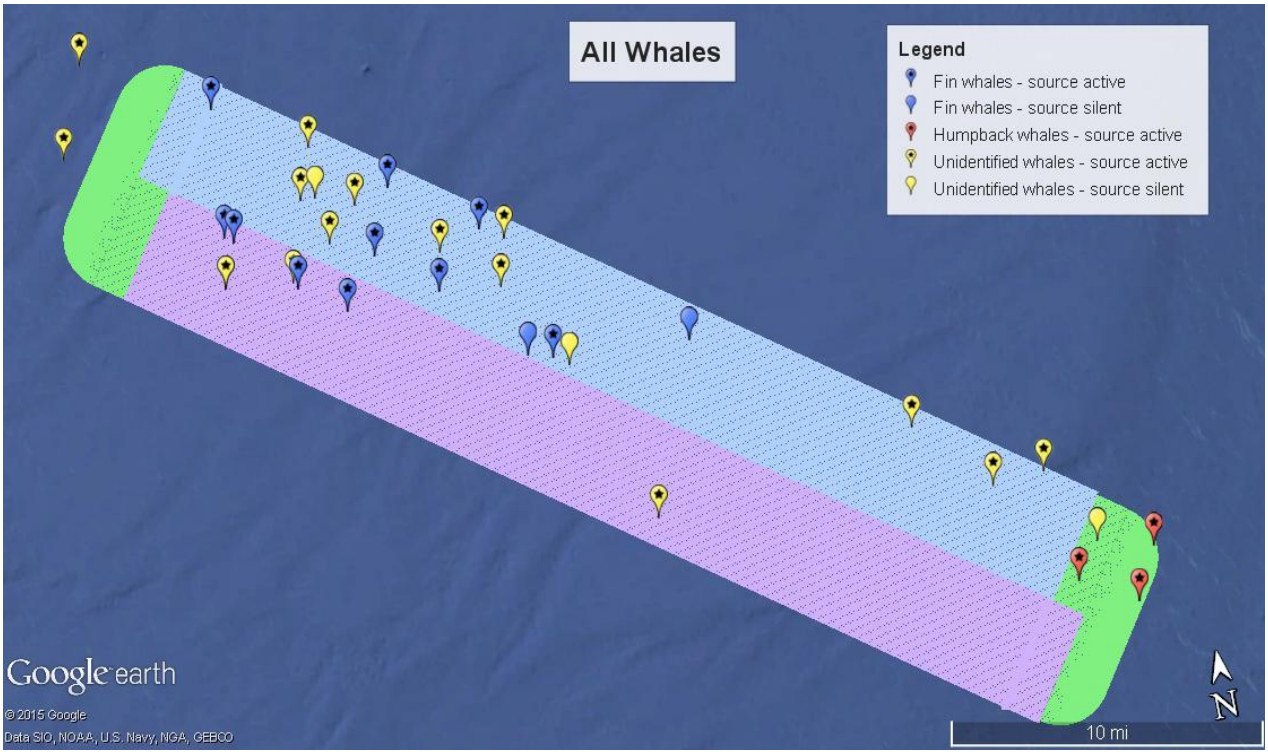

Figure 15: Whales observed during the NJ survey

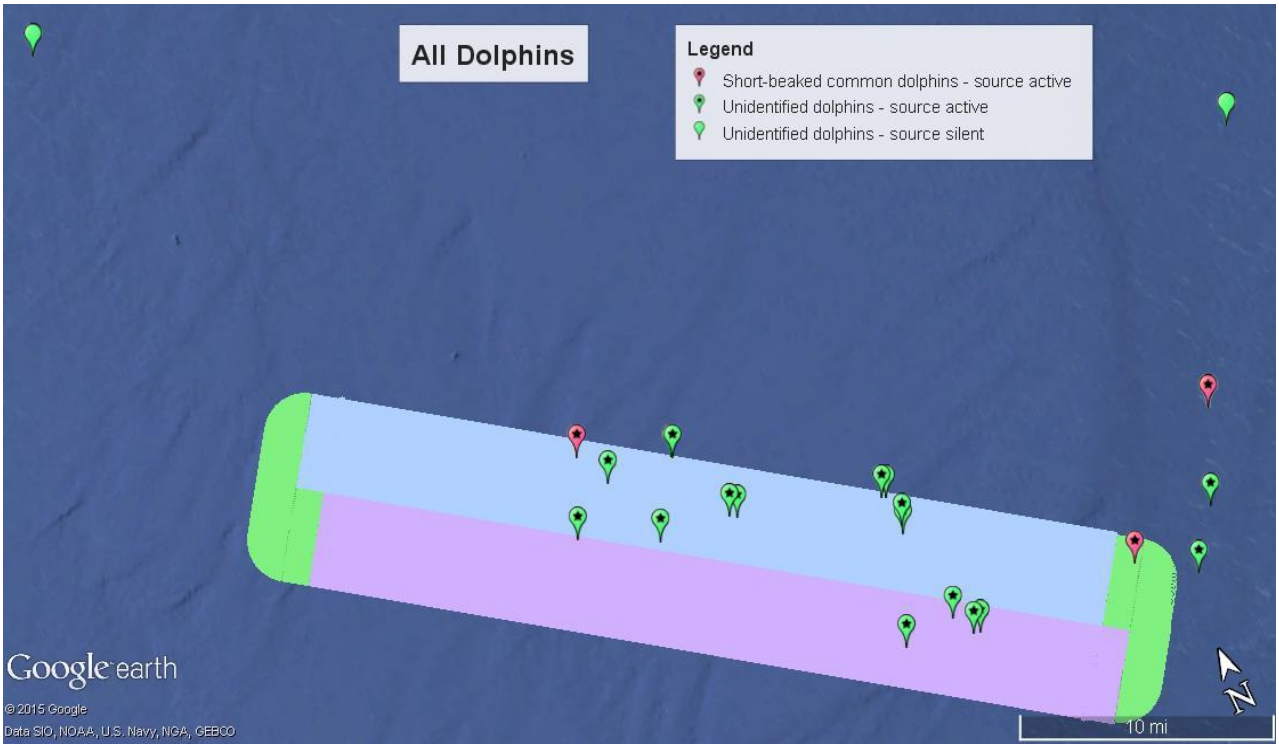

Figure 16: Dolphins observed during the NJ survey

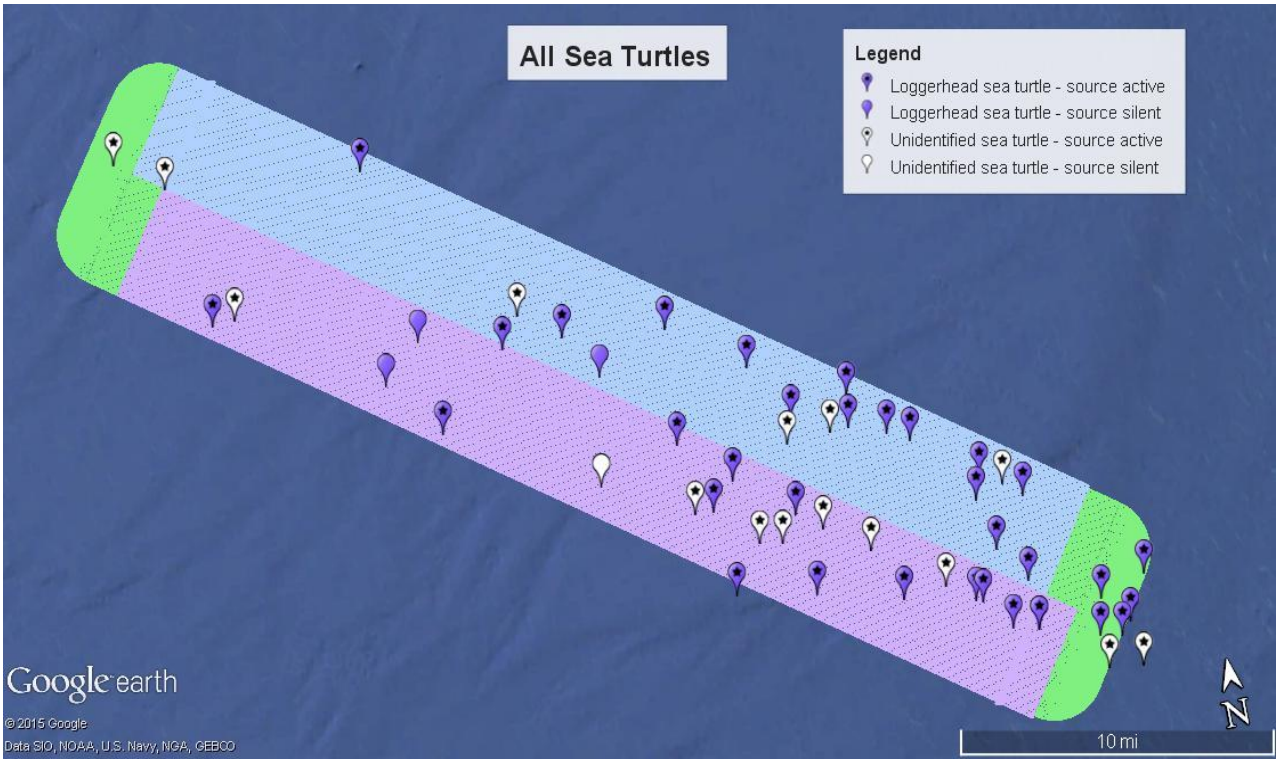

Figure 17: Sea turtles observed during the NJ survey

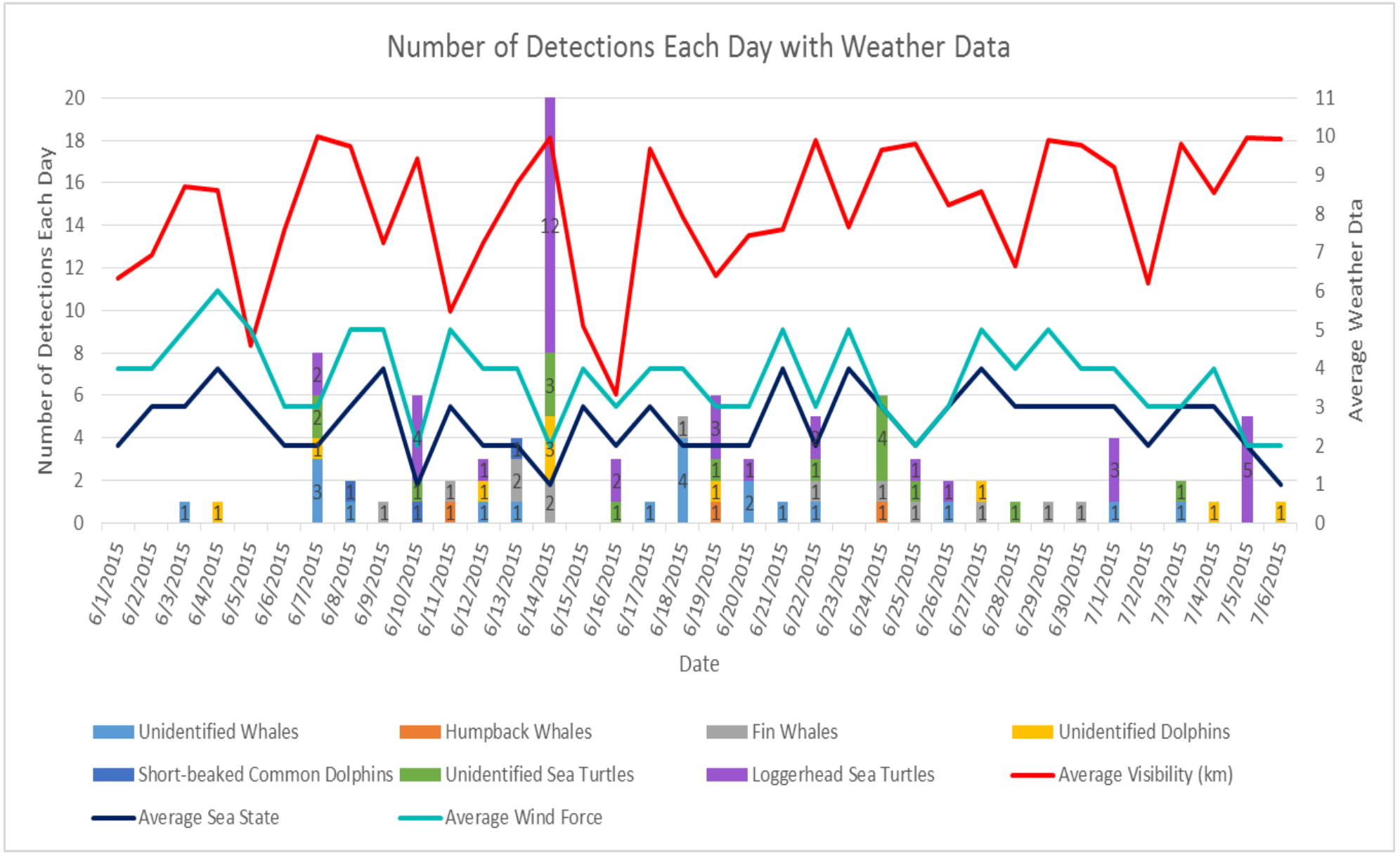

Figure 18: Number of protected species detections each day of the New Jersey project and corresponding weather data for each day

Of the 107 detections of protected species during the NJ survey, 87 detections (81%) occurred while the acoustic source was at full volume, nine detections (9%) occurred while only the single 40 in^3 airgun was active, and 11 detections (10%) occurred while the source was silent. There were no detections of protected species which occurred during ramp-up (Table 7).

Table 7. Average closest approach of protected species to the acoustic source at various volumes

Species Detected	Full Volume Active (700 in^3)		Single Airgun 40 in^3		Ramp-up		Not Active	
	Number of detections	Average closest approach to source (meters)	Number of detections	Average closest approach to source (meters)	Number of detections	Average closest approach to source (meters)	Number of detections	Average closest approach to source (meters)
Loggerhead sea turtle	30	208	4	230	0	-	3	207
Unidentified shelled sea turtle	14	319	1	110	0	-	1	350
All sea turtle species	44	264	5	170	0	-	4	279
Fin whale	10	1563	1	1500	0	-	2	425
Humpback whale	2	630	1	1000	0	-	0	-
Unidentified baleen whale	15	1727	0	-	0	-	3	1833
All whale species	27	1307	5	1250	0	-	2	1129
Short-beaked common dolphin	2	1041	1	320	0	-	0	-
Unidentified dolphin	08	1120	1	400	0	-	1	200
All dolphin species	16	1081	2	360	0	-	2	200

During full volume operations, there were 30 detections of loggerhead sea turtles, 14 detections of unidentified sea turtles, 10 detections of fin whales, two detections of humpback whales, 15 detections of unidentified whales, two detections of short-beaked common dolphins and 14 detections of unidentified dolphins (Figure 19). Of these detections, loggerhead sea turtles had the closest approach to the source during full volume operations with an average of 208 meters (Table 7).

During single 40 in^3 airgun operations, there were four detections of loggerhead sea turtles, one detection of unidentified sea turtles, one detection of fin whales, one detection of humpback whales, one detection of short-beaked common dolphins and one detection of unidentified dolphins (Figure 19). Of these detections, the sea turtles had the closest approach to the source during single 40 in^3 airgun operations, where an unidentified shelled turtle was observed at a closest distance of 110 meters and loggerhead turtles had an average closest distance of 230 meters (Table 7).

While the source was silent, there were three detections of loggerhead sea turtles, one detection of unidentified sea turtles, two detections of fin whales, three detections of unidentified whales and two detections of unidentified dolphins (Figure 19). Of these detections, unidentified dolphins had the closest approach to the source while it was silent with an average of 200 meters (Table 7). If the source was silent due to the array being on board the vessel, the closest approach was recorded as from the position the array would normally occupy when fully deployed.

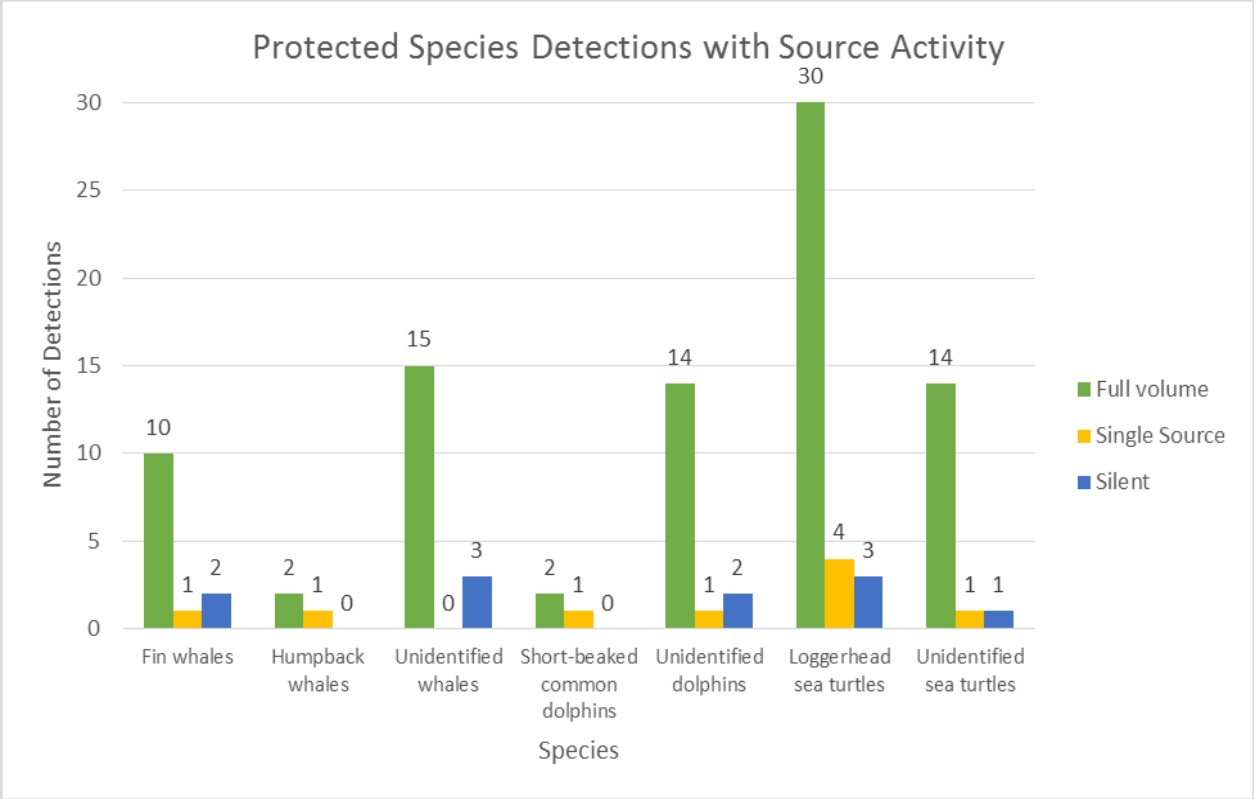

Figure 19: Number of detections of each species with acoustic source activity

Loggerhead sea turtles were observed most frequently during the survey, totaling 37% of all protected species detections. However, dolphins, both unidentified and those positively identified as short-beaked common dolphins, were observed in the largest numbers (165 recorded individuals). The majority of the sea turtles were observed individually; however, most of the dolphins were observed in pods of 20 to 30 individuals. Though a few of the whale detections consisted of two individuals, the majority of the whales observed were also sighted individually (Figure 20).

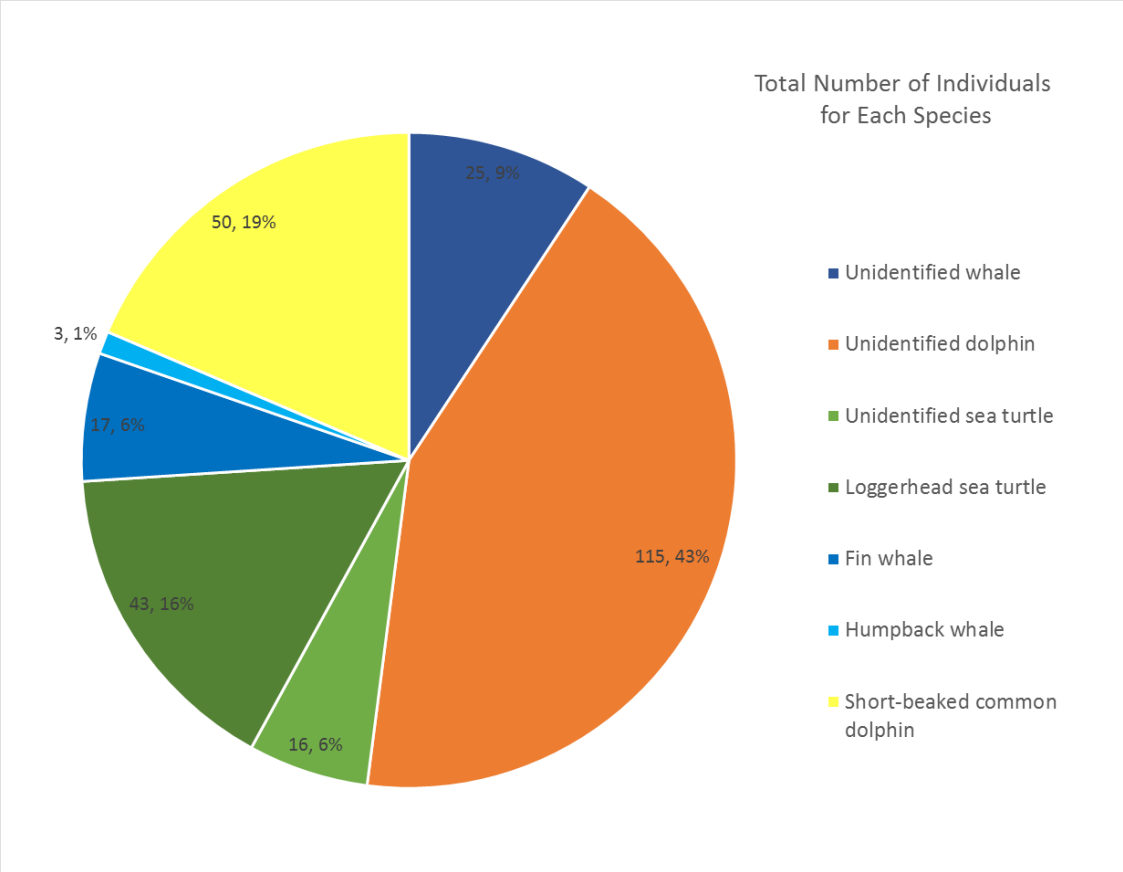

Figure 20. Number of individuals per species detected

5.1.1. Cetacean Detections

There were 47 visual detections of cetaceans during the NJ survey. This total included 13 detections of fin whales, three detections of humpback whales, 18 detections of unidentified whales, three detections of short-beaked common dolphins and 10 detections of unidentified dolphins. Detections of each species group are described in detail below.

5.1.1.1. Fin Whales

There were 13 detections of positively identified fin whales during the survey, totaling 17 individuals. Four of the detections resulted in mitigation actions, four power-downs followed by shut-downs. Each of these mitigation actions were implemented as additional enhanced mitigation measures between 11 and 23 June 2015 after protected species takes for fin whales reached the total number of takes (three) allowed by the IHA (issued on 7 May 2015. On 23 June 2015, NMFS issued a modified IHA, allowing 36 takes for fin whales (representing approximately 2.2% of the regional population), at which point the additional enhanced mitigation measures were suspended. The additional mitigation measures that were implemented for this species included powering down the source anytime a fin whale was positively identified near or within the predicted 160 decibels (dB) re 1 µPa zone for the full volume source (5,240 meters) and then shutting down the source if the whale(s) then came near or within the predicted 160 dB re 1 µPa zone for the mitigation source (955 meters). If the individuals were initially observed within the smaller 160 dB re 1 µPa zone, the source would be immediately shut down. Though

these additional mitigation measures were implemented, an additional six fin whales were observed to be within the predicted 160 dB re 1 µPa zone around the sound source and therefore potentially exposed to received sound levels equal to or greater than 160 dB re 1 µPa

Detections occurred in water depths ranging from 21 meters to 52 meters, and averaged 22 minutes each. There were six detections consisting of two individuals, with the remaining seven detections consisting only of one individual. The closest approach to the source while active was 315 meters and to the source while silent was 400 meters. In general, fin whales were observed traveling at a normal/moderate pace, and no obvious changes in behavior were observed for whales that came within a closer distance to the vessel and source. Two of the fin whale detections also included other species. One detection (visual detection #67) also included a single unidentified whale, and one detection (visual detection #82) also included a single unidentified dolphin. The fin whale observed in detection #25 was also observed simultaneously with the short-beaked common dolphins observed in detection #26, though the two groups were not observed together.

5.1.1.2. Humpback Whales

There were three detections positively identified as humpback whales during the survey, totaling three individuals. None of the detections resulted in mitigation actions. Detections occurred in water depths ranging from 54 meters to 59 meters, and averaged 17 minutes each. The closest approach to the source while active was 415 meters. None of the detections occurred while the source was silent. Two of the humpback whales sighted were observed tail slapping, surfacing to blow and diving showing their flukes, while the third whale was only observed surfacing to blow and then diving showing flukes.

5.1.1.3. Unidentified Whales

There were 18 detections of whales that could not be identified during the survey. The majority of the time, identification of the whales was hindered by either the briefness of the detection or the distance of the whale. Detections occurred in water depths ranging from 20 meters to 65 meters, and averaged 13 minutes each. There were four detections consisting of two individuals, one detection consisting of four individuals and 13 detections consisting only of one individual. The closest approach to the source while active was 250 meters and the source while silent was 100 meters. Only one of the detections resulted in a mitigation action.

5.1.1.4. Short-beaked Common Dolphins

There were three detections of positively identified short-beaked common dolphins during the survey totaling 50 individuals. Two of the detections resulted in mitigation actions, including one power down and one delayed ramp up. The power down was implemented as part of the increased mitigation measures put in place on 11 June 2015 after the maximum allowed number of takes for this species had been reached (36 takes). Additional mitigation measures were implemented such that the source would be powered down anytime the species was positively identified near or within the predicted 160 decibels (dB) re 1 µPa zone for the full volume source (5,240 meters) and then shut down if the dolphins then came near or within the predicted 160 dB re 1 µPa zone for the mitigation source (955 meters). If the individuals were initially observed within the smaller 160 dB re 1 µPa zone, the source would be immediately shut down. Though these additional mitigation measures were implemented, an additional 15 short-beaked common dolphins were observed to be within the predicted 160 dB re 1 µPa zone around the sound source and therefore potentially exposed to received sound levels equal to or greater than 160 dB re 1 µPa. On 23 June 2015, NMFS issued a modified IHA, allowing 2,113 takes for short-

beaked common dolphins (representing approximately 1.2% of the regional population), at which point the additional enhanced mitigation measures were suspended.

Detections occurred in water depths ranging from 25 meters to 62 meters, and averaged 19 minutes each. The pods observed ranged in size from four individuals to 31 individuals. The closest approach to the source while active was 320 meters. None of the detections occurred while the source was silent. One of the detections was simultaneous with an acoustic detection.

5.1.1.5. Unidentified Dolphin

There were 10 visual detections of dolphins that could not be identified to species level during the survey. An additional seven acoustic detections of unidentified dolphins were made that were not accompanied by a visual detection. These detections are discussed in Section 5.2 The majority of the time, identification of the dolphins was hindered by the distance of the pod, and on several occasions by the pod being within the severe glare from the sun during the detection. Detections occurred in water depths ranging from 26 meters to 59 meters, and averaged eight minutes each. Pods observed ranged in size from two individuals to 30 individuals, and there was one detection of a single dolphin which was sighted alongside a fin whale. The closest approach to the source while active was 300 meters and the source while silent was 200 meters. Three of the detections were simultaneous with acoustic detections.

5.1.2. Sea Turtle Detections

There were 53 detections of sea turtles during the NJ survey. Loggerhead sea turtles were the only positively identified species, comprising 37 of the detections, while the remaining 16 detections were unidentified sea turtles. The majority of the turtles observed were initially floating at the surface or swimming sedately just under the surface of the water. Ten of the turtles were observed at the surface until they had exited the exclusion zone astern of the source array, while the others either dove or were lost sight of while still within the exclusion zone. The majority of the turtles sighted were also observed to have a high amount of epiphytes on their carapace as well.

5.1.2.1. Loggerhead sea turtle

There were 37 detections of positively identified loggerhead sea turtles during the survey totaling 43 individuals. Thirty-one of the detections resulted in mitigation actions, including 31 power downs and two shut downs. Detections occurred in water depths ranging from 27 meters to 58 meters, and averaged three minutes each. There was one detection consisting of three individuals and four detections consisting of two individuals, all of which occurred on 14 June 2015. All other detections consisted of one individual each. On average, the turtles were initially sighted at an initial distance of 300 meters. Theclosest approach to the source while active was 75 meters and the closest approach to the source while silent was 150 meters.

5.1.2.2. Unidentified sea turtle

There were 16 detections of sea turtles that could not be identified during the survey. The majority of the time, the turtles were unidentified due to the distance of the turtles from the observers or the few occasions where the turtles were sighted for only a few seconds before they dove and disappeared. Eleven of the detections resulted in mitigation actions, all of which were power downs. Detections occurred in water depths ranging from 25 meters to 56 meters, and averaged three minutes each. All detections consisted of one individual each. On average, the turtles were initially sighted at a distance of

300 meters. The closest approach to the source while active was 110 meters and the closest approach to the source while silent was 350 meters.

5.1.3. Other Wildlife

Observations of other wildlife during the survey included several species of birds, fish, marine invertebrates, and insects. A complete list of birds 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 I. No impacts to any other wildlife species as a result of research activities were observed during the survey.

5.2. ACOUSTIC DETECTIONS

There were eleven acoustic detections during the NJ survey, all consisting of unidentified delphinids. Four of the detections occurred simultaneously with visual detections (see Section 5.3). Screenshots taken of acoustic detections can be found in Appendix G.

On 03 June 2015, at 16:36:44 UTC, whistles from at least two unidentified dolphins were detected both visually and aurally on Pamguard low frequency spectrogram and whistle and moan detector (acoustic detection #1). Down-sweeping whistles were dominant in addition to sinusoidal and concave whistle signatures which ranged from six to 21 kilohertz. The last whistle was detected at 16:48:07 UTC. The detection was not visually confirmed and the dolphins bearing and distance could not be determined.

On 10 June 2015, at 02:54 UTC, unidentified dolphin whistles were observed on Pamguard's low frequency spectrogram (acoustic detection #4). The distance to the dolphins was not localized on Pamguard's map module. Post-analysis of low frequency recordings of this detection through Spectrogram 16 showed whistles of two individual dolphins. Up-sweeping and convex whistles, with frequencies ranging from approximately seven kHz to 23 kHz, occurred from 02:53:14 UTC to 02:54:15 UTC. From 02:54:27 UTC to 02:55:59 UTC, four sinusoidal whistles from one individual dolphin were observed in quick succession. These whistles spanned a frequency range from nine kHz to 13 kHz. The detection registered aurally via the headphones. The acoustic source was at full volume (700 in^3) at the time of this detection. The detection was not visually confirmed and no mitigation actions were required.

On 11 June 2015, at 07:36 UTC, unidentified dolphin whistles registered aurally on the headphones and were observed on Pamguard's low frequency spectrogram display (acoustic detection #5). The dolphins were not localized within Pamguard's map module. Post-analysis of the low frequency recordings through Spectrogram 16 showed the vocalizations of at least two dolphins. Up-sweeping, down-sweeping, and sinusoidal whistle signatures, spanning a frequency range from six kHz to 20 kHz, were observed throughout the detection. The last whistle was detected at 08:03 UTC. At 07:45 UTC, a PSO was alerted to the detection and began watch from the bridge; however, the detection could not be confirmed visually. The acoustic source was active at full volume on a survey line at the time of this detection.

On 15 June 2015, at 05:10 UTC, clicks from unidentified dolphins were observed on the Pamguard high frequency click detector (acoustic detection #7). There were no distinct click trains, so the bearing of the dolphins could not be determined. The clicks were last observed at 05:13 UTC. Post-detection analysis of the high frequency recordings through Spectrogram 16 showed over-lapping recurrent clicks of multiple

individuals, with average frequencies of approximately 84 kHz. The detection did not register on the low frequency monitoring system or aurally via the headphones. During the detection, the acoustic source was at full volume on a survey line; however, this detection was not visually confirmed. No mitigation actions were required.

On 16 June 2015, at 01:03 UTC, unidentified dolphin whistles were observed on Pamguard's low frequency spectrogram and a single click train was observed with a bearing of 20 to 100 degrees (acoustic detection #8). The distance to the dolphins was not localized on Pamguard's map module. Post-analysis of low and high frequency recordings of this detection through Spectrogram 16 showed whistles and clicks of two individual dolphins. Up-sweeping and convex whistles, with frequencies ranging from approximately five kHz to 24 kHz, occurred from 01:03:30 UTC to 01:03:54 UTC. Clicks were observed with a peak frequency range of 32 kHz to 166 kHz. The detection registered aurally via the headphones. The acoustic source was at full volume of 700 dB and in production at the time of this detection. The detection was not visually correlated and no mitigation actions were required.

On 19 June 2015, at 10:35:23 UTC whistles from at least two unidentified dolphins were faintly audible and observed on the Pamguard low frequency spectrogram and whistle and moan detector (acoustic detection #9). The whistles were mainly up-sweeping, with a few down-sweeping and sinusoidal between frequencies seven and 18 kHz. The last whistle was detected at 10:39:58 UTC. During the detection the acoustic source was at full volume on a survey line. The detection was not visually confirmed however, possibly due to thick fog that limited visibility to approximately 500 meters at the time. The bearing and distance of the dolphins could not be determined during the detection via PAM.

On 23 June 2015, at 08:49 UTC, clicks from unidentified dolphins were observed on the Pamguard high frequency click detector (acoustic detection #10). The dolphins were located at a bearing of 45 degrees but their distance from the vessel could not be determined due to the short duration of the detection. The clicks were last observed at 08:50 UTC. Post-detection analysis of the high frequency recording through Spectrogram 16 showed over-lapping recurrent clicks of at least three individuals, with average frequencies of approximately 86 kHz. The detection did not register on the low frequency monitoring system or aurally via the headphones. During the detection, the acoustic source was at full volume on a survey line. This detection was not visually confirmed; no mitigation actions were required.

5.3. CONCURRENT VISUAL AND ACOUSTIC DETECTIONS

There were four concurrent visual and acoustic detections during the NJ survey. One of the detections consisted of positively identified short-beaked common dolphins, while the other three were of unidentified dolphins.

On 04 June 2015, at 19:43 UTC, a simultaneous visual and acoustic detection of four unidentified dolphins occurred (visual detection #2 and acoustic detection #2). The dolphins were visually observed to be swimming at a fast pace and exhibited feeding behaviors among a large flock of birds that also appeared to be feeding. The dolphins and birds came within 100 meters of the port bow of the vessel; however, the dolphins were only briefly observed at the surface, showing only their dorsal fins, and the species could not be identified. Acoustically, whistles from the four dolphins were faintly audible and observed on the Pamguard low frequency spectrogram and whistle and moan detector. The whistles were dominantly upsweeping with a few sinusoidal whistles which had a frequency range of five to 24

kilohertz. As the dolphins were not visually observed within the predicted 180 dB exclusion zone, no mitigation actions were required.

On 8 June 2015, a simultaneous visual and acoustic detection of short-beaked common dolphins occurred (visual detection #12 and acoustic detection #3). The dolphins were detected both visually and acoustically at 19:05 UTC and were visually observed to bow ride briefly and come within 320 meters to the source, the closest distance to the source. Though visually only four individuals were observed, overlapping whistles acoustically detected both aurally on Pamguard low frequency spectrogram and whistle and moan detector indicated the presence of at least eight individuals. Upsweeping, down sweeping and sinusoidal whistle signatures with frequencies ranging from six to 24 kilohertz were observed along with click trains were with frequencies that ranged from 18 to 24 kilohertz. The dolphins were last visually detected at 19:18 UTC, though they continued to be acoustically detected until 19:27 UTC. This detection resulted in a delayed ramp up of the acoustic source.

On 12 June 2015, a simultaneous visual and acoustic detection of unidentified dolphins occurred (visual detection #22 and acoustic detection #6). Visual observers sighted five unidentified dolphins at 09:23 UTC approximately 80 meters off the starboard bow of the vessel. The dolphins were heading towards the bow, but as they approached the vessel, they dove out of sight. Visual observation was lost at 09:24 UTC. At this time clicks from at least two dolphins appeared on the Pamguard high frequency click detector. The clicks had a peak amplitude between 180 and 190 decibels; however there were no distinct click trains, so the bearing of the dolphins could not be determined. The last clicks were observed at 09:29:04 UTC. Post-detection analysis of the recordings in Spectrogram 16 revealed that the clicks had a frequency range between 15 and 94 kilohertz, with several clicks peaking as high as 166 kilohertz. As the dolphins were not visually observed within the predicted 180 dB exclusion zone, no mitigation actions were required.

On 4 July 2015, a simultaneous visual and acoustic detection of unidentified dolphins occurred (visual detection #92 and acoustic detection #11). At 00:31 UTC approximately 16 unidentified dolphins were visually sighted 600 meters off the port bow of the vessel. The dolphins were observed blowing and splashing at the surface, traveling at a moderate pace in the opposite direction of the vessel heading southeast. PSOs notified the PAM operator of the presence of the dolphins, and at 00:32 UTC several faint whistles from at least one individual were audible. Background noise levels were observed to be relatively high during this period of acoustic monitoring and the whistles were not observed on the Pamguard spectrogram or whistle and moan detector. Acoustic detection of the dolphins ended at 00:33 UTC, and the dolphins were last visually observed at 00:38 UTC approximately 800 meters off the port stern still heading away from the vessel. As the dolphins were not visually observed within the predicted 180 dB exclusion zone, no mitigation actions were required.

6. MITIGATION ACTION SUMMARY

There were 53 mitigation actions implemented during the NJ survey due to protected species being observed within, entering or approaching the predicted 180 dB and 190 dB exclusion zone radii. This included one delayed ramp-up for cetaceans totaling 25 minutes; seven power downs for cetaceans totaling two hours 12 minutes 30 seconds; 41 power downs for sea turtles totaling four hours five minutes; two shut downs for cetaceans totaling one hour 42 minutes 30 seconds; and two shut downs for sea turtles totaling eight minutes (Table 8). Overall, mitigation actions during the survey totaled eight hours 33 minutes. Forty of the mitigation actions were implemented during acquisition of a survey line, which resulted in a total production loss of eight hours 13 minutes.

Table 8. Number and duration of mitigation actions implemented during the NJ survey

Mitigation Action	Cetaceans		Sea Turtles	
	Number	Duration (hh:mm)	Number	Duration (hh:mm)
Delayed Ramp-up	1	00:25	-	-
Power-down	7	02:12:30	41	04:05
Shut-down	2	01:42:30	2	00:08
Total	**10**	**04:20**	**43**	**04:13**

Loggerhead sea turtle detections resulted in the greatest number and duration of mitigation actions with 30 power downs and two shut downs of the acoustic source (36% of the total project mitigation downtime). Unidentified sea turtles had the second highest number of mitigation actions with 11 power downs; however, fin whales had the second greatest duration of mitigation actions (29% of the total project mitigation downtime) (Table 9). The mitigation down time for fin whales was a result of the extra mitigation actions implemented for that species between 11 and 23 June 2015. As a species group (whales, dolphins, or turtles), sea turtle detections were responsible for 48% (four hours 13 minutes) of the total mitigation downtime for the survey (Figure 21).

Table 9: Mitigation actions and downtime duration by species

Species	Number of Delayed Ramp-ups	Number of Power-downs	Number of Shut-downs	Duration of Mitigation action (h:mm)	Percentage of Mitigation Downtime
Loggerhead sea turtle	-	30	2	03:10	**36**
Unidentified sea turtle	-	11	-	01:03	**12**
Short-beaked common dolphins	1	1	-	00:59	**11**
Unidentified dolphins	-	2	-	00:30	**6**
Fin whales	-	3	2	02:20	**29**
Unidentified whales	-	1	-	00:31	**6**

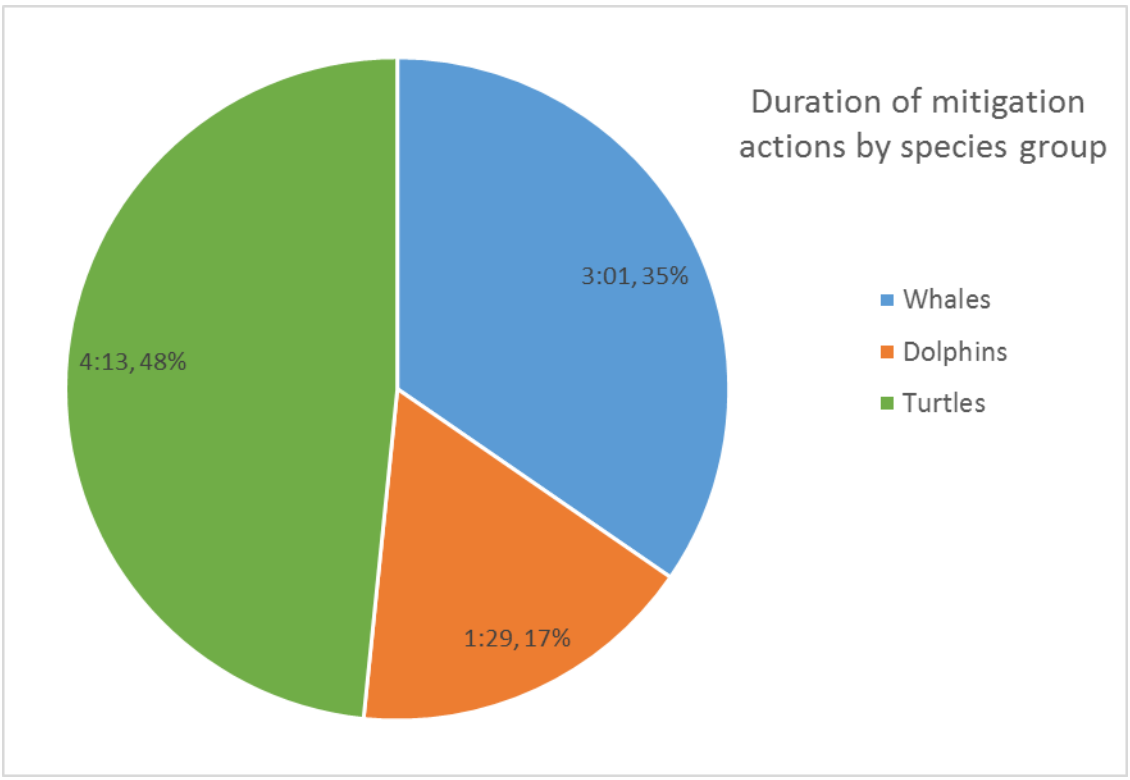

Figure 21: Duration of mitigation actions by protected species group

Each mitigation action implemented during the survey is summarized in

Table 10 and described in detail below. In order to resume operations following a power-down or shut-down implemented for a sea turtle, the speed of the vessel was used to calculate the distance traveled by the vessel which would place the turtle outside of the predicted radius, assuming that the turtle is relatively stationary with respect to the vessel.

On 7 June 2015, five power-downs were implemented for marine mammals and sea turtles totaling 38 minutes.

At 12:45 UTC, the acoustic source was powered-down for a visual detection of unidentified dolphins observed within the predicted 180 dB exclusion zone (visual detection #3). The dolphins were initially observed 900 meters from the source, but they came within a closest distance of 300 meters during the detection. The dolphins were last observed still inside the 180 dB exclusion zone at 12:47 UTC and after the required 15 minute wait period for small cetaceans, the source resumed full volume at 13:02 UTC. As the vessel was on a line change during this time, there was no production loss associated with this mitigation action.

At 14:49 UTC, a power-down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #5). The turtle was initially observed approximately 450 meters from the source and movement of the vessel brought the turtle within 300 meters at the closest observed distance, at which time the source had already been reduced in volume to the single active airgun. Sighting of the turtle was lost at 14:50 UTC and the source was returned to full volume at 14:55 UTC. As the vessel was on line at this time, there was six minutes of production loss associated with this mitigation action.

At 18:16 UTC, a power-down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #7). The turtle was initially observed within 300 meters to the source and movement of the vessel brought the turtle within 200 meters (by which time the source had already been reduced in volume to the single active airgun) before sighting was lost. The source resumed full volume at 18:21 UTC. As the vessel was on line at this time, there was five minutes of production loss associated with this mitigation action.

At 20:34 UTC, a power-down was implemented for an unidentified sea turtle observed within the predicted 180 dB exclusion zone (visual detection #9). The turtle was initially observed 300 meters from the source and movement of the vessel brought the turtle within 200 meters (by which time the source had already been reduced in volume to the single active airgun) before sighting was lost. The source resumed full volume at 20:38 UTC. As the vessel was on a line change during this time there was no production loss associated with this mitigation action.

The final mitigation action on 7 June 2015 occurred at 20:55 UTC when a power-down was implemented for an unidentified sea turtle observed within the predicted 180 dB exclusion zone (visual detection #10). The turtle was initially sighted 300 meters from the source and movement of the vessel brought the turtle within 200 meters, (by which time the source had already been reduced in volume to the single active airgun), the closest distance from the source during detection. The turtle was last sighted outside of the 180dB zone, at 400 meters astern of the source, at which point the full volume was resumed at 21:01 UTC. As the vessel was on line at this time, there was six minutes of production loss associated with this mitigation action.

On 8 June 2015, ramp up of the source was delayed for 25 minutes following a detection of common dolphins observed within the predicted 180 dB exclusion zone (visual detection #12 and acoustic detection #3). The dolphins were initially observed approximately 1100 meters from the source and were observed at the closest distance of 320 meters. The last visual detection of the dolphins was at

19:18 UTC still inside the 180 dB exclusion zone, though they continued to be acoustically detected for several additional minutes. There was a miscommunication between the PAM operator, PSOs, and the seismic observers regarding the time of last visual detection which resulted in ramp up of the source being delayed 25 minutes instead of the required 15 minutes for small cetaceans. However, the additional 10 minutes of delay did not result in the loss of any acquisition of data along the survey track line and therefore no production loss was associated with the mitigation action.

On 10 June 2015, there were five mitigation actions for sea turtles implemented, with four power-downs totaling 18 minutes and one shut-down totaling five minutes. The shut-down and one of the power-downs were implemented for the same detection.

At 14:25 UTC, a power-down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #14). The turtle was initially observed 300 meters from the source and movement of the vessel brought the turtle within 250 meters (by which time the source had already been reduced in volume to the single active airgun) before sighting was lost. The source resumed full volume at 14:31 UTC, and as the vessel was on line at this time, there were six minutes of production loss associated with this mitigation action.

At 17:25 UTC, a power-down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #15). The turtle was initially observed 200 meters from the source, and came within 150 meters (by which time the source had already been reduced in volume to the single active airgun), the closest distance during the detection. The source resumed full volume at 17:30 UTC, and as the vessel was on a line change during this time, there was no production loss associated with this mitigation action.

At 17:58 UTC, a power-down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #16). The turtle was initially observed 300 meters from the source. However, the vessel was turning at the time, and movement of the vessel brought the turtle within 75 meters of the source (by which time the source had already been reduced in volume to the single active airgun), within the 190 dB exclusion zone, and a shut-down was implemented at 17:59 UTC. The mitigation gun was re-enabled at 18:04 UTC and the source resumed full volume at 18:07 UTC. As the vessel was on a line change during this time, there was no production loss associated with these mitigation actions.

At 19:47 UTC, a power-down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #19). The turtle was initially observed 400 meters from the source and was observed at 175 meters (by which time the source had already been reduced in volume to the single active airgun), the closest distance during the detection. The source resumed full volume at 19:53 UTC, and as the vessel was on line during this time, there were six minutes of production loss associated with this detection.

On 12 June 2015, there were two mitigation actions implemented. Both were power-downs, one for a loggerhead sea turtle and one for an unidentified whale, totaling 37 minutes.

At 17:57 UTC, a power-down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #23). The turtle was initially observed 330 meters from the source and at the vessel approached to within 200 meters (by which time the source had already been reduced in volume to the single active airgun), the closest distance during the detection. The source resumed full volume at 18:03 UTC and as the vessel was on line during this time, there were six minutes of production loss associated with this mitigation action.

At 22:21 UTC, a power-down was implemented for an unidentified whale observed within the predicted 180 dB exclusion zone (visual detection #24). The whale was initially observed at a distance of 500 meters from the source and at 250 meters, the closest distance during the detection. Sighting of the whale was lost at 22:22 UTC when it dove still inside the predicted 180 dB zone, and as the whale was not observed leaving the exclusion zone, the source did not resume full volume until 22:52 UTC, after the required 30 minutes had passed. As the vessel was on line during this time, there were 31 minutes of production loss associated with this mitigation action.

On 13 June 2015, there were two mitigation actions implemented, both of which were power downs for fin whales and short-beaked common dolphins totaling one hour eight minutes. Both mitigation actions were performed following the implementation of extra mitigation measures in response to the takes for these two species having already been exceeded (see Section 5.1.1).

At 14:34 UTC, a power-down was implemented for a pod of positively identified short-beaked common dolphins observed with the predicted 160 dB zone for the full volume source (visual detection #26). The dolphins were initially sighted at a distance of 1500 meters to the source, and came within a closest distance of 1089 meters during the detection. At the beginning of the detection, a whale had been sighted nearby the dolphins a few minutes earlier at a distance of 2000 meters (visual detection #25). At 14:38 UTC the whale was last sighted at 2400 meters and was positively identified as a fin whale. The dolphins were last observed still within the full volume predicted 160 dB zone at 14:46 UTC. However, as the fin whale was also last observed within this area, the source did not resume full volume until 15:08 UTC, after the required 30 minutes had passed since the last sighting of the whale. As the vessel was on line at this time, there were 34 minutes of production loss associated with this mitigation action.

At 15:49 UTC, a power-down was implemented for two positively identified fin whales observed within the predicted 160 dB zone for the full volume source (visual detection #27). The whales had initially been sighted approximately 5500 meters from the source, but were not positively identified until the time of the power-down, when they were at 1089 meters, the closest distance during the detection. Sighting of the whales was lost at 15:53 UTC, and as they were last observed within the full volume predicted 160 dB zone, the source did not resume full volume until 16:23 UTC after the required 30 minutes had passed. As the vessel was on line at this time, there were 34 minutes of production loss associated with this mitigation action.

On 14 June 2015, 13 mitigation actions were implemented for protected species totaling two hours eight minutes. This includes 11 power downs totaling one hour 24 minutes and two shut downs totaling 44 minutes. Nine of the power downs were implemented for sea turtles, along with one for dolphins and one for whales. The whale power down also resulted in one of the shut downs, and one of the sea turtle power downs resulted in the other shut down.

At 10:27 UTC, a power down was implemented for a whale thought to be a fin whale observed within the predicted 160 dB zone for the full volume source (visual detection #30). The whale was positively identified as a fin whale at 10:30 UTC, and as it was within the predicted 160 dB zone for the mitigation gun (955 meters), the source was immediately shut down. The whale was observed at of 500 meters, the closest distance to the source during the detection. As the whale was not observed leaving the predicted 160 dB zone for the full source (5,240 meters), and the source was shut down for longer than the allowable eight minutes of silence during the detection, a ramp up was performed from 11:11 UTC to 11:41 UTC after the required 30 minutes for large cetaceans had passed. As the vessel was on line during this time, there was one hour and 15 minutes of production loss associated with this mitigation action.

At 13:37 UTC, the source was powered down for two loggerhead sea turtles observed within the predicted 180 dB exclusion zone (visual detection #32). The turtles were initially observed at a distance of 745 meters from the starboard bow of the vessel and 990 meters from the source, and came within 120 meters (by which time the source had already been reduced in volume to the single active airgun), the closest distance from the source during the detection. Sighting of both turtles was lost at 13:40 UTC and, as neither was observed exiting the 180 dB radius, the source resumed full volume at 13:45 UTC. As the vessel was on line at this time, there were eight minutes of production loss associated with this mitigation action.

At 14:11 UTC, a power down was implemented for an unidentified sea turtle observed within the predicted 180 dB exclusion zone (visual detection #34). The turtle was initially observed 883 meters from the source off the port bow of the vessel, and was observed at 200 meters (by which time the source had already been reduced in volume to the single active airgun), the closest distance from the source during the detection. Sighting of the turtle was lost at 14:12 UTC and the source resumed full volume at 14:17 UTC. As the vessel was on line during this time, there were six minutes of production loss associated with this mitigation action.

At 14:37 UTC, a power down was implemented for an unidentified sea turtle observed within the predicted 180 dB exclusion zone (visual detection #36). The turtle was initially sighted within the exclusion zone approximately 300 meters from the source, and was observed at 210 meters (by which time the source had already been reduced in volume to the single active airgun), the closest distance from the source during the detection. The turtle was sighted exiting the 180 dB radius at 14:43 UTC and the source resumed full volume at 14:45 UTC. As the vessel was on line during this time, there were eight minutes of production loss associated with this mitigation action.

At 14:51 UTC, a power down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #37). The turtle was initially sighted 773 meters from the source at 14:48 UTC off the port bow of the vessel and entered the exclusion zone at 14:51 UTC. At 14:53 UTC, the turtle entered the 190 dB exclusion zone, coming within 95 meters (by which time the source had already been reduced in volume to the single active airgun), the closest distance from the source during the detection, and a shut-down was implemented. The turtle was observed leaving the 180 dB radius of the full source at 14:56 UTC and the source resumed full volume at this time. As the vessel was on line at this time, there were five minutes of protection loss associated with these mitigation actions.

At 15:13 UTC, a power down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #38). The turtle was initially observed approximately 340 meters from the source off the port side of the vessel. At 15:16 UTC, a second loggerhead sea turtle (visual detection #39) was sighted within the 180 dB exclusion zone, also at an initial distance of approximately 340 meters to the source. The first turtle was observed at 200 meters (by which time the source had already been reduced in volume to the single active airgun), the closest distance from the source to the source, and the second turtle at a closest distance of 270 meters. The first turtle was observed leaving the 180 dB radius at 15:17 UTC, at which time sighting of the second turtle was also lost when it was still within that radius. The survey line ended at 15:18 UTC, and the operators decided to leave the mitigation gun active through the line change, and the source did not resume full volume until the next survey line. There were five minutes of production loss associated with this mitigation action.

At 17:10 UTC, a power down was implemented for two loggerhead sea turtles observed within the predicted 180 dB exclusion zone (visual detection #42). The turtles were initially observed approximately

340 meters to the source and at 250 meters, the closest distance from the source during the detection. The turtles were last observed at 17:13 UTC still within the 180 dB radius, and the source resumed full volume at 17:18 UTC. As the vessel was on line during this time there were eight minutes of production loss associated with this mitigation action.

At 17:27 UTC, a power down was implemented for two loggerhead sea turtles observed within the predicted 180 dB exclusion zone (visual detection #43). The turtles were observed at an initial distance of approximately 300 meters from the source and then at 200 meters (by which time the source had already been reduced in volume to the single active airgun), the closest distance from the source during the detection. Sighting of the turtles was lost at 17:35 UTC and the source resumed full volume at 17:40 UTC. As the vessel was on line at this time there were 13 minutes of production loss associated with this mitigation action.

At 17:56 UTC, a power down was implemented for dolphins that were initially thought to be short-beaked common dolphins within the predicted 160 dB zone for the full volume source (visual detection #44). The dolphins were initially sighted 1000 meters off the port bow of the vessel, and came no closer than 1500 meters to the source during the detection. At 18:02 UTC, observers determined that they were not short-beaked common dolphins and gave clearance to resume full volume. However, before the full source could be initiated, a loggerhead sea turtle was sighted within the 180 dB exclusion zone (visual detection #45), so the source remained powered down until after the turtle was clear. The source resumed full volume at 18:09 UTC and, as the vessel was on line during this time, there were 13 minutes of production loss associated with this mitigation action.

At 18:59 UTC, a power down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #47). The turtle was initially sighted approximately 300 meters from the source and at approached to within 120 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). At 19:04 UTC the turtle was observed exiting the 180 dB radius and a second turtle was sighted within the 180 dB exclusion zone at an initial distance of 400 meters to the source. This turtle came within 350 meters (the source still powered down with only the single airgun active) at the time sighting was lost at 19:06 UTC. The source resumed full volume at 19:11 UTC and, as the vessel was on line during this time, there were 12 minutes of production loss associated with this mitigation action.

The final mitigation action on the 14th was a power down at 19:32 UTC for a loggerhead sea turtle observed within the 180 dB exclusion zone (visual detection #48). The turtle was observed at an initial distance of approximately 300 meters to the source and approached to within 190 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). The turtle was sighted exiting the 180 dB radius at 19:37 UTC and the source resumed full volume at 19:38 UTC. As the vessel was on line during this time, there were six minutes of production loss associated with the mitigation action.

There were two mitigation actions implemented on 16 June 2015, both for loggerhead sea turtles, totaling 12 minutes.

At 13:50 UTC, a power down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #49). The turtle was initially observed floating at the surface heading away from the vessel approximately 50 meters off the starboard side of the vessel and 300 meters from the source. Due to a thick fog at the time which limited visibility to approximately 200 meters, sighting of the turtle was quickly lost off the starboard stern when the turtle was approximately 130 meters from the source (by which time the source had already been reduced in volume to the single

active airgun). The source resumed full volume at 13:55 UTC and, as the vessel was on line at the time, there were six minutes of production loss associated with this mitigation action.

At 15:42 UTC, a power down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #51). The turtle was sighted briefly at the surface approximately 250 meters from the source off the starboard side of the vessel and came within 200 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). Sighting of the turtle was lost at 15:43 UTC and the source resumed full volume at 15:48 UTC. As the vessel was on line during this time, there were six minutes of production loss associated with this mitigation action.

There were three mitigation actions implemented 19 June 2015 for loggerhead sea turtles, totaling 18 minutes.

At 13:32 UTC, a power down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #58). The turtle was initially sighted 300 meters from the source and was later observed at 270 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). Sighting of the turtle was lost at 13:32 UTC and the source resumed full volume at 13:37 UTC. As the vessel was on line during this time, there were five minutes of production loss associated with this mitigation action.

At 16:48 UTC, a power down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #59). The turtle was initially sighted approximately 300 meters from the source and was later observed at 125 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). Sighting of the turtle was lost at 16:50 UTC and the source resumed full volume at 16:54 UTC. As the vessel was on line during this time, there were six minutes of production loss associated with this mitigation action.

At 19:12 UTC, a power down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #61). The turtle was sighted approximately 300 meters from the source and was later observed at 190 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). Sighting of the turtle was lost as 19:14 UTC and the source resumed full volume at 19:19 UTC. As the vessel was on line during this time, there were seven minutes of production loss associated with this mitigation action.

There was one mitigation action implemented on 20 June 2015. At 09:53 UTC a power down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #64). The turtle was initially sighted 300 meters from the source off the starboard side of the vessel and was immediately lost from view. The source resumed full volume at 09:58 UTC. As the vessel was on line during this time, there were five minutes of production loss associated with this mitigation action.

There were five mitigation actions implemented on 22 June 2015, including a power down and a shut down for fin whales and three power downs for sea turtles totaling one hour 50 minutes.

At 13:51 UTC, a power down was implemented for an unidentified whale sighted within the predicted 180 dB exclusion zone (visual detection #67). The whale was initially sighted 1535 meters from the source and was observed at 315 meters the closest distance from the source during the detection. Less

than a minute later, the whale was positively identified as a fin whale. Per the additional mitigation actions put in place for that species at the time, the source was immediately shut down at 13:51 UTC. At 13:56 UTC, a second fin whale was sighted 505 meters from the source, which was also that whales' closest distance from the source. Sighting of the second whale was lost at 14:09 UTC when it was 2314 meters from the source, and sighting of the first whale was lost at 14:23 UTC when it was 3796 meters from the source. As neither whale was observed leaving the predicted 160 dB zone for the full volume source (5,240 meters), ramp-up was not initiated until the required 30 minutes had passed at 14:53 UTC. The source reached full volume at 15:24 UTC and the survey line was resumed at that time. As the vessel was on line during the detection, there was one hour and 33 minutes of production loss associated with these mitigation actions.

At 17:06 UTC, a power down of the source was implemented for a loggerhead sea turtle that was sighted within the predicted 180 dB radius (visual detection #68). The turtle was initially sighted 300 meters from the source and came within 270 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). The turtle was last sighted at 17:07 UTC and the source resumed full volume at 17:12 UTC. As the vessel was on line during this time, there were six minutes of production loss associated with this mitigation action.

At 17:32 UTC, a power down was implemented for an unidentified sea turtle sighted within the predicted 180 dB radius (visual detection #69). The turtle was initially sighted 300 meters from the source and approached to within 200 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). The turtle was last sighted at 17:34 UTC and the source resumed full volume at 17:38 UTC. As the vessel was on line during this time, there were six minutes of production loss associated with this mitigation action.

Finally, at 18:19 UTC a power down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #70). The turtle was initially sighted approximately 300 meters from the source and was later observed at 280 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). Sighting of the turtle was lost almost immediately after its initial detection, and the source resumed full volume at 18:24 UTC. As the vessel was on line during this time there were five minutes of production loss associated with this mitigation action.

On 24 June 2014, there were four mitigation actions implemented for sea turtles totaling 22 minutes.

At 14:26 UTC, a power down was implemented for an unidentified sea turtle observed within the predicted 180 dB exclusion zone (visual detection #71). The turtle was initially sighted approximately 300 meters from the source and was observed at a closest distance of 150 meters during the detection (by which time the source had already been reduced in volume to the single active airgun). The turtle was observed exiting the exclusion zone at 14:29 UTC and the source resumed full volume at 14:30 UTC. As the vessel was on line during this time, there were four minutes of production loss associated with this mitigation action.

At 14:52 UTC, a power down was implemented for an unidentified sea turtle observed within the predicted 180 dB exclusion zone (visual detection #72). The turtle was initially sighted approximately 300 meters from the source and was later observed at 150 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). Sighting of the turtle was lost at 14:53 UTC while it was still within the exclusion zone, and the

source resumed full volume at 14:58 UTC. As the vessel was on line during this time, there were six minutes of production loss associated with this mitigation action.

At 17:17 UTC, a power down was implemented for an unidentified sea turtle observed within the predicted 180 dB exclusion zone (visual detection #73). The turtle was initially sighted approximately 300 meters from the source and was later observed at 250 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). Sighting of the turtle was lost at 17:18 UTC while it was still within the exclusion zone, and the source resumed full volume at 17:23 UTC. As the vessel was on a line change during this time, there was no production loss associated with this mitigation action.

At 20:05 UTC, a power down was implemented for an unidentified sea turtle observed within the predicted 180 dB exclusion zone (visual detection #75). The turtle was initially sighted approximately 340 meters from the source and was later observed at 270 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). Sighting of the turtle was lost almost immediately after initial observation, and the source resumed full volume at 20:11 UTC. As the vessel was on line during this time, there were six minutes of production loss associated with this mitigation action.

On 28 June 2015, there was one mitigation action implemented. At 19:20 UTC a power down was implemented for an unidentified sea turtle observed within the predicted 180 dB exclusion zone (visual detection #83). The turtle was initially sighted approximately 290 meters from the source and later observed at 150 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). Sighting of the turtle was lost at 19:21 UTC and the source resumed full volume at 19:26 UTC. As the vessel was on line during this time, there were six minutes of production loss associated with this mitigation action.

On 1 July 2015, there were three mitigation actions implemented for loggerhead sea turtles totaling 18 minutes.

At 15:18 UTC, a power down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #86). The turtle was initially sighted 300 meters from the source and was later observed at a closest distance of 270 meters during the detection (by which time the source had already been reduced in volume to the single active airgun). Sighting of the turtle was lost at 15:19 UTC and the source resumed full volume at 15:24 UTC. As the vessel was on line during this time, there were six minutes of production loss associated with this mitigation action.

At 16:33 UTC, a power down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #87). The turtle was initially sighted 300 meters from the source and was later observed at 270 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). Sighting of the turtle was lost at 16:34 UTC and the source resumed full volume at 16:39 UTC. As the vessel was on a line change during this time, there was no production loss associated with this mitigation action.

At 17:20 UTC, a power down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #88). The turtle was initially sighted 300 meters from the source and was later observed at 270 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). Sighting of the turtle was lost at 17:21 UTC and the source resumed full volume at 17:26 UTC. As the

vessel was on line during this time, there were six minutes of production loss associated with this mitigation action.

On 3 July 2015, there was one mitigation action implemented. At 14:29 UTC a power down was implemented for an unidentified sea turtle sighted within the predicted 180 dB exclusion zone (visual detection #90). The turtle was initially sighted approximately 310 meters from the source and was later observed at 300 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). The turtle was quickly diving out of sight when it was initially observed and the source resumed full volume at 14:34 UTC. As the vessel was on line during this time, there were five minutes of production loss associated with this mitigation action.

On 5 July 2015, there were five mitigation actions implemented for loggerhead sea turtles totaling 29 minutes.

At 14:58 UTC, a power down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #93). The turtle was initially sighted approximately 600 meters from the source, and was later observed at 270 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). Sighting of the turtle was lost at 14:58 UTC when it dove when it was still within the 180 dB radius, and the source resumed full volume at 15:04 UTC. As the vessel was on line during this time, there were six minutes of production loss associated with this mitigation action.

At 16:32 UTC, a power down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #94). The turtle was initially sighted approximately 300 meters from the source, which was also the closest distance the sea turtle was observed to the source. The turtle dove out of sight almost immediately after first observation, and the source resumed full volume at 16:37 UTC. As the vessel was on line during this time, there were five minutes of production loss associated with this mitigation action.

At 18:32 UTC, a power down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #95). The turtle was initially sighted approximately 300 meters from the source, and was later observed at 200 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). The turtle dove out of sight at 18:33 UTC when it was still within the 180 dB radius, and the source resumed full volume at 18:38 UTC. The vessel was on a line change during this time and there was no production loss associated with this mitigation action.

At 19:09 UTC, a power down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #96). The turtle was initially sighted approximately 320 meters from the source, and was later observed at 120 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). Sighting of the turtle was lost at 19:10 UTC and the source resumed full volume at 19:16 UTC. As the vessel was on a line change during this time, and there was no production loss associated with this mitigation action.

At 21:59 UTC, a power down was implemented for a loggerhead sea turtle observed within the predicted 180 dB exclusion zone (visual detection #97). The turtle was initially sighted approximately 300 meters from the source, and was later observed at 250 meters, the closest distance from the source during the detection (by which time the source had already been reduced in volume to the single active airgun). Sighting of the turtle was lost almost immediately after initial observation and the source

resumed full volume at 22:04 UTC. As the vessel was on line during this time, there were five minutes of protection loss associated with this mitigation action.

Table 10. Summary of each mitigation action implemented during the NJ 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	Total Duration of Production Loss
7 June 2015	3	Unidentified dolphin	2	Full volume off line	300	Power down	00:17	00:00
7 June 2015	5	Loggerhead sea turtle	1	Full volume on line	300	Power down	00:06	00:06
7 June 2015	7	Loggerhead sea turtle	1	Full volume on line	200	Power down	00:05	00:05
7 June 2015	9	Unidentified sea turtle	1	Full volume off line	200	Power down	00:04	00:00
7 June 2015	10	Unidentified sea turtle	1	Full volume on line	200	Power down	00:06	00:06
8 June 2015	12	Short-beaked common dolphins	4	Single 40 in^3 gun	320	Delayed ramp-up	00:25	00:00
10 June 2015	14	Loggerhead sea turtle	1	Full volume on line	250	Power down	00:06	00:06
10 June 2015	15	Loggerhead sea turtle	1	Full volume off line	150	Power down	00:05	00:00
10 June 2015	16	Loggerhead sea turtle	1	Full volume off line	75	Power down/shut down	00:06	00:00
10 June 2015	19	Loggerhead sea turtle	1	Full volume on line	175	Power down	00:06	0:06
12 June 2015	23	Loggerhead sea turtle	1	Full volume on line	200	Power down	00:06	00:06
12 June 2015	24	Unidentified whale	1	Full volume on line	250	Power down	00:31	00:31
13 June 2015	25	Fin whale	1	Full volume on line	2000	Power down	00:34	00:34
13 June 2015	26	Short-beaked common dolphins	15	Full volume on line	1500			
13 June 2015	27	Fin whale	2	Full volume on line	1089	Power down	00:34	00:34
14 June 2015	30	Fin whale	1	Full volume on line	500	Power down/shut down	00:44	01:15
14 June 2015	32	Loggerhead sea turtle	2	Full volume on line	120	Power down	00:08	00:08
14 June 2015	34	Unidentified sea turtle	1	Full volume on line	200	Power down	00:06	00:06
14 June 2015	36	Unidentified sea turtle	1	Full volume on line	210	Power down	00:08	00:08
14 June 2015	37	Loggerhead sea turtle	1	Full volume on line	95	Power down/shut down	00:05	00:05
14 June 2015	38	Loggerhead sea turtle	1	Full volume on line	200	Power down	00:05	00:05

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	Total Duration of Production Loss
14 June 2015	42	Loggerhead sea turtle	2	Full volume on line	250	Power down	00:08	00:08
14 June 2015	43	Loggerhead sea turtle	2	Full volume on line	200	Power down	00:13	00:13
14 June 2015	44	Unidentified dolphins	30	Full volume on line	1500	Power down	00:13	00:13
14 June 2015	45	Loggerhead sea turtles	1	Single 40 in^3 gun	300			
14 June 2015	47	Loggerhead sea turtle	2	Full volume on line	120	Power down	00:12	00:12
14 June 2015	48	Loggerhead sea turtle	1	Full volume on line	190	Power down	00:06	00:06
14 June 2015	49	Loggerhead sea turtle	1	Full volume on line	130	Power down	00:06	00:06
16 June 2015	51	Loggerhead sea turtle	1	Full volume on line	200	Power down	00:06	00:06
19 June 2015	58	Loggerhead sea turtle	1	Full volume on line	270	Power down	00:05	00:05
19 June 2015	59	Loggerhead sea turtle	1	Full volume on line	125	Power down	00:06	00:06
19 June 2015	61	Loggerhead sea turtle	1	Full volume on line	190	Power down	00:07	00:07
20 June 2015	64	Loggerhead sea turtle	1	Full volume on line	300	Power down	00:05	00:05
22 June 2015	67	Fin whale	2	Full volume on line	315	Power down/shut down	01:02	01:33
22 June 2015	68	Loggerhead sea turtle	1	Full volume on line	270	Power down	00:06	00:06
22 June 2015	69	Unidentified sea turtle	1	Full volume on line	200	Power down	00:06	00:06
22 June 2015	70	Loggerhead sea turtle	1	Full volume on line	280	Power down	00:05	00:05
24 June 2015	71	Unidentified sea turtle	1	Full volume on line	150	Power down	00:04	00:04
24 June 2015	72	Unidentified sea turtle	1	Full volume on line	150	Power down	00:06	00:06
24 June 2015	73	Unidentified sea turtle	1	Full volume on line	250	Power down	00:06	00:06
24 June 2015	75	Unidentified sea turtle	1	Full volume on line	270	Power down	00:06	00:06
28 June 2015	83	Unidentified sea turtle	1	Full volume on line	150	Power down	0:06	00:06
1 July 2015	86	Loggerhead sea turtle	1	Full volume on line	270	Power down	0:06	00:06
1 July 2015	87	Loggerhead sea turtle	1	Full volume off line	270	Power down	0:06	00:00
1 July 2015	88	Loggerhead sea turtle	1	Full volume on line	270	Power down	0:06	00:06

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	Total Duration of Production Loss
3 July 2015	90	Unidentified sea turtle	1	Full volume on line	300	Power down	00:05	00:05
5 July 2015	93	Loggerhead sea turtle	1	Full volume on line	270	Power down	00:06	00:06
5 July 2015	94	Loggerhead sea turtle	1	Full volume on line	300	Power down	00:05	00:05
5 July 2015	95	Loggerhead sea turtle	1	Full volume off line	200	Power down	00:06	00:00
5 July 2015	96	Loggerhead sea turtle	1	Full volume off line	120	Power down	00:07	00:00
5 July 2015	97	Loggerhead sea turtle	1	Full volume on line	250	Power down	00:05	00:05

6.1. MARINE MAMMALS OBSERVED WITHIN THE PREDICTED 160 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 32 marine mammal species and four sea turtle species. 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 (loggerhead sea turtles and an unidentified shelled turtle) 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 180dB mitigation zone.

A total of 20,926 takes were authorized, including 20,686 marine mammal takes (including 79 takes of ESA-listed whales) and 240 endangered sea turtle takes. Direct visual observations recorded by PSOs include three species of marine mammals and one species of sea turtles under which Level B harassment takes were granted in the IHA. These observations provide a minimum estimate of the actual number of protected species potentially exposed to received sound levels within the predicted 190 dB, 180 dB and 160 dB zones.

During the NJ survey, 13 fin whales, two humpback whales, 18 unidentified whales, 50 short-beaked common dolphins, 108 unidentified dolphins, 40 loggerhead sea turtles and 15 unidentified sea turtles were observed within the predicted 160 dB radius (166 dB for sea turtles), where Level B harassment is expected to occur, while the source was active (Table 11). Of these totals, two fin whales, one unidentified whale, two unidentified dolphins, 32 loggerhead sea turtles and 11 unidentified sea turtles were observed within the predicted 180 dB radius, and two loggerhead sea turtles were observed within the predicted 190 dB radius.

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 the estimated numbers of animals recorded during each sighting event were underestimates due to some animals not being seen or having moved away before they were observed. This is most likely to have occurred during detection events consisting of many animals, where it would be difficult to count all of those present, and for sea turtles that were not close enough to the surface to be sighted from the vessel. The Beaufort Ssea state has a large impact on the ability to visibly detect many smaller or unobtrusive marine species such as beaked whales and sea turtles. During the NJ Survey, there were a few days during the survey where high Beaufort sea states (greater than level 4) may have resulted in some missed species detections; however, 85% of visual observations were undertaken in conditions where the Beaufort Sea State was rated levels 1-3. Besides night time hours, there were several occasions during daytime when the entire 190 dB, 180 dB and 160 dB radii were not visible due to fog and rain. There were several days when visibility was less than 300 meters for several hours, which would have prevented sighting of any protected species at a greater distance from the vessel.

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 similarly 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 12 describes the behavior of all animals, including unidentified species, which were observed in the predicted 190/180/160 dB zones during the survey. There were no highly distinct behavioral reactions observed in relation to the vessel or acoustic source during the seismic survey.

Table 11. Takes authorized by NMFS IHA and ITS for the NJ survey and number of known individuals observed within the 190 dB, 180 dB and 160 dB zones through visual observations

Species	IHA or ITS Authorized Takes	Number of animals observed within the predicted zones for		
		190 dB	180 dB	160 dB
ESA Listed Species				
North Atlantic right whale	3	0	0	0
Humpback whale	3	0	0	2
Sei whale	5	0	0	0
Fin whale	36	0	2	11
Blue whale	1	0	0	0
Sperm whale	31	0	0	0
Non-Listed Species				
Minke whale	2	0	0	0
Dwarf sperm whale	2	0	0	0
Pygmy sperm whale	2	0	0	0
Cuvier's beaked whale	27	0	0	0
Gervais' beaked whale	27	0	0	0
Sowerby's beaked whale	27	0	0	0
True's Beaked whale	27	0	0	0
Blainville's beaked whale	27	0	0	0
Bottlnose dolphin	12,532	0	0	0
Pantropical spotted dolphin	6	0	0	0
Atlantic spotted dolphin	4,067	0	0	0
Striped dolphin	52	0	0	0
Short-beaked common dolphin	2,113	0	0	50
White-beaked dolphin	16	0	0	0
Atlantic white-sided dolphin	53	0	0	0
Risso's dolphin	1,532	0	0	0
Clymene dolphin	27	0	0	0
Pygmy killer ehale	2	0	0	0
False kiler whale	7	0	0	0
Killer whale	7	0	0	0
Long-finned pilot whale	21	0	0	0
Short-finned pilot whale	21	0	0	0
Harbor porpoise	4	0	0	0
Gray seal	2	0	0	0
Harbor seal	2	0	0	0
Harp seal	2	0	0	0
Sea turtles				
Green sea turtle	27	0	0	0
Kemp's ridley sea turtle	26	0	0	0
Leatherback sea turtle	23	0	0	0
Loggerhead sea turtle	164	2	32	6
Unidentified species				

Unidentified whale	-	0	1	17
Unidentified dolphin	-	0	2	106
Unidentified seal	-	0	0	0
Unidentified sea turtle	-	0	11	4

Table 12: Behavior of species observed within the predicted 160 dB, 180dB, and 190 dB zones

Species	Detection No.	No. of Animals	Predicted 160 dB, 180 dB, and 190 dB Zone	Initial behavior	Initial direction in relation to vessel	Subsequent and Final behavior	Subsequent and Final direction in relation to vessel
Fin whale	13	1	160	Blowing	Perpendicular, ahead of vessel	Normal travel, blowing	Away from vessel
	21	2	160	Blowing	Perpendicular, ahead of vessel	Normal travel, blowing	Away from vessel
	25	1	160	Surface activity	Unknown	Fast travel, blowing	Away from vessel
	27	2	160	Blowing	Parallel, opposite direction	Normal travel, blowing	Parallel, opposite direction
	30	1	160	Surfacing	Parallel, same direction	Slow travel, surfacing	Parallel, same direction
	67	2	180	Blowing	Perpendicular, ahead of vessel	Normal travel, surfacing, blowing, diving	Away from vessel
	76	2	160	Blowing	Away from vessel	Slow travel, surfacing	Away from vessel
	77	1	160	Blowing	Parallel, opposite direction	Slow travel, surfacing, blowing, diving	Parallel, opposite direction
	82	1	160	Blowing	Perpendicular, ahead of vessel	Normal travel, Surfacing, blowing	Away from vessel
Humpback whale	60	1	160	Blowing	Milling	Surfacing, partial breach, tail slapping, blowing	Away from vessel
	74	1	160	Blowing	Perpendicular, ahead of vessel	Normal travel, blowing, surfacing, diving showing fluke	Away from vessel
Unidentified whale	1	1	160	Blowing	Unknown	Normal travel, blowing	Away from vessel
	4	1	160	Blowing	Perpendicular, ahead of vessel	Normal travel, blowing	Parallel, opposite direction
	6	1	160	Blowing	Parallel, opposite direction	Normal travel, blowing	Parallel, opposite direction
	8	1	160	Breaching	Away from vessel	Normal travel, breaching	Away from vessel
	24	1	180	Blowing	Away from vessel	Normal travel, fluking	Parallel, opposite direction

Species	Detection No.	No. of Animals	Predicted 160 dB, 180 dB, and 190 dB Zone	Initial behavior	Initial direction in relation to vessel	Subsequent and Final behavior	Subsequent and Final direction in relation to vessel
Unidentified whale	28	2	160	Blowing	Variable	Normal travel surfacing	Away from vessel
	52	1	160	Blowing	Parallel, opposite direction	Normal travel, surfacing	Parallel, opposite direction
	53	2	160	Blowing	Parallel, same direction	Normal travel, surfacing	Away from vessel
	54	1	160	Blowing	Parallel, opposite direction	Normal travel, blowing	Parallel, opposite direction
	55	2	160	Blowing	Away from vessel	Norma travel, surfacing	Away from vessel
	65	1	160	Blowing	Parallel, opposite direction	Slow travel, surfacing	Parallel, opposite direction
	66	1	160	Blowing	Parallel, opposite direction	Normal travel, surfacing	Parallel, opposite direction
	67	1	160	Blowing	Perpendicular, ahead of vessel	Normal travel, blowing	Away from vessel
	89	1	160	Blowing	Parallel, opposite direction	Normal travel, surfacing, blowing	Parallel, opposite direction
	91	1	160	Blowing	Parallel, opposite direction	Splashing, surfacing, diving	Parallel, opposite direction
Short-beaked common dolphins	12	4	160	Porpoising	Perpendicular, ahead of vessel	Fast travel, surfacing, bow-riding	Away from vessel
	17	31	160	Porpoising	Perpendicular, ahead of vessel	Fast travel, surfacing, porpoising	Away from vessel
	26	15	160	Porpoising	Away from vessel	Fast travel, porpoising	Away from vessel
Unidentified dolphin	2	4	160	Porpoising	Perpendicular, ahead of vessel	Fast travel, possibly feeding	Perpendicular, ahead of vessel
	3	2	180	Surface activity	Parallel, opposite direction	Normal travel, breaching	Parallel, opposite direction
	22	5	160	Porpoising	Towards vessel	Fast travel	Towards vessel
	35	20	160	Surfacing	Away from vessel	Fast travel, porpoising	Away from vessel
	44	30	160	Surface activity	Variable	Normal travel, porpoising, possibly feeding	Away from vessel

Species	Detection No.	No. of Animals	Predicted 160 dB, 180 dB, and 190 dB zone	Initial behavior	Initial direction in relation to vessel	Subsequent and Final behavior	Subsequent and Final direction in relation to vessel
Unidentified dolphin	46	20	160	Porpoising	Parallel, opposite direction	Normal travel, porpoising	Parallel, opposite direction
	57	10	160	Surfacing	Parallel, opposite direction	Fast travel, porpoising	Parallel, opposite direction
	82	1	160	Porpoising	Away from vessel	Normal travel, surfacing	Away from vessel
	92	16	160	Swimming	Parallel, opposite direction	Splashing, surfacing, jumping, blowing	Parallel, opposite direction
Loggerhead sea turtle	5	1	180	Swimming	Away from vessel	Normal travel, swimming	Away from vessel
	7	1	180	Swimming	Parallel, opposite direction	Slow travel, swimming	Parallel, opposite direction
	14	1	180	Swimming	Away from vessel	Normal travel, swimming	Away from vessel
	15	1	180	Swimming	Away from vessel	Slow travel, swimming	Away from vessel
	16	1	190	Swimming	Parallel, opposite direction	Slow travel, surfacing	Parallel, opposite direction
	19	1	180	Floating	Parallel, opposite direction	Slow travel	Parallel, opposite direction
	23	1	180	Swimming	Parallel, same direction	Slow travel, surfacing	Parallel, same direction
	32	2	180	Floating	Parallel, same direction	Slow travel, swimming, diving	Parallel, same direction
	37	1	190	Floating	Parallel, opposite direction	Slow travel, swimming diving	Away from vessel
	38	1	180	Surfacing	Away from vessel	Slow travel	Away from vessel
	39	1	160	Surfacing	Parallel, same direction	Normal travel, swimming	Parallel, same direction
	40	3	160	Swimming	Away from vessel	Normal travel, swimming, diving	Away from vessel
	41	1	160	Surfacing	Towards vessel	Slow travel	Towards vessel
	42	2	180	Surfacing	Towards vessel	Slow travel, swimming, diving	Towards vessel

Species	Detection No.	No. of Animals	Predicted 160 dB, 180 dB, and 190 dB zone	Initial behavior	Initial direction in relation to vessel	Subsequent and Final behavior	Subsequent and Final direction in relation to vessel
Loggerhead sea turtle	43	2	180	Surfacing	Parallel, same direction	Normal travel, swimming diving	Parallel, same direction
	45	1	160	Surfacing	Parallel, opposite direction	Slow travel, swimming	Parallel, opposite direction
	47	2	180	Surfacing	Parallel, same direction	Slow travel	Parallel, same direction
	48	1	180	Swimming	Away from vessel	Slow travel, swimming	Parallel, opposite direction
	49	1	180	Floating	Away from vessel	Slow travel, floating	Away from vessel
	51	1	180	Swimming	Parallel, opposite direction	Normal travel, diving	Away from vessel
	58	1	180	Swimming	Parallel, same direction	Slow travel, diving	Parallel, same direction
	59	1	180	Swimming	Parallel, opposite direction	Normal travel, diving	Parallel, opposite direction
	61	1	180	Floating	Parallel, same direction	Slow travel	Parallel, same direction
	64	1	180	Floating	Parallel, same direction	Slow travel, diving	Parallel, same direction
	68	1	180	Swimming	Parallel, opposite direction	Slow travel, diving	Parallel, opposite direction
	70	1	180	Swimming	Parallel, same direction	Fast travel, swimming, diving	Parallel, same direction
	86	1	180	Swimming	Parallel, same direction	Fast travel, swimming, diving	Parallel, same direction
	87	1	180	Swimming	Parallel, same direction	Fast travel, swimming, diving	Parallel, same direction
	88	1	180	Swimming	Parallel, opposite direction	Normal travel, swimming, diving	Parallel, opposite direction
	93	1	180	Floating	Towards vessel	Fast travel, diving	Parallel, opposite direction
	94	1	180	Swimming	Parallel, opposite direction	Diving	Parallel, opposite direction
	95	1	180	Swimming	Parallel, opposite direction	Diving	Parallel, opposite direction

Species	Detection No.	No. of Animals	Predicted 160 dB, 180 dB, and 190 dB zone	Initial behavior	Initial direction in relation to vessel	Subsequent and Final behavior	Subsequent and Final direction in relation to vessel
Loggerhead sea turtle	96	1	180	Swimming	Away from vessel	Diving	Away from vessel
	97	1	180	Swimming	Parallel, opposite direction	Fast travel, diving	Parallel, opposite direction
Unidentified sea turtle	9	1	180	Swimming	Away from vessel	Fast travel, swimming	Away from vessel
	10	1	180	Floating	Parallel, opposite direction	Slow travel	Parallel, opposite direction
	18	1	160	Floating	Away from vessel	Slow travel	Away from vessel
	33	1	160	Floating	Away from vessel	Slow travel	Away from vessel
	34	1	180	Swimming	Away from vessel	Normal travel, swimming	Away from vessel
	36	1	180	Floating	Towards vessel	Slow travel, swimming	Towards vessel
	50	1	160	Swimming	Away from vessel	Fast travel, diving	Away from vessel
	62	1	160	Floating	Towards vessel	Slow travel	Towards vessel
	69	1	180	Swimming	Parallel, opposite direction	Normal travel, diving	Parallel, opposite direction
	71	1	180	Swimming	Away from vessel	Slow travel	Away from vessel
	72	1	180	Swimming	Parallel, same direction	Normal travel, diving	Parallel, same direction
	73	1	180	Swimming	Parallel, opposite direction	Normal travel, diving	Parallel, opposite direction
	75	1	180	Swimming	Parallel, same direction	Normal travel, swimming	Parallel, same direction
	83	1	180	Swimming	Parallel, same direction	Slow travel, diving	Parallel, same direction
	90	1	180	Diving	Parallel, same direction	Fast travel, diving	Parallel, same direction

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

In order to minimize the potential impacts to protected species and incidental taking of marine mammals and sea turtles during the NJ survey, mitigation measures were implemented whenever these protected species were seen approaching, entering, or within the safety radii designated in the IHA and ITS. Fifty-three mitigation actions were implemented during this survey for cetaceans and sea turtles. Forty-eight power-downs of the acoustic source were implemented, four shut-downs of the acoustic source were implemented and one significant ramp-up delay occurred for a cetacean detection during this survey for 25 minutes. The confirmation of 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 NJ 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. No North Atlantic right whales were observed during the NJ survey and therefore no special mitigation measures were implemented.

Also, concentrations of humpback (*Megaptera novaengliea*), sei (*Balaenoptera borealis*), fin (*Balaenoptera physalus*), blue (*Balaenoptera musculus*), and/or sperm whales (*Physeter macrocephalus*) were to be avoided when possible (i.e. exposing concentrations of animals to 160 dB), and the array was to be powered-down if necessary. For the purpose of the survey, NMFS defined a concentration of whales to be six or more individuals visually sighted that did not appear to be traveling (e.g. feeding, socializing, etc.). Fifteen individual whales of these species and 18 additional unidentified whales were observed while the acoustic source was active; however, each detection consisted of fewer than six animals in a group such that this mitigation requirement was not required.

In addition, from 11 to 23 June 2015, further mitigation measures were implemented by L-DEO for fin whales and short beaked common dolphins, due to the number of originally authorized Level B takes for those species being reached. While additional takes were requested for those specific species, the added measures employed included: powering down the source whenever either species was positively identified within the predicted 160 dB zone for the full source (5,240 meters) and then shutting down the source if they were observed within the predicted 160 dB zone for the single source (955 meters). On 23 June, the IHA and ITS were revised and the number of authorized Level B takes for fin whales increased from three to 36 and the number of Level B takes for short beaked common dolphins increased from 36 to 2,113.

Passive acoustic monitoring was conducted 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 travels at higher speeds (greater than six 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 was 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. Eleven acoustic detections were made during this cruise and consisted mainly of unidentified dolphins. Four detections, consisting of short-beaked common dolphins and unidentified dolphins, were made simultaneous with visual detections.

Of the 20,686 marine mammal takes authorized in the IHA, (including 79 takes of ESA-listed whales), and the 240 endangered turtles authorized for takes in the ITS, a total of 20,926 takes of protected species were authorized. During the survey, a total of 246 protected species were observed to be within the predicted 160 dB zone and potentially taken. This level of potential take represents only approximately 1% of total authorized takes, including the increase in authorized takes for two species. These potential takes included 18 unidentified whales, 13 fin whales, two humpback whales, 108 unidentified dolphins, 50 short-beaked common dolphins, 15 unidentified sea turtles and 40 loggerhead sea turtles. Of these species, fin whales, humpback whales and loggerhead sea turtles are ESA-listed. Observation conditions were moderate to good during most of the survey, but not excellent, therefore it is unlikely that PSOs detected all animals during survey operations, especially given there were night time operations. Even if PSOs did not detect all animals present, it is highly unlikely that the actual number of animals taken during survey operations reached anywhere near the authorized levels of take for all species. The combination of conservative predicted mitigation zones with conservative take estimation by NMFS (i.e. precautionary approach), however, appears for most species to have resulted in an overestimation of take and of overall impact on marine species from the proposed activity.

For the two species in which authorized marine mammal take levels were reached during survey operations, according to NMFS, the originally authorized take levels represented less than approximately 0.02% and 0.23% of the regional population sizes for short beaked common dolphins and fin whale, respectively. The take levels that were revised and re-authorized represented only approximately 1.2% and 2.2% of the regional population sizes for short beaked common dolphins and fin whale, respectively. Based on actual PSO observations, these revised take limits were not reached, but rather only 0.03% and 0.8% of the regional population sizes for short beaked common dolphins and fin whale, respectively. Because of factors such as uncertainty in species regional abundance sizes and density numbers, and variability in environmental conditions (e.g., unexpected warm surface temperatures or higher prevalence of prey), authorized take levels issued for species at these very low levels may be at greater risk for being reached during survey operations than for those species where takes are issued at much higher levels. This scenario has occurred during previous Langseth surveys when take estimates have been unexpectedly reached during survey operations. It may be prudent, therefore, to increase take authorizations levels in situations when takes are estimated at very low levels, such as below 0.1% of a regional population (or stock) size.

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. Other monitoring and mitigation measures set forth in the Final Amended EA, such as Notice to Mariners, avoidance of fishing vessels in the survey area, and coordination with area dive shops/organizations, were also successfully implemented during survey operations.

7. ACKNOWLEDGEMENTS

The Protected Species Observers on board R/V *Langseth* during the NJ survey in the Atlantic Ocean would like to thank Rutgers University, University of Texas at Austin Institute for Geophysics, the National Science Foundation and Lamont-Doherty Earth Observatory for the opportunity to work on this project. It was a pleasure to work with Dr. Gregory Mountain, Dr. Mladen Nedimovic, Dr. James Austin, and Dr. Craig Fulthorpe. We would also like to thank the marine crew and science team on board the R/V *Langseth* for their assistance and hospitality.

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- Matthew Dellinger from RPS for providing logistical support for the project
- We also thank Stephanie Milne, the RPS Program Manager for this survey, for project support

8. LITERATURE CITED

NOAA, 2015. Endangered Species Act Section 7 Consultation Biological Opinion for a seismic survey by Lamont-Doherty Earth Observatory along New Jersey and NFMS IHA issuance.

APPENDIX A: **Incidental Harassment Authorization for the USGS ECS 2-D marine geophysical survey**

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

INCIDENTAL HARASSMENT AUTHORIZATION

We hereby authorize the Lamont-Doherty Earth Observatory (Lamont- Doherty) Columbia University, P.O. Box 1000, 61 Route 9W, Palisades, New York 10964–8000, and/or its designees (*i.e.*, the National Science Foundation and Rutgers, the State University of New Jersey, the Holders of the Authorization) under section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA; 16 U.S.C. 1361 *et seq.*) and 50 CFR 216.107, to take marine mammals, by harassment, incidental to a marine geophysical survey conducted by the R/V *Marcus G. Langseth* (*Langseth*) marine geophysical survey in the Atlantic Ocean offshore New Jersey, June through August, 2015.

1. Effective Dates

This Authorization is valid from June 1, 2015 through August 31, 2015.

2. Specified Geographic Region

This Authorization is valid only for specified activities associated with the *Langseth's* seismic operations as specified in Lamont-Doherty's Incidental Harassment Authorization (Authorization) application and environmental analysis in the following specified geographic area:

a. In the Atlantic Ocean bounded by the following coordinates: in the Atlantic Ocean, approximately 25 to 85 km (15.5 to 52.8 mi) off the coast of New Jersey between approximately 39°38.00'N, 73°44.36'W; 39°43.12'N, 73°41.00'W; 39°25.30'N, 73°06.12'W; and 39°20.06'N, 73°10.06'W, as specified in Lamont-Doherty's application and the National Science Foundation's Amended Environmental Assessment.

3. Species Authorized and Level of Take

a. This Authorization limits the incidental taking of marine mammals, by Level B harassment only, to the species listed in Table 1in the area described in Condition 2(a):

   i. During the seismic activities, if the Holder of this Authorization encounters any marine mammal species that are not listed in Condition 3 for authorized taking and are likely to be exposed to sound pressure levels greater than or equal to 160 decibels (dB) re: 1 µPa, then the Holder of the Authorization must alter speed or course or shut-down the airguns to avoid take.

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

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

c. This Authorization limits the methods authorized for taking by Level B harassment to the following acoustic sources without an amendment to this Authorization:

   i. An airgun array with a total capacity of 700 cubic inches (in^3) (or smaller).

d. Lamont-Doherty will not operate the multi-beam echosounder or the sub-bottom profiler during transit to or from the survey area.

4. Reporting Prohibited Take

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

5. Cooperation

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

6. Mitigation and Monitoring Requirements

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

Visual Observers

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

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

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

   iii. Visual observers will also conduct monitoring while the *Langseth* crew deploy and recover the airgun array and streamers from the water.

   iv. When feasible, visual observers will conduct observations during daytime periods when the seismic system is not operating for comparison of sighting rates and behavioral reactions during, between, and after airgun operations.

   v. The *Langseth's* vessel crew will also assist in detecting marine mammals, when practicable.

   vi. Visual observers will have access to reticle binoculars (7×50 Fujinon), and big-eye binoculars (25×150), optical range finders, and night vision devices.

Exclusion Zones

b. Establish a 180-dB and 190-dB exclusion zone before starting the airgun subarray (700 in^3 or smaller); and a 180-dB and 190-dB exclusion zone for the single airgun (40 in^3). Observers will use the predicted radius distance for the 180-dB and 190-dB exclusion zones for mitigation shown in Table 2 (attached).

Visual Monitoring at the Start of Airgun Operations

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

d. Delay airgun operations if the visual observer sees a cetacean within the 180-dB exclusion zone (as defined in Table 2) until the marine mammal(s) has left the area.

Delay airgun operations if the visual observer sees a pinniped within the 190-dB exclusion zone (as defined in Table 2) until the marine mammal(s) has left the area.

i. If the visual observer sees a marine mammal that surfaces, then dives below the surface, the observer shall wait 15 minutes for species with shorter dive durations (*i.e.*, small odontocetes or pinnipeds), or 30 minutes for species with longer dive durations (*i.e.*, mysticetes and large odontocetes, including sperm (*Physeter macrocephalus*), pygmy sperm (*Kogia breviceps*), dwarf sperm (*Kogia sima*), killer (*Orcinus orca*), and beaked whales (*Ziphius* and *Mesoplodon spp.*). If the observer sees no marine mammals during that time, he/she should assume that the animal has moved beyond the relevant exclusion zone (as defined in Table 2).

ii. If, for any reason the visual observer cannot see the full relevant exclusion zone (as defined in Table 2) for the entire 30 minutes (*i.e.*, rough seas, fog, darkness), or if marine mammals are near, approaching, or within zone, the *Langseth* may not resume airgun operations.

iii. If one airgun is already running at a source level of at least 180 dB re: 1 µPa, the *Langseth* may start the second gun–and subsequent airguns–without observing relevant exclusion zones for 30 minutes, provided that the observers have not seen any marine mammals near the relevant exclusion zones (in accordance with Condition 6(b)).

Passive Acoustic Monitoring

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

f. Do and record the following when an observer detects an animal by the PAM:

i. Notify the visual observer immediately of a vocalizing marine mammal so a power-down or shut-down can be initiated, if required;

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

Ramp-Up Procedures

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

Recording Visual Detections

h. Visual observers must record the following information when they detect a marine mammal:

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

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

iii. The data listed under 6(h)(ii) at the start and end of each observation watch and during a watch whenever there is a change in one or more of the variables.

Speed or Course Alteration

i. Alter speed or course during seismic operations if a marine mammal, based on its position and relative motion, appears likely to enter the relevant exclusion zone. If speed or course alteration is not safe or practicable, or if after alteration the marine mammal still appears likely to enter the relevant exclusion zone, Lamont-Doherty will implement further mitigation measures, such as a power-down or shutdown.

Power-Down Procedures

j. Power down the airguns if a visual observer detects a marine mammal within, approaching, or entering the relevant exclusion zone (as defined in Table 2). A power-down means reducing the number of operating airguns to a single operating 40 in^3 airgun. This would reduce the relevant exclusion zone to the degree that the animal(s) is/are outside of that zone. When appropriate or possible, power-down of the airgun array shall also occur when the vessel is moving from the end of one trackline to the start of the next trackline.

Resuming Airgun Operations after a Power-Down

k. Following a power-down, if the marine mammal approaches the smaller exclusion zone (as defined in Table 2), then the *Langseth* must completely shut down the airguns. Airgun activity will not resume until the observer has visually observed the marine mammal(s) exiting the exclusion zone and is not likely to return, or the observer has not seen the animal within the relevant exclusion zone for 15 minutes for species with shorter dive durations (*i.e.*, small odontocetes) or 30 minutes for species with longer dive durations (*i.e.*, mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, killer, and beaked whales.

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

Shutdown Procedures

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

n. If an observer visually detects a North Atlantic right whale (*Eubalaena glacialis*), the *Langseth* will shut-down the airgun array regardless of the distance of the animal(s) to the sound source. The array will not resume firing until 30 minutes after the last documented North Atlantic right whale visual sighting.

Resuming Airgun Operations after a Shutdown

o. Following a shutdown, if the observer has visually confirmed that the animal has departed the relevant exclusion zone within a period of less than or equal to 8 minutes after the shutdown, then the *Langseth* may resume airgun operations at full power.

p. Else, if the observer has not seen the animal depart the relevant exclusion zone (with buffer), the *Langseth* shall not resume airgun activity until 15 minutes has passed for species with shorter dive times (*i.e.*, small odontocetes and pinnipeds) or 30 minutes has passed for species with longer dive durations (*i.e.*, mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, killer, and beaked whales). The *Langseth* will follow the ramp-up procedures described in Conditions 6(g).

Survey Operations

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

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

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

Mitigation Airgun

t. The *Langseth* may operate a small-volume airgun (*i.e.*, mitigation airgun) during turns and maintenance at approximately one shot per minute. During turns or brief transits between seismic tracklines, one airgun would continue to operate. The *Langseth* would not operate the small-volume airgun for longer than three hours in duration during turns.

Special Procedures for Large Whale Concentrations

u. The *Langseth* will avoid concentrations of humpback (*Megaptera novaeangliae*), sei (*Balaenoptera borealis*), fin (*Balaenoptera physalus*), blue (*Balaenoptera musculus*), minke (*Balaenoptera acutorostrata*) and/or sperm whales (*Physeter macrocephalus*) if possible (*i.e.*, exposing concentrations of animals to 160 dB re: 1 µPa), and powered-down the array. For purposes of the survey, a concentration or group of whales will consist of six or more individuals visually sighted that do not appear to be traveling (*e.g.*, feeding, socializing, etc.). The *Langseth* will follow the procedures described in Conditions 6(k) for resuming operations after a power down.

7. Reporting Requirements

This Authorization requires the Holder of this Authorization to:

a. Submit a draft report on all activities and monitoring results to the Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, within 90 days of the completion of the *Langseth's* cruise. This report must contain and summarize the following information:

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

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

   iii. An estimate of the number (by species) of marine mammals with known exposures to the seismic activity (based on visual observation) at received levels greater than or equal to 160 dB re: 1 µPa and/or 180 dB or 190-dB re: 1 µPa for cetaceans and pinnipeds, respectively and a discussion of any specific behaviors those individuals exhibited.

   iv. An estimate of the number (by species) of marine mammals with estimated exposures (based on modeling results) to the seismic activity at received levels greater than or equal to 160 dB re: 1 µPa and/or 180 dB or 190-dB re: 1 µPa with a discussion of the nature of the probable consequences of that exposure on the individuals.

   v. A description of the implementation and effectiveness of the: (A) Terms and Conditions of the Biological Opinion's Incidental Take Statement; and (B) mitigation measures of the Incidental Harassment Authorization. For the Biological Opinion, the

report will confirm the implementation of each Term and Condition, as well as any conservation recommendations, and describe their effectiveness, for minimizing the adverse effects of the action on Endangered Species Act listed marine mammals.

b. Submit a final report to the Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, within 30 days after receiving comments from us on the draft report. If we decide that the draft report needs no comments, we will consider the draft report to be the final report.

8. Reporting Prohibited Take

In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner not permitted by the Authorization, such as an injury, serious injury, or mortality (*e.g.*, ship-strike, gear interaction, and/or entanglement), Lamont-Doherty shall immediately cease the specified activities and immediately report the take to the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to Jolie.Harrison@noaa.gov.

Lamont-Doherty must also contact the NMFS Greater Atlantic Region Marine Mammal Stranding Network at 866-755-6622 (Mendy.Garron@noaa.gov).

The report must include the following information:

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

Lamont-Doherty shall not resume its activities until we are able to review the circumstances of the prohibited take. We shall work with Lamont-Doherty to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. Lamont-Doherty may not resume their activities until notified by us via letter, email, or telephone.

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

In the event that Lamont-Doherty discovers an injured or dead marine mammal, and the lead visual observer determines that the cause of the injury or death is unknown and the death is relatively recent (*i.e.*, in less than a moderate state of decomposition as we describe in the next section), Lamont-Doherty will immediately report the incident to the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to Jolie.Harrison@noaa.gov.

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

10. Reporting an Injured or Dead Marine Mammal Unrelated to the Activities

In the event that Lamont-Doherty discovers an injured or dead marine mammal, and the lead visual observer determines that the injury or death is not associated with or related to the authorized activities (*e.g.*, previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), Lamont-Doherty would report the incident to the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to Jolie.Harrison@noaa.gov.

Lamont-Doherty must also contact the NMFS Greater Atlantic Region Marine Mammal Stranding Network at 866-755-6622 (Mendy.Garron@noaa.gov).

Lamont-Doherty would provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS.

11. Endangered Species Act Biological Opinion and Incidental Take Statement

Lamont-Doherty must comply with the Terms and Conditions of the Incidental Take Statement corresponding to the Endangered Species Act Biological Opinion issued to the National Science Foundation and NMFS' Office of Protected Resources, Permits and Conservation Division.

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

MAY - 7 2015

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

Date

Table 1 – Authorized Level B harassment take numbers for each marine mammal species during Lamont-Doherty's marine seismic survey in the Atlantic Ocean, June 1, 2015 through August 31, 2015.

ESA Listed Species	Authorized Level B Take
North Atlantic right whale	3
Humpback whale	3
Sei whale	5
Fin whale	3
Blue whale	1
Sperm whale	31
Non-Listed Species	**Authorized Level B Take**
Minke whale	2
Dwarf sperm whale	2
Pygmy sperm whale	2
Cuvier's beaked whale	27
Gervais' beaked whale	27
Sowerby's beaked whale	27
True's beaked whale	27
Blainville's beaked whale	27
Bottlenose dolphin	12,532
Pantropical spotted dolphin	6
Atlantic spotted dolphin	4,067
Striped dolphin	52
Short-beaked common dolphin	36
White-beaked dolphin	16
Atlantic white-sided dolphin	53
Risso's dolphin	1,532
Clymene dolphin	27
Pygmy killer whale	2
False killer whale	7
Killer whale	7
Long-finned pilot whale	21
Short-finned pilot whale	21
Harbor porpoise	4
Gray seal	2
Harbor seal	2
Harp seal	2

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

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

INCIDENTAL HARASSMENT AUTHORIZATION

We hereby authorize the Lamont-Doherty Earth Observatory (Lamont- Doherty) Columbia University, P.O. Box 1000, 61 Route 9W, Palisades, New York 10964–8000, and/or its designees (*i.e.*, the National Science Foundation and Rutgers, the State University of New Jersey, the Holders of the Authorization) under section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA; 16 U.S.C. 1361 *et seq.*) and 50 CFR 216.107, to take marine mammals, by harassment, incidental to a marine geophysical survey conducted by the R/V *Marcus G. Langseth* (*Langseth*) marine geophysical survey in the Atlantic Ocean offshore New Jersey, June through August, 2015.

1. Effective Dates

This Authorization is valid from June 1, 2015 through August 31, 2015.

2. Specified Geographic Region

This Authorization is valid only for specified activities associated with the *Langseth's* seismic operations as specified in Lamont-Doherty's Incidental Harassment Authorization (Authorization) application and environmental analysis in the following specified geographic area:

a. In the Atlantic Ocean bounded by the following coordinates: in the Atlantic Ocean, approximately 25 to 85 km (15.5 to 52.8 mi) off the coast of New Jersey between approximately 39°38.00'N, 73°44.36'W; 39°43.12'N, 73°41.00'W; 39°25.30'N, 73°06.12'W; and 39°20.06'N, 73°10.06'W, as specified in Lamont-Doherty's application and the National Science Foundation's Amended Environmental Assessment.

3. Species Authorized and Level of Take

a. This Authorization limits the incidental taking of marine mammals, by Level B harassment only, to the species listed in Table 1in the area described in Condition 2(a):

   i. During the seismic activities, if the Holder of this Authorization encounters any marine mammal species that are not listed in Condition 3 for authorized taking and are likely to be exposed to sound pressure levels greater than or equal to 160 decibels (dB) re: 1 µPa, then the Holder of the Authorization must alter speed or course or shut-down the airguns to avoid take.

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

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

c. This Authorization limits the methods authorized for taking by Level B harassment to the following acoustic sources without an amendment to this Authorization:

   i. An airgun array with a total capacity of 700 cubic inches (in^3) (or smaller).

d. Lamont-Doherty will not operate the multi-beam echosounder or the sub-bottom profiler during transit to or from the survey area.

4. Reporting Prohibited Take

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

5. Cooperation

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

6. Mitigation and Monitoring Requirements

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

Visual Observers

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

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

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

   iii. Visual observers will also conduct monitoring while the *Langseth* crew deploy and recover the airgun array and streamers from the water.

   iv. When feasible, visual observers will conduct observations during daytime periods when the seismic system is not operating for comparison of sighting rates and behavioral reactions during, between, and after airgun operations.

   v. The *Langseth's* vessel crew will also assist in detecting marine mammals, when practicable.

   vi. Visual observers will have access to reticle binoculars (7×50 Fujinon), and big-eye binoculars (25×150), optical range finders, and night vision devices.

Exclusion Zones

b. Establish a 180-dB and 190-dB exclusion zone before starting the airgun subarray (700 in^3 or smaller); and a 180-dB and 190-dB exclusion zone for the single airgun (40 in^3). Observers will use the predicted radius distance for the 180-dB and 190-dB exclusion zones for mitigation shown in Table 2 (attached).

Visual Monitoring at the Start of Airgun Operations

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

d. Delay airgun operations if the visual observer sees a cetacean within the 180-dB exclusion zone (as defined in Table 2) until the marine mammal(s) has left the area.

   Delay airgun operations if the visual observer sees a pinniped within the 190-dB exclusion zone (as defined in Table 2) until the marine mammal(s) has left the area.

   i. If the visual observer sees a marine mammal that surfaces, then dives below the surface, the observer shall wait 15 minutes for species with shorter dive durations (*i.e.*, small odontocetes or pinnipeds), or 30 minutes for species with longer dive durations (*i.e.*, mysticetes and large odontocetes, including sperm (*Physeter macrocephalus*), pygmy sperm (*Kogia breviceps*), dwarf sperm (*Kogia sima*), killer (*Orcinus orca*), and beaked whales (*Ziphius* and *Mesoplodon spp.*). If the observer sees no marine mammals during that time, he/she should assume that the animal has moved beyond the relevant exclusion zone (as defined in Table 2).

   ii. If, for any reason the visual observer cannot see the full relevant exclusion zone (as defined in Table 2) for the entire 30 minutes (*i.e.*, rough seas, fog, darkness), or if marine mammals are near, approaching, or within zone, the *Langseth* may not resume airgun operations.

   iii. If one airgun is already running at a source level of at least 180 dB re: 1 μPa, the *Langseth* may start the second gun–and subsequent airguns–without observing relevant exclusion zones for 30 minutes, provided that the observers have not seen any marine mammals near the relevant exclusion zones (in accordance with Condition 6(b)).

Passive Acoustic Monitoring

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

f. Do and record the following when an observer detects an animal by the PAM:

   i. Notify the visual observer immediately of a vocalizing marine mammal so a power-down or shut-down can be initiated, if required;

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

Ramp-Up Procedures

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

Recording Visual Detections

h. Visual observers must record the following information when they detect a marine mammal:

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

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

iii. The data listed under 6(h)(ii) at the start and end of each observation watch and during a watch whenever there is a change in one or more of the variables.

Speed or Course Alteration

i. Alter speed or course during seismic operations if a marine mammal, based on its position and relative motion, appears likely to enter the relevant exclusion zone. If speed or course alteration is not safe or practicable, or if after alteration the marine mammal still appears likely to enter the relevant exclusion zone, Lamont-Doherty will implement further mitigation measures, such as a power-down or shutdown.

Power-Down Procedures

j. Power down the airguns if a visual observer detects a marine mammal within, approaching, or entering the relevant exclusion zone (as defined in Table 2). A power-down means reducing the number of operating airguns to a single operating 40 in^3 airgun. This would reduce the relevant exclusion zone to the degree that the animal(s) is/are outside of that zone. When appropriate or possible, power-down of the airgun array shall also occur when the vessel is moving from the end of one trackline to the start of the next trackline.

Resuming Airgun Operations after a Power-Down

k. Following a power-down, if the marine mammal approaches the smaller exclusion zone (as defined in Table 2), then the *Langseth* must completely shut down the airguns. Airgun activity will not resume until the observer has visually observed the marine mammal(s) exiting the exclusion zone and is not likely to return, or the observer has not seen the animal within the relevant exclusion zone for 15 minutes for species with shorter dive durations (*i.e.*, small odontocetes) or 30 minutes for species with longer dive durations (*i.e.*, mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, killer, and beaked whales.

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

Shutdown Procedures

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

n. If an observer visually detects a North Atlantic right whale (*Eubalaena glacialis*), the *Langseth* will shut-down the airgun array regardless of the distance of the animal(s) to the sound source. The array will not resume firing until 30 minutes after the last documented North Atlantic right whale visual sighting.

Resuming Airgun Operations after a Shutdown

o. Following a shutdown, if the observer has visually confirmed that the animal has departed the relevant exclusion zone within a period of less than or equal to 8 minutes after the shutdown, then the *Langseth* may resume airgun operations at full power.

p. Else, if the observer has not seen the animal depart the relevant exclusion zone (with buffer), the *Langseth* shall not resume airgun activity until 15 minutes has passed for species with shorter dive times (*i.e.*, small odontocetes and pinnipeds) or 30 minutes has passed for species with longer dive durations (*i.e.*, mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, killer, and beaked whales). The *Langseth* will follow the ramp-up procedures described in Conditions 6(g).

Survey Operations

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

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

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

Mitigation Airgun

t. The *Langseth* may operate a small-volume airgun (*i.e.*, mitigation airgun) during turns and maintenance at approximately one shot per minute. During turns or brief transits between seismic tracklines, one airgun would continue to operate. The *Langseth* would not operate the small-volume airgun for longer than three hours in duration during turns.

Special Procedures for Large Whale Concentrations

u. The *Langseth* will avoid concentrations of humpback (*Megaptera novaeangliae*), sei (*Balaenoptera borealis*), fin (*Balaenoptera physalus*), blue (*Balaenoptera musculus*), minke (*Balaenoptera acutorostrata*) and/or sperm whales (*Physeter macrocephalus*) if possible (*i.e.*, exposing concentrations of animals to 160 dB re: 1 μPa), and powered-down the array. For purposes of the survey, a concentration or group of whales will consist of six or more individuals visually sighted that do not appear to be traveling (*e.g.*, feeding, socializing, etc.). The *Langseth* will follow the procedures described in Conditions 6(k) for resuming operations after a power down.

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This Authorization requires the Holder of this Authorization to:

a. Submit a draft report on all activities and monitoring results to the Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, within 90 days of the completion of the *Langseth's* cruise. This report must contain and summarize the following information:

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

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

   iii. An estimate of the number (by species) of marine mammals with known exposures to the seismic activity (based on visual observation) at received levels greater than or equal to 160 dB re: 1 μPa and/or 180 dB or 190-dB re: 1 μPa for cetaceans and pinnipeds, respectively and a discussion of any specific behaviors those individuals exhibited.

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- Water depth;
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- Description of all marine mammal observations in the 24 hours preceding the incident;
- Species identification or description of the animal(s) involved;
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Donna S. Wieting

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

JUN 23 2015

Date

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Blainville's beaked whale	27
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White-beaked dolphin	16
Atlantic white-sided dolphin	53
Risso's dolphin	1,532
Clymene dolphin	27
Pygmy killer whale	2
False killer whale	7
Killer whale	7
Long-finned pilot whale	21
Short-finned pilot whale	21
Harbor porpoise	4
Gray seal	2
Harbor seal	2
Harp seal	2

Table 2 –Exclusion Zones

Source and Volume (in^3)	Tow Depth (m)	Water Depth (m)	Predicted RMS Distances (m)[1]		
			190 dB	180 dB	160 dB
Single Bolt airgun (40 in^3)	6	< 100	21	73	995
4-Airgun subarray (700 in^3)	4.5	<100	101	378	5,240
4-Airgun subarray (700 in^3)	6	<100	118	439	6,100

Table 2 –Exclusion Zones

Source and Volume (in^3)	Tow Depth (m)	Water Depth (m)	Predicted RMS Distances (m)[1]		
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APPENDIX B: Basic Data Summary Form

BASIC DATA FORM				
LDEO Project Number		MGL1510		
Seismic Contractor		Lamont-Doherty Earth Observatory of Columbia University		
Area Surveyed During Reporting Period		Atlantic Ocean 25-85 km off NJ Coast between 39-3-39.7 N and 73.2-73.8W		
Survey Type		S-D surface seismic		
Vessel and/or Rig Name		R/V *Marcus G. Langseth*		
Permit Number		IHA issued on 7 May and 23 June 2015		
Location / Distance of Airgun Deployment		300 meters aft of PSO tower		
Water Depth	**Min**	20		
	Max	75		
Dates of project		1 June 2015	THROUGH	6 July 2015
Total time airguns operating – all power levels:		701:24		
Time airguns operating at full power on survey lines:		563:38		
Time airguns operating at full power on line changes:		99:03		
Amount of time mitigation gun (40 in³) operations:		31:26		
Amount of time in ramp-up:		06:59		
Number daytime ramp-ups:		12		
Number of night time ramp-ups:		2		
Number of ramp-ups from mitigation source:		6		
Amount of time conducted in airgun testing:		00:18		
Duration of visual observations:		553:34		
Duration of observations while airguns active:		436:37		
Duration of observation during airgun silence:		117:56		
Duration of acoustic monitoring:		676:18		
Duration of acoustic monitoring while airguns active:		663:27		
Duration of acoustic monitoring during airgun silence:		12:51		
Duration of simultaneous acoustic and visual monitoring:		412:23		
Lead Protected Species Observer:		Amanda Dubuque		
Protected Species Observers:		Cassandra Frey		
		Amy Schmitt		
		Shelia O'Dea		
Acoustic Observer:		Amy Piko		
Number of Marine Mammals Visually Detected:		47		
Number of Marine Mammals Acoustically Detected:		11		
Number of simultaneous visual and acoustic detections:		4		
Number of Sea Turtles detected:		53		
List Mitigation Actions (e.g. Power-downs, shut-downs, ramp-up delays)		1 delayed ramp up (00:24); 48 power downs (06:17:30); 4 shut downs (01:50:30)		
Duration of operational downtime due to mitigation:		08:33		

APPENDIX C: Passive Acoustic Monitoring System Specifications

Main cable:

1.1 Hydrophone Cable
Cable serial number SM 4450
Mechanical Information
Length 250m
Diameter 14mm over cable 32mm over moldings 45mm over connectors
Weight 100kg
Connector Seiche 36 pin

Hydrophone elements
Hydrophone 1 Sphere 1 Broad band 200Hz to 200 kHz (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 Deck cable
Deck serial number SM 1786
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 G. Langseth*

The hydrophone deployment procedure is a draft document and may be altered at any time to reflect changes in the deployment over time. The deployment requires the PAM operator and one additional person to complete.

Overview

A 250 meter conventional towed linear array was used for the survey. The linear hydrophone array contained two broadband (200 Hz to 200 kHz) hydrophone elements, two low frequency hydrophone elements (2 kHz to 200 kHz), and a depth gauge (100m capacity) potted directly into the cable. Figure 22 shows the position of the four hydrophones and the depth gauge on the array cable. A 100 meter deck cable connected the hydrophone cable from a winch on the port gun deck to the data processing unit, located in the science lab.

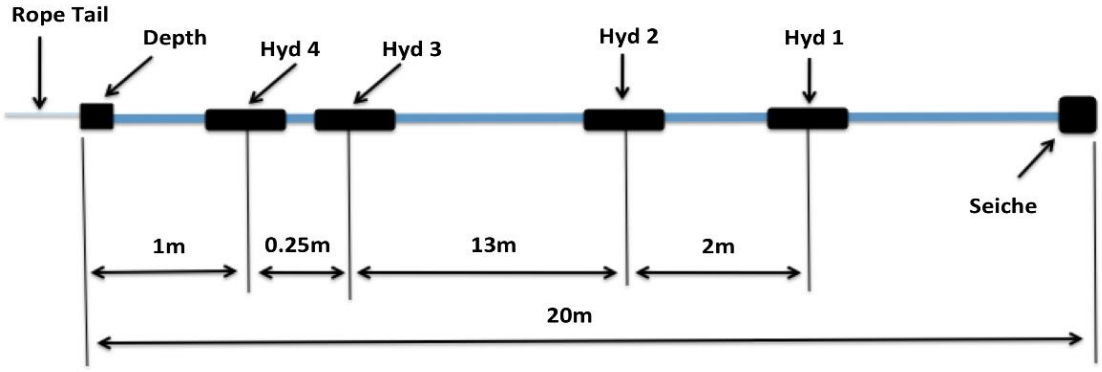

Figure 22: Diagram of the hydrophone array cable indicating the position and separation of the individual hydrophone elements.

The hydrophone cable was spooled onto a port hydraulic winch (Figure 23). The cable was deployed directed off the stern of the vessel, just aft of the winch. To help keep the cable from tangling with the seismic gear, the cable was attached via a Chinese finger to a lifting rope which offset the towing point of the PAM cable system approximately 2 meters to the port (Figure 24).

Figure 23: PAM tow cable spooled onto the winch and running aft.

Figure 24: The PAM tow cable connecting to the offset rope via shackle.

Pre-Deployment Tasks

The PAM data processing unit and laptops were setup in the main science lab and secured in the event of rough weather (Figure 25). A GPS feed (GNGGA string) was supplied by the ships navigation system Seapath 200.

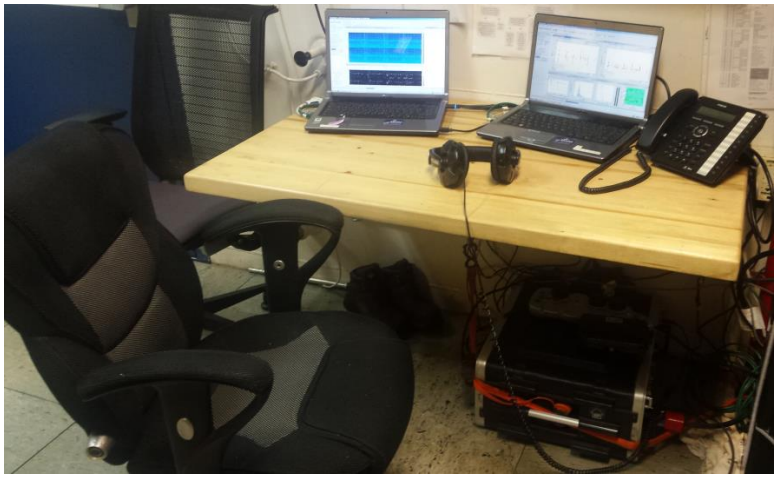

Figure 25: Passive acoustic monitoring station located in the main science lab.

Two 100 meter deck cables were routed from the main science lab to the port gun deck winch. One deck cable was designated as the main cable and the other acted as a spare, for ease of replacement at sea.

The PAM cable was measured and marked in 10 meter increments for the first 150 meters.

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

Deployment

- PAM electronics unit was powered down.
- The bridge was alerted of pending hydrophone deployment.
- The deck cable was disconnected from the hydrophone tow cable.
- The winch was powered on.
- 130m of the hydrophone cable was let out from the winch, deployed into the water on port side of the gun umbilicus.
- The winch was powered off.
- The cable was attached to the offsetting line.
- The deck cable was connected to the hydrophone cable.
- The electronics in the instrument room were powered up.

Retrieval

- The electronics in the instrument room were powered down.
- The bridge was alerted of pending hydrophone retrieval.
- The deck cable was disconnected from the hydrophone cable and both connectors were covered and taped to prevent corrosion.
- The cable was disconnected from the offsetting line.
- The winch was powered on.
- The hydrophone cable was retrieved and wound evenly onto the winch.
- The winch was powered off.

Health Safety and Environment (HSE) Requirements

Normal working deck Personal Protective Equipment (PPE) was required (hard hat, boots, gloves, eye protection, and coveralls). A life vest was required for any work involving items going over the side.
The operation carried relatively low risk. Hazards included working close to the side of the vessel, trip hazards, and pinch points at the winch.
A Job Safety Analysis (JSA) was been completed for this task. Further review of JSA was required in the event of modifications to the procedures.

APPENDIX E: Survey Lines Acquired

Survey Line	Date Acquisition Commenced	Time Acquisition Commenced (UTC)	Date Acquisition Completed	Time Acquisition Completed (UTC)
MGL15102860	2015-06-02	20:22	2015-06-03	02:51
MGL15101924	2015-06-03	03:56	2015-06-03	10:16
MGL15102836	2015-06-03	19:34	2015-06-04	01:48
MGL15101900	2015-06-04	02:58	2015-06-04	04:51
MGL15102812	2015-06-04	17:40	2015-06-04	23:58
MGL15101900R	2015-06-05	01:07	2015-06-05	07:29
MGL15102788	2015-06-05	08:38	2015-06-05	14:54
MGL15101876	2015-06-05	16:03	2015-06-05	22:58
MGL15102764	2015-06-06	23:36	2015-06-06	03:11
MGL15101852	2015-06-06	14:20	2015-06-06	20:35
MGL15102740	2015-06-06	21:43	2015-06-07	03:56
MGL15101828	2015-06-07	05:04	2015-06-07	22:26
MGL15102716	2015-06-07	13:07	2015-06-07	19:40
MGL15101924R	2015-06-07	20:44	2015-06-08	03:30
MGL15102692	2015-06-08	04:31	2015-06-08	07:52
MGL15102668	2015-06-08	20:30	2015-06-09	03:01
MGL15101804	2015-06-09	04:17	2015-06-09	10:40
MGL15102644	2015-06-09	11:48	2015-06-09	18:12
MGL15101780	2015-06-09	20:17	2015-06-10	01:34
MGL15102620	2015-06-10	02:48	2015-06-10	09:24
MGL15101780R	2015-06-10	10:30	2015-06-10	18:07
MGL15102596	2015-06-10	18:21	2015-06-11	01:06
MGL15101756	2015-06-11	02:12	2015-06-11	09:01
MGL15102668R	2015-06-11	14:51	2015-06-11	20:14
MGL15101732	2015-06-11	21;30	2015-06-12	03:45
MGL15102860R	2015-06-12	05:48	2015-06-12	12:17
MGL15101708	2015-06-12	13:42	2015-06-12	20:18
MGL15102572	2015-06-12	21:25	2015-06-13	10:17
MGL15102692R	2015-06-13	11:22	2015-06-13	16:35
MGL15101684	2015-06-13	17:48	2015-06-14	00:19
MGL15102548	2015-06-14	01:26	2015-06-14	07:47
MGL15101660	2015-06-14	08:54	2015-06-14	15:18
MGL15102572R	2015-06-14	16:45	2015-06-14	22:52
MGL15101636	2015-06-15	00:08	2015-06-15	06:25
MGL15102524	2015-06-15	07:32	2015-06-15	14:02
MGL15101612	2015-06-15	15:10	2015-06-15	22:08
MGL15102500	2015-06-15	23:16	2015-06-16	06:25
MGL15101588	2015-06-16	07:33	2015-06-16	14:08
MGL15102476	2015-06-16	15:57	2015-06-16	22:13

Survey Line	Date Acquisition Commenced	Time Acquisition Commenced (UTC)	Date Acquisition Completed	Time Acquisition Completed (UTC)
MGL15101564	2015-06-16	23:23	2015-06-17	05:32
MGL15102452	2015-06-17	06:40	2015-06-17	13:01
MGL15101540	2015-06-17	14:09	2015-06-17	20:31
MGL15102428	2015-06-17	21:41	2015-06-18	04:06
MGL1510516	2015-06-18	05:24	2015-06-18	12:10
MGL15102404	2015-06-18	13:16	2015-06-18	20:09
MGL15101756I	2015-06-18	22:01	2015-06-18	22:52
MGL15101756J	2015-06-19	04:06	2015-06-19	05:15
MGL15102572S	2015-06-19	06:24	2015-06-19	10:45
MGL15101900I	2015-06-19	12:51	2015-06-19	17:19
MGL15102380	2015-06-19	18:22	2015-06-19	22:19
MGL15101660S	2015-06-20	03:41	2015-06-20	06:44
MGL15102356	2015-06-20	07:46	2015-06-20	14:09
MGL15101492	2015-06-20	15:14	2015-06-20	21:28
MGL15102332	2015-06-20	22:35	2015-06-21	04:51
MGL15101468	2015-06-21	05:57	2015-06-21	12:26
MGL15102308	2015-06-21	13:27	2015-06-21	20:02
MGL15101444	2015-06-21	21:20	2015-06-22	03:55
MGL15102284	2015-06-22	04:57	2015-06-22	11:39
MGL15101420	2015-06-22	12:44	2015-06-22	19:16
MGL15102260	2015-06-22	20:19	2015-06-23	02:49
MGL15101396	2015-06-23	03:55	2015-06-23	10:28
MGL15102236	2015-06-23	11:31	2015-06-23	17:57
MGL15101372	2015-06-23	19:05	2015-06-24	01:35
MGL15102212	2015-06-24	02:42	2015-06-24	09:14
MGL15101348	2015-06-24	10:30	2015-06-24	16:52
MGL15102164	2015-06-24	17:57	2015-06-25	00:24
MGL15101324	2015-06-25	01:30	2015-06-25	07:58
MGL15102116	2015-06-25	09:02	2015-06-25	14:57
MGL15102068	2015-06-26	01:06	2015-06-26	07:32
MGL15101300	2015-06-26	08:45	2015-06-26	15:16
MGL15102020	2015-06-26	16:15	2015-06-26	17:33
MGL15101276	2015-06-27	01:05	2015-06-27	07:51
MGL15102020R	2015-06-27	08:53	2015-06-27	15:39
MGL15101252	2015-06-27	16:43	2015-06-27	23:23
MGL15101996	2015-06-28	00:23	2015-06-28	06:48
MGL15101228	2015-06-28	07:50	2015-06-28	14:22
MGL15102188	2015-06-28	15:33	2015-06-28	21:59
MGL15101204	2015-06-28	23:12	2015-06-29	05:44
MGL15101948	2015-06-30	21:19	2015-06-30	23:51
MGL15102140	2015-06-01	01:33	2015-06-01	08:01
MGL15101972	2015-06-01	09:13	2015-06-01	15:29

Survey Line	Date Acquisition Commenced	Time Acquisition Commenced (UTC)	Date Acquisition Completed	Time Acquisition Completed (UTC)
MGL15102092	2015-06-01	16:46	2015-06-01	23:08
MGL15101420R	2015-06-01	23:53	2015-06-02	06:01
MGL15102044	2015-06-02	06:55	2015-06-02	13:47
MGL15101948A	2015-06-02	14:56	2015-06-02	19:16
MGL15101300R	2015-06-02	19:52	2015-06-02	22:26
MGL15101660R	2015-06-02	23:51	2015-06-03	05:38
MGL15102116R	2015-06-03	06:10	2015-06-03	12:37
MGL15101204A	2015-06-03	13:38	2015-06-03	20:18
MGL15102428R	2015-06-03	21:35	2015-06-04	04:01
MGL15101180	2015-06-04	05:12	2015-06-04	11:55
MGL15101156	2015-06-04	18:39	2015-06-05	01:12
MGL15101132	2015-06-05	02:43	2015-06-05	06:56
MGL15101108	2015-06-05	08:15	2015-06-05	12:38
MGL15101084	2015-06-05	14:12	2015-06-05	18:09
MGL15101348R	2015-06-05	19:21	2015-06-05	20:20
MGL15102188R	2015-06-05	21:18	2015-06-06	00:17
MGL15101756R	2015-06-06	01:20	2015-06-06	03:52
MGL15102166S	2015-06-06	05:23	2015-06-06	08:44

APPENDIX F: Summary of visual detections of protected species during the NJ 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	3 June 2015	20:05	Unidentified whale	1	39°27.28'N 73°10.53'W	Full volume on line	AV	BV	600m/Full volume	None	Observed within the predicted 160 dB zone
2	4 June 2015	19:43	Unidentified delphinid	4	39.51717°N 073.29083°W	Full volume on line	PE/AH	FT DV FF	480m/Full Volume	None	Observed within the 160 dB zone; also acoustically detected (AD#2)
3	7 June 15	12:37	Unidentified dolphins	2	39.39994°N 073.10457°W	Full volume offline	PV/OD	NS, SA, FF	300m/ Single 40 in^3 gun	Power-down	Dolphins last sighted in 180 dB EZ; source powered down for 17 minutes, no production loss.
4	7 June 15	14:28	Unidentified whale	1	39.48617°N 073.24800°W	Full volume online	PE/AH	BV, NS	1500m/Full volume	None	Whale last observed within 160 dB zone
5	7 June 15	14:48	Loggerhead sea turtle	1	39.50300°N 073.27817°W	Full volume online	AV	NS, DI	300m/Single 40 in^3 gun	Power-down	Turtle last observed in 180 dB EZ; source powered down for 6 minutes
6	7 June 15	17:10	Unidentified whale	1	39.60703°N 073.46635°W	Full volume online	PV/OD	BV, NS	500m/Full volume	None	Whale last observed in 160 dB zone
7	7 June 15	18:16	Loggerhead sea turtle	1	39.64717°N 073.53983°W	Full volume online	PV/OD	NS	200m/ Single 40 in^3 gun	Power-down	Turtle last observed in 180 dB EZ; source powered down for 5 minutes

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
8	7 June 15	18:40	Unidentified whale	1	39.66483°N 073.57200°W	Full volume online	AV	SA	3000m/Full volume	None	Whale last observed in 160 dB zone
9	7 June 15	20:33	Unidentified sea turtle	1	39.67317°N 073.68617°W	Full Volume offline	AV	FT, SS	200m/ Single 40 in^3 gun	Power-down	Turtle last observed in 180 dB EZ; source powered down for 4 minutes
10	7 June 15	20:55	Unidentified sea turtle	1	39.65751°N 073.65813°W	Full volume online	PV/OD	FL	200m/ Single 40 in^3 gun	Power-down	Turtle last observed in 180 dB EZ; source powered down for 6 minutes
11	8 June 15	13:56	Unidentified whale	1	39.41950°N 073.15217°W	Silent	PV/SD	BV	1000m/Silent	None	Acoustic source on board
12	8 June 15	19:05	Short-beaked common dolphins	4	39.47983°N 073.04608°W	Mitigation gun active	PE/AH	SA, FT, BR	320m/ Single 40 in^3 gun	Delayed ramp-up	Simultaneous with AD#3, last visually observed within 180 dB EZ; ramp-up delayed 25 minutes
13	9 June 15	19:57	Fin whale	1	39.63317°N 073.63185°W	Full volume offline	PE/AH	BV, NS	583m.Full volume	None	Whale last observed in 160 dB zone
14	10 June 15	14:23	Loggerhead sea turtle	1	39.49717°N 073.38400°W	Full volume online	AV	NS	250m/ Single 40 in^3 gun	Power-down	Turtle last observed in 180 dB EZ; source powered down for 6 minutes
15	10 June 15	17:26	Loggerhead sea turtle	1	39.37505°N 073.15835°W	Full volume online	AV	NS	150m/ Single 40 in^3 gun	Power-down	Observed with a shark. Turtle last observed in 180 dB EZ; source powered down for 5 minutes
16	10 June 15	17:57	Loggerhead sea turtle	1	39.39757°N 073.12520°W	Full volume online	PV/OD	NS	75m/Silent	Power-down and shut-down	Turtle last observed in 190 dB EZ; source powered down for 1 minute and shut down for 5 minutes.
17	10 June 15	18:21	Short-beaked common dolphins	31	39.42070°N 073.14403°W	Full volume online	PE/AH	FT, SA, PO,	583m/Full volume	None	Dolphins last observed in 160 dB zone

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
18	10 June 15	19:07	Unidentified sea turtle	1	39.44983°N 073.19717°W	Full volume online	AV	FL	400m/Full volume	None	Turtle last observed outside 180 dB EZ.
19	10 June 15	19:46	Loggerhead sea turtle	1	39.47713°N 073.24630°W	Full volume online	PV/OD	FL	175m/ Single 40 in^3 gun	Power-down	Turtle last observed outside of 180 dB EZ; source powered down for 6 minutes
20	11 June 15	13:25	Humpback whale	1	39.41200°N 073.11950°W	Mitigation gun active	AV	SA, BV, DF	1000m/ Single 40 in^3 gun	None	Whale last observed in 160 dB zone
21	11 June 15	19:54	Fin whale	2	39.69089°N 073.62533°W	Full volume online	PE/AH	NS, BV, DV	632m/Full volume	None	Whales last observed in 160 dB zone
22	12 June 15	09:23	Unidentified dolphins	5	39.58933°N 073.41665°W	Full volume online	TV	P0, FT	420m/Full volume	None	Dolphins last observed in 160 dB zone
23	12 June 15	17:57	Loggerhead sea turtle	1	39.47835°N 073.35869°W	Full volume online	PV/SD	NS	200m/ Single 40 in^3 gun	Power-down	Turtle last observed in 180 dB EZ; source powered down for 6 minutes
24	12 June 15	22:14	Unidentified whale	1	39.45343°N 073.20690°W	Full volume online	AV	BV, DF	300m/ Single 40 in^3 gun	Power-down	Whale last observed in 180 dB EZ; source powered down for 31 minutes
25	13 June 15	14:26	Fin whale	1	39.61317°N 073.48017°W	Full volume online	UN	SA, BV, DV	1900m/ Single 40 in^3 gun	Power-down	Whale last observed in 160 dB radius for full volume source
26	13 June 15	14:28	Short-beaked common dolphins	15	39.61317°N 073.48017°W	Full volume online	AV	FT, SA	1089m/ Single 40 in^3 gun	Power-down	Dolphins last observed in 160 dB radius for full volume source
27	13 June 15	15:08	Fin whale	2	39.64000°N 073.52950°W	Full volume online	UN	NS, BV	1089m/ Single 40 in^3 gun	Power-down	Whales last observed in 160 dB radius for full volume source
28	13 June 15	18:58	Unidentified whale	2	39.60702°N 073.59608°W	Full volume online	UN	NS, BV	1500m/Full Volume	None	Whales last observed in 160 dB radius for full volume source

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
29	14 June 2015	10:06	Fin Whale	1	39.60410°N 073.59387°W	Full volume online	PV/OD	BV, NS	6000m/Full volume	None	Whale did not enter 160 dB radius
30	14 June 2015	10:27	Fin Whale	1	39.58947°N 073.56723°W	Full volume online	PV/SD	NS, DV	500m/ Single 40 in^3 gun	Power down then shut down	Whale last observed within 160 dB radius for mitigation gun. Source powered-down for 3 minutes and shut down for 41 minutes.
31	14 June 2015	10:58	Loggerhead sea turtle	1	39.56637°N 073.52495°W	Not active	PV/SD	FL ST	200m/Silent	None	Source already shut down for whale
32	14 June 2015	13:34	Loggerhead sea turtle	2	39.45583°N 073.32250°W	Full volume online	PV/SD	FL,ST, DI	120m/Single 40 in^3 gun	Power down	Turtle last observed within 180 dB radius. Source powered-down for 8 minutes
33	14 June 2015	13:36	Unidentified sea turtle	1	39.44717°N 073.30800°W	Full volume online	AV	FL, ST	1089m/Full volume online	None	Turtle did not enter 180 dB exclusion zone.
34	14 June 2015	14:06	Unidentified sea turtle	1	39.43333°N 073.28250°W	Full volume online	AV	NS	200m/Single 40 in^3 gun	Power down	Turtle last observed within 180 dB radius. Source powered-down for 6 minutes.
35	14 June 2015	14:14	Unidentified dolphin	21	39.42517°N 073.26800°W	Mitigation gun	AV	DV, SA, PO, FT	400m/Full volume	None	Source initially on mitigation gun for turtle power down; dolphins last observed in 160 dB radius
36	14 June 2015	14:36	Unidentified sea turtle	1	39.41083°N 073.24283°W	Full volume online	TV	FL, ST	210m/Single 40 in^3 gun	Power down	Turtle last observed within 160 dB radius. Source powered-down for 8 minutes.
37	14 June 2015	14:48	Loggerhead sea turtle	1	39.40200°N 073.22683°W	Full volume online	PV/OD	FL,ST, DI	95m/Silent	Power down then shut down	Turtle last observed within 160 dB radius. Source powered-down for 2 minutes and shut down for 3 minutes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
38	14 June 2015	15:13	Loggerhead sea turtle	1	39.38350°N 073.19350°W	Full volume online	AV	ST	200m/ Single 40 in^3 gun	Power down	Turtle last observed within 160 dB radius. Source powered-down for 5 minutes.
39	14 June 2015	15:16	Loggerhead sea turtle	1	39.38350°N 073.19350°W	Mitigation gun	PV/SD	NS, SS	270m/ Single 40 in^3 gun	None	Source powered down for previous turtle at start of detection
40	14 June 2015	15:46	Loggerhead sea turtle	3	39.37317°N 073.14550°W	Mitigation gun	AV	NS, SS, DI	200m/ Single 40 in^3 gun	None	Source mitigation gun active on line change
41	14 June 2015	15:52	Loggerhead sea turtle	1	39.37833°N 073.13900°W	Mitigation gun	TV	ST	150m/ Single 40 in^3 gun	None	Source mitigation gun active on line change
42	14 June 2015	17:13	Loggerhead sea turtle	2	39.44272°N 073.18665°W	Full volume online	V	ST,SS, DI	250m/ Single 40 in^3 gun	Power down	Turtles last observed within 180 dB radius. Source powered-down for 8 minutes.
43	14 June 2015	17:35	Loggerhead sea turtle	2	39.45547°N 073.20982°W	Full volume online	PV/SD	NS,SS, DI	200m/ Single 40 in^3 gun	Power down	Turtles last observed within 160 dB radius. Source powered-down for 13 minutes.
44	14 June 2015	18:18	Unidentified dolphin	30	39.47455°N 073.25102°W	Full volume online	V	NS,SV, SA,FF	1500m/ Single 40 in^3 gun	Power down	Dolphins last observed within 160 dB radius. Source powered-down for 7 minutes.
45	14 June 2015	18:04	Loggerhead sea turtle	1	39.48260°N 073.25909°W	Mitigation gun	PV/OD	ST,SS	300m/ Single 40 in^3 gun	Power down	Source powered down for dolphins at the start of the detection. Source remained powered-down for 6 minutes.
46	14 June 2015	18:23	Unidentified dolphin	20	39.49785°N 073.28642°W	Full volume online	PV/OD	NS, PO,SA	3922m/Full volume	None	Dolphins last observed within 160 dB radius.
47	14 June 2015	18:59	Loggerhead sea turtle	2	39.52412°N 073.33380°W	Full volume online	PV/SD	ST	120m/ Single 40 in^3 gun	Power down	First turtle last observed in 160 dB radius, second turtle last observed in 180 dB radius. Source powered-down for 12 minutes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
48	14 June 2015	19:32	Loggerhead sea turtle	1	39.54883°N 073.37750°W	Full volume online	AV	ST,SS	190m/ Single 40 in^3 gun	Power down	Turtles last observed within 160 dB radius. Source powered-down for 6 minutes.
49	16 June 2015	13:49	Loggerhead sea turtle	1	39.38667°N 073.20850°W	Full volume online	AV	FL	130m/ Single 40 in^3 gun	Power down	Turtle last observed within 180 dB radius. Source powered-down for 6 minutes.
50	16 June 2015	14:46	Unidentified sea turtle	1	39.35800°N 073.13683°W	Mitigation gun	AV	FT, SS, DI	110m/ Single 40 in^3 gun	None	Turtle last observed within 160 dB radius for mitigation gun.
51	16 June 2015	15:42	Loggerhead sea turtle	1	39.48857°N 073.28110°W	Full volume online	AV	FT, SS, DI	200m/ Single 40 in^3 gun	Power down	Turtle last observed within 180 dB radius. Source powered-down for 6 minutes.
52	17 June 2015	11:42	Unidentified whale	1	39.63521°N 073.55102°W	Full volume online	PV/OD	BV, NS	2600m/Full volume	None	Whale last observed within 160 dB radius.
53	18 June 2015	18:10	Unidentified whale	2	39.60687°N 073.50587°W	Full volume online	PV/OD	BV, NS	3922m/Full volume	None	Whale last observed within the 160 dB radius.
54	18 June 2015	20:51	Unidentified whale	1	39.72217°N 073.69883°W	Full volume offline	PV/SD	BV,NS	1900m/Full volume	None	Whale last observed within the 160 dB radius.
55	18 June 2015	21:33	Unidentified whale	2	39.68198°N 073.71862°W	Full volume offline	AV	BV,NS	1800m/Full volume	None	Whale last observed within the 160 dB radius.
56	18 June 2015	22:48	Fin whale	1	39.63025°N 073.62678°W	Mitigation gun	PV/OD	BV,NS	1900m/ Single 40 in^3 gun	None	Whale never entered 160 dB radius.
57	19 June 2015	13:08	Unidentified dolphins	10	39.57200°N 073.50533°W	Full volume online	PV/OD	DV, SA,FT, PO	541m/Full volume	None	Dolphins last observed within the 160 dB radius.
58	19 June 2015	13:31	Loggerhead sea turtle	1	39.55533°N 073.47583°W	Full volume online	PV/SD	ST, DI	270m/ Single 40 in^3 gun	Power down	Turtle last observed within 180 dB radius. Source powered down for 5 minutes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
59	19 June 2015	16:48	Loggerhead sea turtle	1	39.40037°N 073.22303°W	Full volume online	PV/OD	NS, DI	125m/ Single 40 in^3 gun	Power down	Turtle last observed within 180 dB radius. Source powered down for 6 minutes.
60	19 June 2015	17:59	Humpback whale	1	39.38917°N 073.13467°W	Full volume offline	MI	BV, SA, DF	845m/Full volume	None	Whale last observed within 160 dB radius.
61	19 June 2015	19:12	Loggerhead sea turtle	1	39.44521°N 073.21464°W	Full volume online	PV/SD	FL, DI	190m/ Single 40 in^3 gun	Power down	Turtle last observed within 180 dB radius. Source powered down for 7 minutes.
62	19 June 2015	20:12	Unidentified sea turtle	1	39.48817°N 073.29233°W	Full volume online	TV	FL, DI	690m/Full volume	None	Turtle last observed within 160 dB radius.
63	20 June 2015	00:00	Unidentified whale	2	39.64193°N 073.57373°W	Silent	AV	ST, BV	1500m/Silent	None	Source array on board and single mitigation gun silent.
64	20 June 2015	09:52	Loggerhead sea turtle	1	39.49815°N 073.31370°W	Full volume online	PV/SD	FL, DI	300m/ Single 40 in^3 gun	Power down	Turtle last observed within 180 dB radius. Source powered down for 5 minutes.
65	20 June 2015	11:51	Unidentified whale	1	39.58599°N 073.47378°W	Full volume online	PV/OD	BV, ST	1500m/Full volume	None	Whale last observed within 160 dB radius.
66	21 June 2015	18:58	Unidentified whale	1	39.64243°N 073.58248°W	Full volume online	PV/OD	BV, NS	2614m/Full volume	None	Whale was last sighted within 160 dB radius for full volume source.
67	22 June 2015	13:33	Fin whales	2	39.61083°N 073.63667°W	Full volume online	PE/AH	BV, NS, DI, DV	315m/Single 40 in^3 gun	Power down then shut down	Whales last observed within 160 dB radius for full volume source. Source silent for 01:02.
67	22 June 2015	13:43	Unidentified whale	1	39.61083°N 073.63667°W	Full volume online	PE/AH	BV, NS	2914m/Full volume	None	Whale last observed within 160 dB radius for full volume source.
68	22 June 2015	17:06	Loggerhead sea turtle	1	39.46487°N 073.37035°W	Full volume online	PV/OD	ST, DI	270m/Single 40 in^3 gun	Power down	Turtle last observed within 180 dB radius. Source powered down for 6 minutes

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
69	22 June 2015	17:33	Unidentified sea turtle	1	39.44472°N 073.33340°W	Full volume online	PV/OD	NS, DI	200m/Single 40 in^3 gun	Power down	Turtle last observed within 180 dB radius. Source powered down for 6 minutes
70	22 June 2015	18:19	Loggerhead sea turtle	1	39.40903°N 073.26905°W	Full volume online	PV/SD	FT, SS, DI	280m/Single 40 in^3 gun	Power down	Turtle last observed within 180 dB radius. Source powered down for 5 minutes
71	24 June 2015	14:26	Unidentified sea turtle	1	39.46567°N 073.38133°W	Full volume online	AV	ST, SS	150m/Single 40 in^3 gun	Power down	Turtle last observed within 160 dB radius. Source powered down for 4 minutes.
72	24 June 2015	14:51	Unidentified sea turtle	1	39.44683°N 073.34693°W	Full volume online	PV/SD	NS, SS, DI	150m/Single 40 in^3 gun	Power down	Turtle last observed within 180 dB radius. Source powered down for 6 minutes
73	24 June 2015	17:17	Unidentified sea turtle	1	39.36020°N 073.15708°W	Full volume offline	PV/OD	NS, SS, DI	250m/Single 40 in^3 gun	Power down	Turtle last observed within 180 dB radius. Source powered down for 6 minutes.
74	24 June 2015	18:47	Humpback whale	1	39.40397°N 073.16767°W	Full volume online	PE/AH	BV, NS, DF	415m/Full volume	None	Whale last observed within 160 dB radius.
75	24 June 2015	20:05	Unidentified sea turtle	1	39.48736°N 073.31889°W	Full volume online	PV/SD	NS, SS	270m/Single 40 in^3 gun	Power down	Turtle last observed within 180 dB radius. Source powered down for 6 minutes.
76	24 June 2015	22:55	Fin whale	2	39.61138°N 073.54487°W	Full volume online	AV	NS, BV	2614m/Full volume	None	Whales last observed within 160 dB radius.
77	25 June 2015	13:58	Fin whale	1	39.58967°N 073.51083°W	Full volume online	PV/OD	ST, BV	700m/Full volume	None	Whale last observed within 160 dB radius.
78	25 June 2015	17:34	Loggerhead sea turtle	1	39.55012°N 073.54878°W	Silent	PV/OD	ST,FL	150m/Silent	None	Source on board.
79	25 June 2015	19:12	Unidentified sea turtle	1	39.48633°N 073.43333°W	Silent	PV/OD	FL, FT, DI	350m/Silent	None	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
80	26 June 2015	19:59	Loggerhead sea turtle	1	39.53400°N 073.42167°W	Silent	TV	NS, SS, DI	270m/Silent	None	Source on board.
81	26 June 2015	20:20	Unidentified whale	4	39.54550°N 073.44233°W	Silent	PV/OD	NS, BV	3000m/Silent	None	Source on board.
82	27 June 2015	12:45	Fin whale	1	39.55037°N 073.45110°W	Full volume online	PE/AH	NS, BV	1200m/Full volume	None	Whale last observed within 160 dB radius.
82	27 June 2015	12:45	Unidentified dolphin	1	39.55037°N 073.45110°W	Full volume on line	AV	NS, PO	1200m/Full volume	None	Dolphin last observed within 160 dB radius.
83	28 June 2015	19:20	Unidentified sea turtle	1	39.56867°N 073.46317°W	Full volume on line	PV/SD	SS, DI	150m/Single 40 in^3 gun	Power down	Turtle was last observed within the 180 dB radius. Source powered down for 6 minutes.
84	29 June 2015	14:52	Fin whale	2	39.54517°N 073.36883°W	Silent	PE/AH, PE/OD	BV, FT	400m/silent	None	Source on board.
85	30 June 2015	00:00	Fin whale	2	39.55370°N 073.46562°W	Silent	PE/AH	BV, ST	450m/Silent	None	Source on board.
86	1 July 2015	15:18	Loggerhead sea turtle	1	39.40537°N 073.19398°W	Full volume on line	PV/SD	FT, DI	270m/Single 40 in^3 gun	Power down	Turtle last observed within the 180 dB radius. Source powered down for 6 minutes.
87	1 July 2015	16:33	Loggerhead sea turtle	1	39.39092°N 073.15340°W	Full volume off line	PV/SD	FT, DI	270m/Single 40 in^3 gun	Power down	Turtle last observed within the 180 dB radius. Source powered down for 6 minutes.
88	1 July 2015	17:20	Loggerhead sea turtle	1	39.42190°N 073.20878°W	Full volume on line	PV/OD	NS, DI	270m/Single 40 in^3 gun	Power down	Turtle last observed within the 180 dB radius. Source powered down for 6 minutes.
89	1 July 2015	21:56	Unidentified whale	1	39.62072°N 073.57017°W	Full volume on line	PV/OD	NS, BV	500m/Full volume	None	Whale last observed within 160 dB radius

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
90	3 July 2015	14:29	Unidentified sea turtle	1	39.59317°N 073.63100°W	Full volume on line	PV/SD	FT,DI	300m/ Single 40 in^3 gun	Power down	Turtle last observed within the 180 dB radius. Source powered down for 5 minutes.
91	3 July 2015	17:31	Unidentified whale	1	39.47075°N 073.40743°W	Full volume on line	PV/OD	BV, SA, DI	800m/Full volume	None	Whale last observed within the 160 dB radius.
92	4 July 2015	00:31	Unidentified dolphins	16	39.54317°N 073.39280°W	Full volume on line	PV/OD	BV, NS, SV	600m/Full volume	Non	Dolphins last observed within the 160 dB radius.
93	5 July 2015	14:56	Loggerhead sea turtle	1	39.59250°N 073.64483°W	Full volume on line	TV; PV/OD	FL, ST, SS, FT, DI	270m/Single 40 in^3 gun	Power down	Turtle last observed within the 180 dB radius. Source powered down for 6 minutes.
94	5 July 2015	16:32	Loggerhead sea turtle	1	39.52423°N 073.52052°W	Full volume on line	PV/OD	ST,DI	300m/Single 40 in^3 gun	Power down	Turtle last observed within the 180 dB radius. Source powered down for 5 minutes.
95	5 July 2015	18:32	Loggerhead sea turtle	1	39.42667°N 073.36650°W	Full volume off line	PV.OD	ST, DI	200m/Single 40 in^3 gun	Power down	Turtle last observed within the 180 dB radius. Source powered down for 6 minutes.
96	5 July 2015	19:09	Loggerhead sea turtle	1	39.41967°N 073.31933°W	Full volume off line	AV	NS, DI	120m/Single 40 in^3 gun	Power down	Turtle last observed within the 180 dB radius. Source powered down for 7 minutes.
97	5 July 2015	21:59	Loggerhead sea turtle	1	39.55488°N 073.43927°W	Full volume on line	PV.OD	FT, DI	250m/Single 40 in^3 gun	Power down	Turtle last observed within the 180 dB radius. Source powered down for 5 minutes.
98	6 July 2015	12:48	Unidentified dolphins	7	39.94837°N 073.71645°W	Silent	V	SA, PO, NS, FF	200m/Silent	None	Source on board

APPENDIX G: Summary of acoustic detections of protected species during the NJ survey

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
1	3 June 2015	16:36	Unidentified delphinid	2	39.61565°N 072.94382°W	Silent	At 16:36:44 UTC, whistles from at least two unidentified delphinids were detected both visually and aurally on Pamguard low frequency spectrogram and whistle and moan detector. Down-sweeping whistles were dominant in addition to sinusoidal and concave whistle signatures which ranged from 6 to 21 kilohertz. The last whistle was detected at 16:48:07 UTC.	Unknown/ Silent	None	Not visually confirmed
2	4 June 2015	19:43	Unidentified delphinid	4	39.51717°N 073.29083°W	Full volume on line	At 19:43:37 UTC, whistles from four unidentified dolphins were faintly audible and observed on the Pamguard low frequency spectrogram and whistle and moan detector. The whistles were dominantly upsweeping with a few sinusoidal whistles which had a frequency range of 5 to 24 kilohertz. The last whistles were detected at 19:46:09 UTC.	480m/Full Volume	None	Also visually observed (VD#2)
3	8 June 15	19:05	Common dolphins	8	39.47967°N 073.04600°W	Mitigation gun	At 19:05 UTC, whistles from at least eight unidentified delphinids were detected both visually and aurally on Pamguard low frequency spectrogram and whistle and moan detector. Upsweeping, down sweeping and sinusoidal whistle signatures with frequencies ranging from 6 to 24 kilohertz were observed. From 19:12:09 to 19:12:21 and 19:15:10 to 19:15:12, click trains were observed with frequencies that ranged from 18 to 24 kilohertz. The last whistle was detected at 19:27 UTC.	320/Mitigation gun	Delayed ramp up	Simultaneous with visual detection #12; ramp up delayed for 25 minutes

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
4	10 June 15	02:53	Unidentified delphinids	2	39.43042°N 073.07557°W	Full volume online	At 02:54 UTC, unidentified dolphin whistles were observed on Pamguard's low frequency spectrogram. The distance to the dolphins was not localized on Pamguard's map module. Post-analysis of low frequency recordings of this detection through Spectrogram 16 showed whistles of two individual dolphins. Up-sweeping and convex whistles, with frequencies ranging from approximately 7 kHz to 23 kHz, occurred from 02:53:14 UTC to 02:54:15 UTC. From 02:54:27 UTC to 02:55:59 UTC, four sinusoidal whistles from one individual dolphin were observed in quick succession. These whistles spanned a frequency range from 9 kHz to 13 kHz. The detection registered aurally via the headphones. The acoustic source was at full volume of 700 dB and in production at the time of this detection. The detection was not visually correlated and no mitigation actions were required.	Unknown/Full volume	None	Not visually confirmed

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
5	11 June 15	07:36	Unidentified dolphins	2	39.43900°N 073.28183°W	Full volume online	At 07:36 UTC, unidentified dolphin whistles registered aurally on the headphones and were observed on Pamguard's low frequency spectrogram display. The dolphins were not localized within Pamguard's map module. Post-analysis of the low frequency recordings through Spectrogram 16 showed the vocalizations of at least two dolphins. Up-sweeping, down-sweeping, and sinusoidal whistle signatures, spanning a frequency range from 6kHz to 20 kHz, were observed throughout the detection. The last whistle was detected at 08:03 UTC. At 07:45 UTC, a PSO was alerted to the detection and began watch from the bridge; however, the detection could not be confirmed visually. The acoustic source was active at full volume on a survey line at the time of this detection.	Unknown/Full volume	None	Visual PSO could not confirm detection.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
6	12 June 15	09:24	Unidentified delphinid	2	39.58983°N 073.41765°W	Full volume online	At 09:24:07 UTC clicks from at least two unidentified delphinids were observed on the Pamguard high frequency click detector. The clicks had a peak amplitude between 180 and 190 decibels; however there were no distinct click trains, so the bearing of the dolphins could not be determined. The last clicks were observed at 09:29:04 UTC. Post-detection analysis of the recordings in Spectrogram 16 revealed that the clicks had a frequency range between 15 and 94 kilohertz, with several clicks peaking as high as 166 kilohertz. At the start of the detection, visual observers indicated that they were sighting dolphins approximately 80 meters off the starboard bow of the vessel. During the detection, the acoustic source was at full volume on a survey line; however, as the dolphins were not visually observed within the 180 dB exclusion zone, no mitigation actions were required.	420m/Full volume	None	Simultaneous with visual detection #22. Dolphins not visually observed within the 180 dB EZ so no mitigation actions were required. Dolphins last visually observed at 09:24 UTC in 160 dB zone.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
7	15 June 2015	05:10	Unidentified dolphins	2	39.42612°N 073.27293° W	Full volume online	At 05:10 UTC, clicks from unidentified dolphins were observed on the Pamguard high frequency click detector. There were no distinct click trains, so the bearing of the dolphins could not be determined. The clicks were last observed at 05:13 UTC. Post-detection analysis of the high frequency recordings through Spectrogram 16 showed over-lapping recurrent clicks of multiple individuals, with average frequencies of approximately 84kHz. The detection did not register on the low frequency monitoring system or aurally via the headphones. During the detection, the acoustic source was at full volume on a survey line; however, this detection was not visually confirmed. No mitigation actions were required.	Unknown/ Full volume	None	Not visually confirmed
8	16 June 2015	01:03	Unidentified dolphins	2	39.49383°N 073.28813° W	Full volume online	At 01:03 UTC, unidentified dolphin whistles were observed on Pamguard's low frequency spectrogram. A single click train was observed with a bearing of 20^{o} to 100^{o} . The distance to the dolphins was not localized on Pamguard's map module. Post-analysis of low and high frequency recordings of this detection through Spectrogram 16 showed whistles and clicks of two individual dolphins. Up-sweeping and convex whistles, with frequencies ranging from approximately 5 kHz to 24 kHz, occurred from 01:03:30 UTC to 01:03:54 UTC. Clicks were observed with a peak frequency range of 32 kHz to 166 kHz. The detection registered aurally via the headphones. The acoustic source was at full volume of 700 dB and in production at the time of this detection. The detection was not visually correlated and no mitigation actions were required.	Unknown/ Full volume	None	Not visually confirmed

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
9	19 June 2015	10:35	Unidentified dolphins	2	39.59250°N 073.46767°W	Full volume online	At 10:35:23 UTC whistles from at least two unidentified delphinids were faintly audible and observed on the Pamguard low frequency spectrogram and whistle and moan detector. The whistles were mainly up-sweeping, with a few down-sweeping and sinusoidal between frequencies 7 and 18 kilohertz. The last whistle was detected at 10:39:58 UTC. During the detection the acoustic source was at full volume on a survey line. The detection was not visually confirmed however, due to thick fog that limited visibility to approximately 500 meters at the time. The bearing and distance of the dolphins could not be determined during the detection via PAM.	Unknown/ Full volume	None	Not visually confirmed
10	23 June 2015	08:49	Unidentified dolphins	3	39.43643°N 073.32153°W	Full volume online	At 08:49 UTC, clicks from unidentified dolphins were observed on the Pamguard high frequency click detector. The dolphins were located at a bearing of 45 degrees but their distance from the vessel could not be determined due to the short duration of the detection. The clicks were last observed at 08:50 UTC. Post-detection analysis of the high frequency recording through Spectrogram 16 showed over-lapping recurrent clicks of at least three individuals, with average frequencies of approximately 86kHz. The detection did not register on the low frequency monitoring system or aurally via the headphones. During the detection, the acoustic source was at full volume on a survey line. This detection was not visually confirmed; no mitigation actions were required.	Unknown/Full volume	None	Not visually confirmed

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
11	4 July 2015	00:32	Unidentified dolphins	1	39.54582°N 073.39748°W	Full volume on line	At 00:32 UTC, the visual PSOs notified the PAM operator that dolphins were detected off the port bow. Soon thereafter, faint whistles were audible via the headphones. The acoustic noise score was judged to be a 4, with 5 being the highest; as such, the whistles were not observed on the Pamguard spectrogram. Post-detection analysis of the low frequency recording through Spectrogram 16 showed faint sinusoidal whistles with a maximum frequency of 10 kHz. This detection did not register on the high frequency system. During the detection, the acoustic source was at full volume on a survey line. This detection was visually confirmed. The dolphins did not enter the 180dB exclusion zone so no mitigation actions were required.	600m/Full volume	None	Simultaneous with visual detection #92

APPENDIX H: **Photographs of identified protected species visually detected during the NJ survey.**

Figure 26: Loggerhead sea turtle; Visual detection #5; 7 June 2015

Figure 27: Fin whale; Visual detection #13; 9 June 2015

Figure 28: Loggerhead sea turtle; Visual detection #16; 10 June 2015

Figure 29: Short-beaked common dolphins; Visual detection #17; 10 June 2015

Figure 30: Humpback whale; Visual detection #20; 11 June 2015

Figure 31: Fin whales; Visual detection #21; 11 June 2015

Figure 32: Short-beaked common dolphins; Visual detection #26; 13 June 2015

Figure 33: Loggerhead sea turtle; Visual detection #32; 4 June 2015

Figure 34: Loggerhead sea turtle; Visual detection #58; 19 June 2015

Figure 35: Humpback whale; Visual detection #60; 19 June 2015

Figure 36: Fin whale; Visual detection #67; 22 June 2015

Figure 37: Loggerhead sea turtle; Visual detection #70; 22 June 2015

Figure 38: Humpback whale; Visual detection #74; 24 June 2015

Figure 39: Fin whale; Visual detection #82; 27 June 2015

Figure 40: Fin whale and unidentified dolphin; Visual detection #82; 27 June 2015

Figure 41: Two fin whales; Visual detection #84; 29 June 2015

Figure 42: Loggerhead sea turtle and common terns; Visual detection #93; 5 July 2015

APPENDIX I: Screenshots taken during acoustic detections of protected species during the NJ

survey.

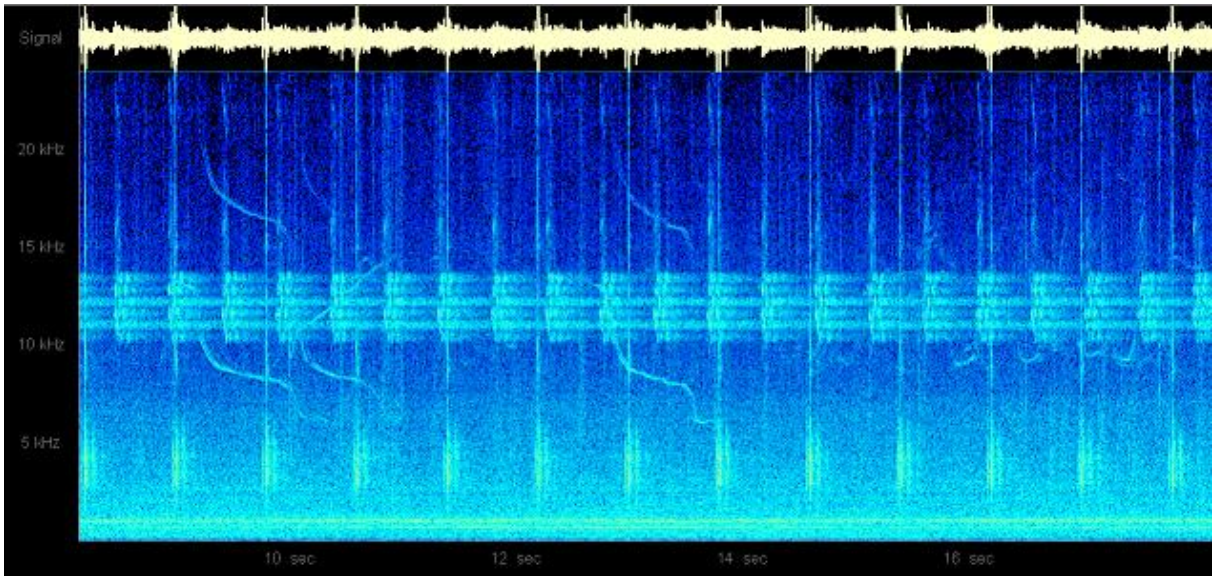

Figure 43: Low frequency whistles from two unidentified dolphins; Spectrogram 16; Acoustic detection #1; 3 June 2015

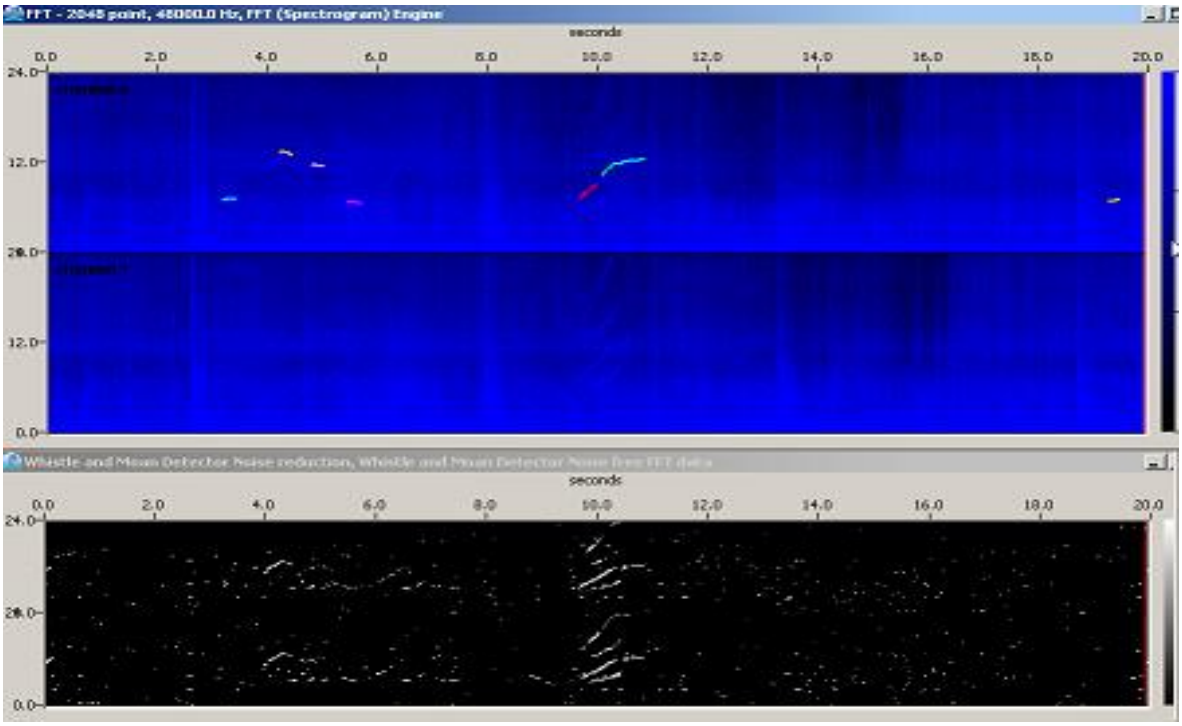

Figure 44: Whistles from four unidentified dolphins; Pamguard low frequency spectrogram and whistle and moan detector; Acoustic detection #2; 4 June 2015

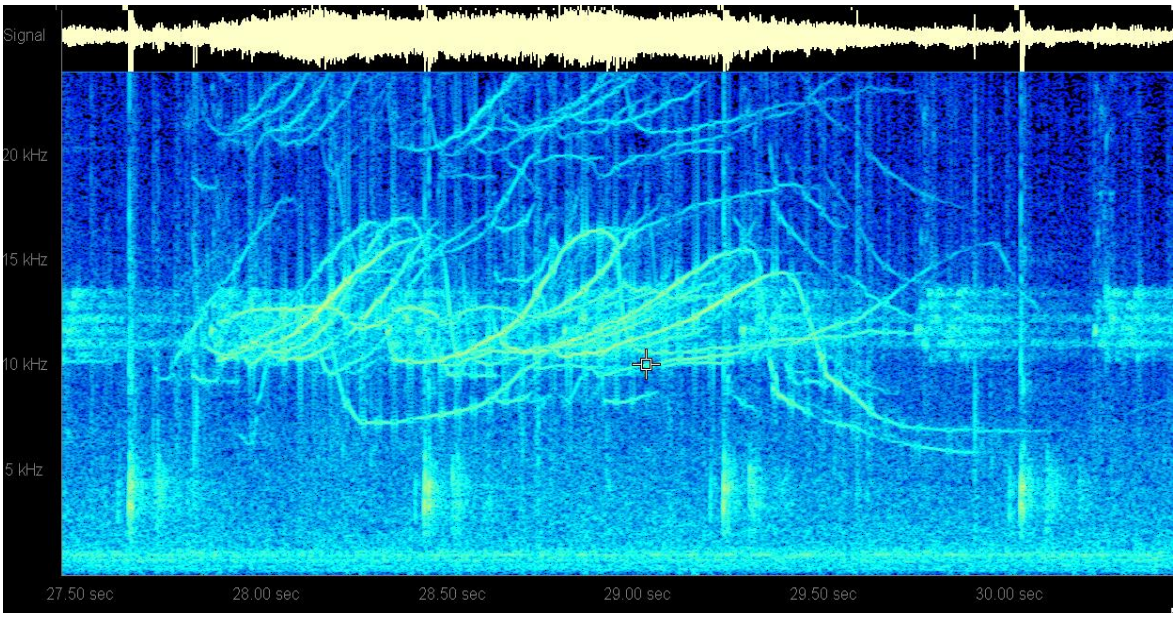

Figure 45: Low frequency whistles from eight short-beaked common dolphins; Spectrogram 16; Acoustic detection #3; 8 June 2015

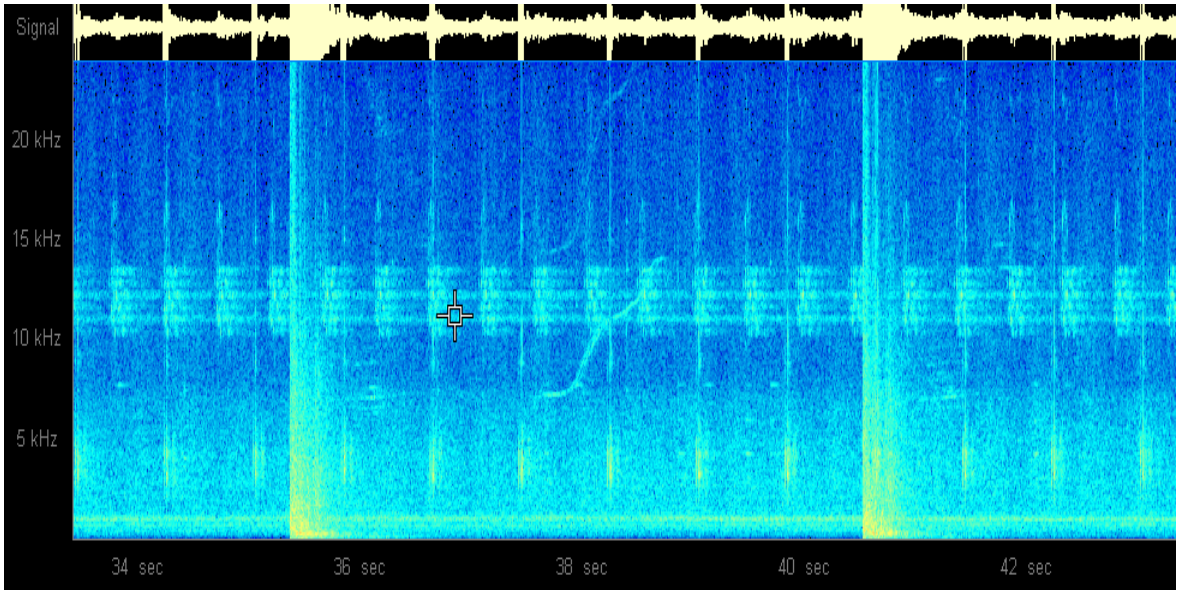

Figure 46: Low frequency whistles from two unidentified dolphins; Spectrogram 16; Acoustic detection #4; 10 June 2015

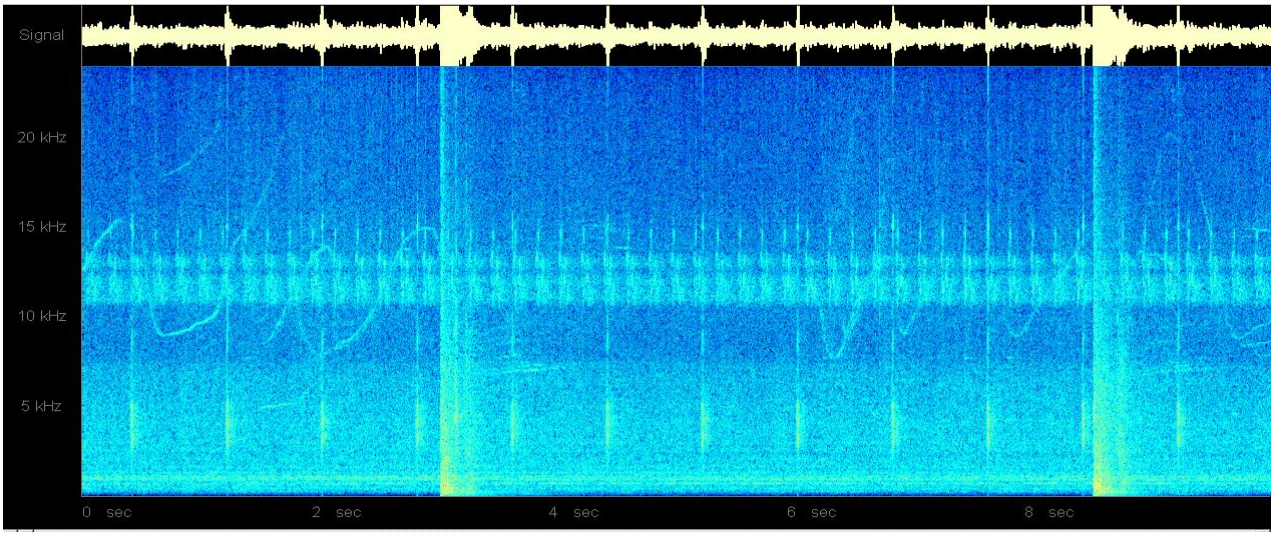

Figure 47: Low frequency whistles from two unidentified dolphins; Spectrogram 16; Acoustic detection #5; 11 June 2015

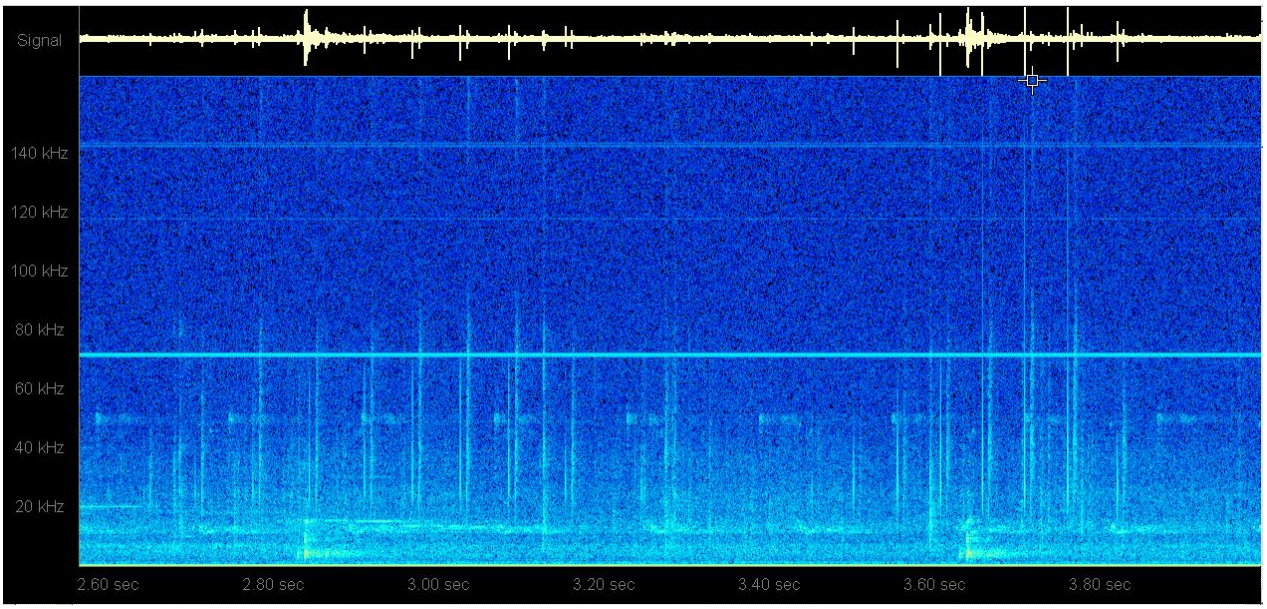

Figure 48: High frequency clicks from unidentified dolphins; Spectrogram 16; Acoustic detection #6; 12 June 2015

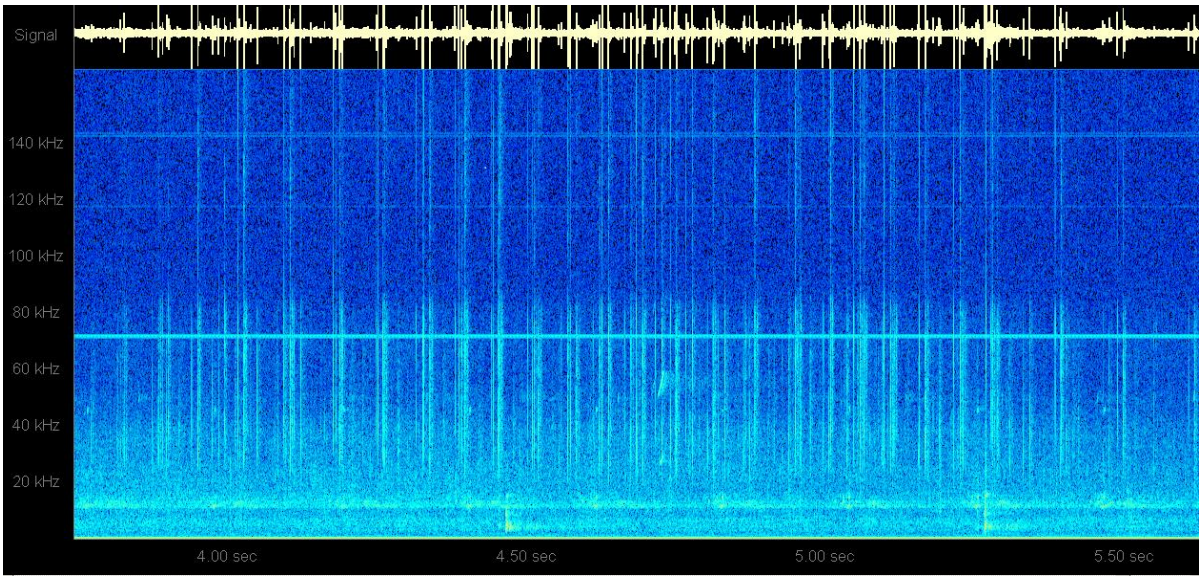

Figure 49: High frequency clicks from unidentified dolphins; Spectrogram 16; Acoustic detection #7; 15 June 2015

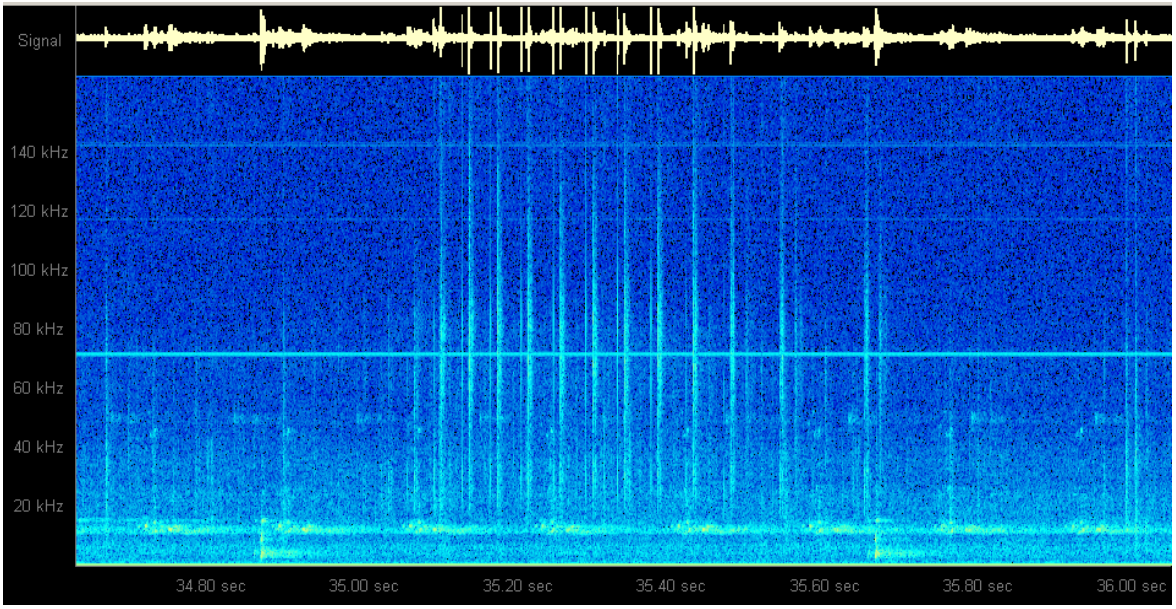

Figure 50: High frequency clicks from unidentified dolphins; Spectrogram 16; Acoustic detection #8; 16 June 2015

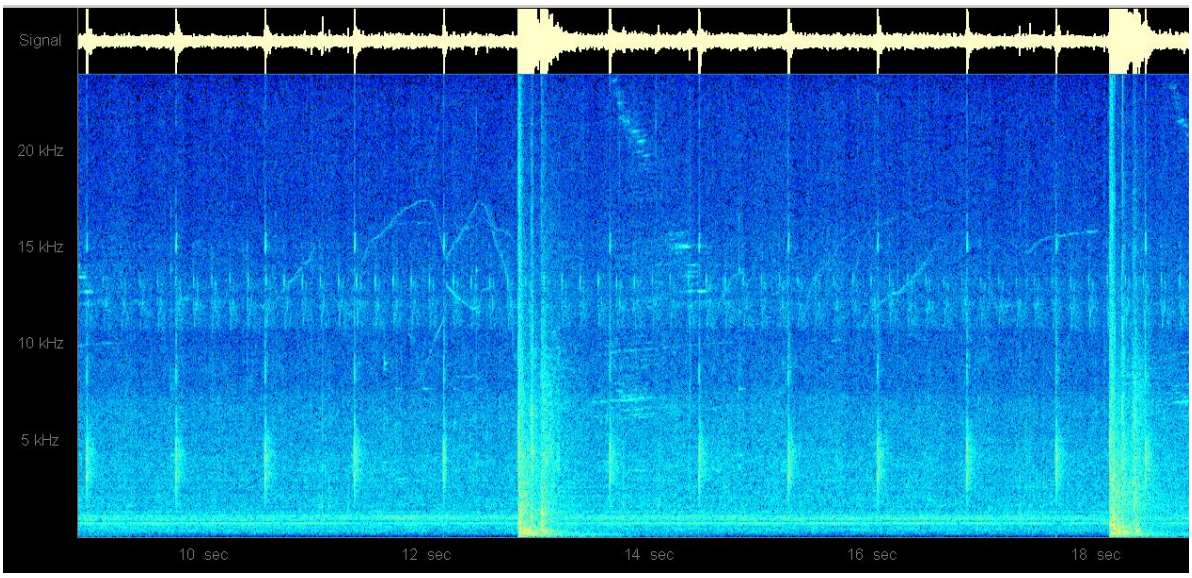

Figure 51: Low frequency whistles from unidentified dolphins; Spectrogram 16; Acoustic detection #9; 19 June 2015

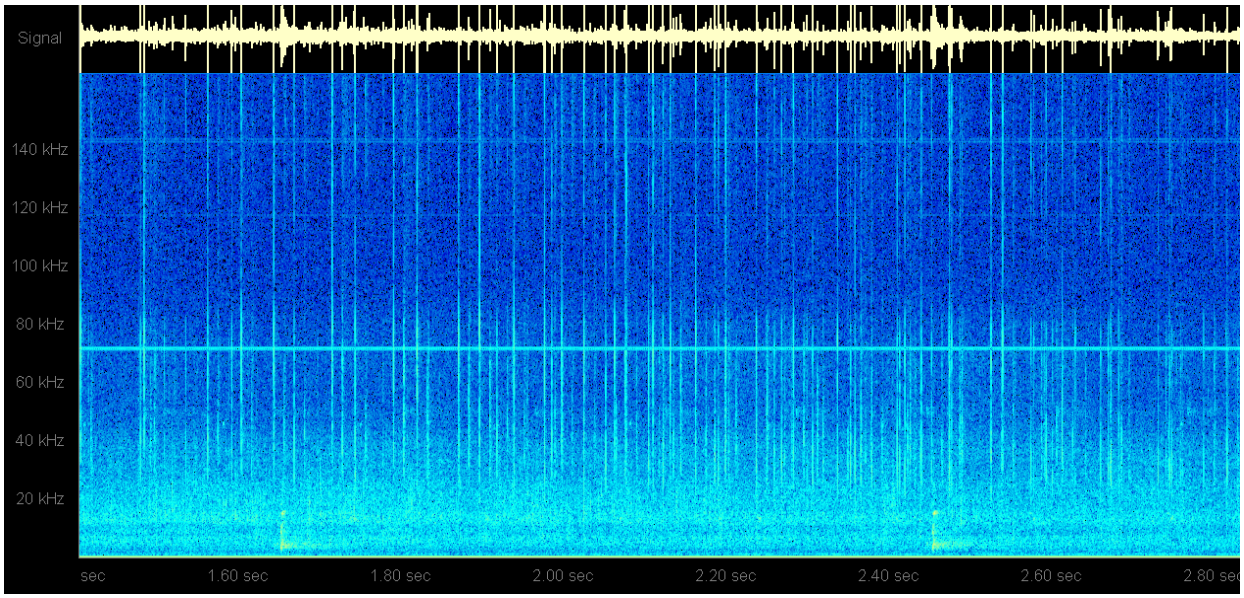

Figure 52: High frequency clicks from unidentified dolphins; Spectrogram 16; Acoustic Detection # 10; 23 June 2015

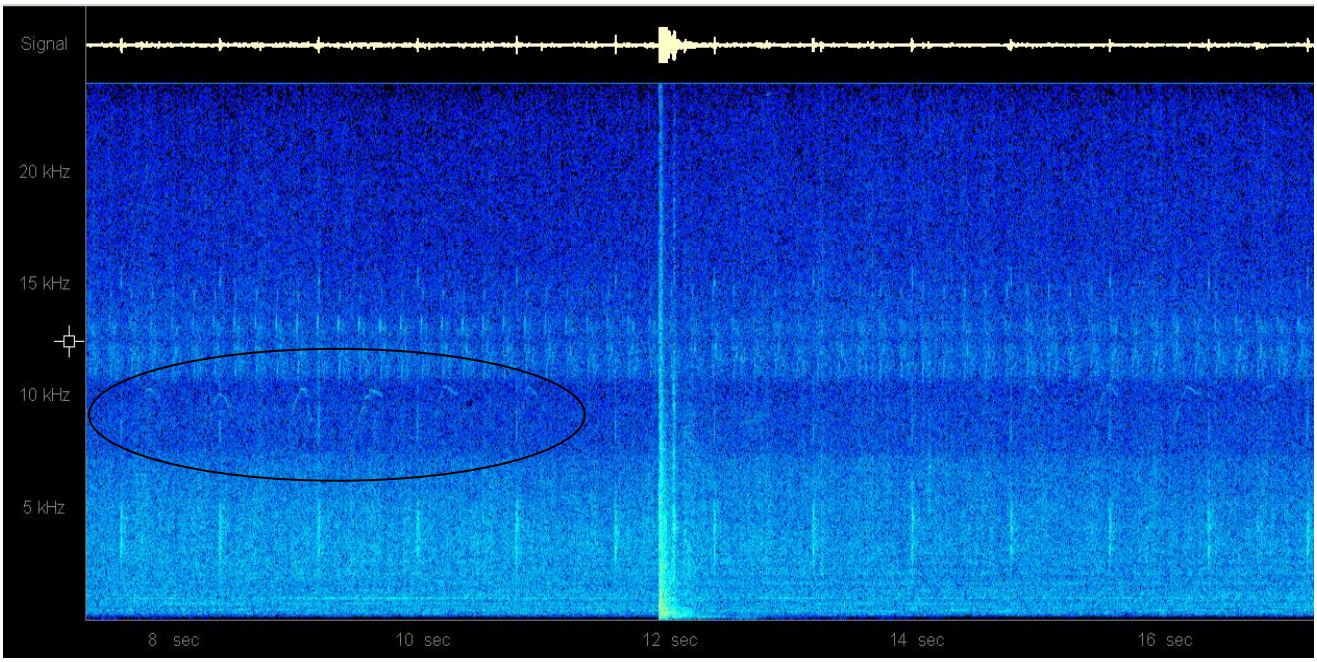

Figure 53: Faint sinusoidal whistle signatures of an unidentified dolphin; Acoustic Detection # 11; 4 July 2015

APPENDIX J: Species of birds and other wildlife observed during the NJ survey

Common Name	Family	Genus	Species	Approximate Number Individuals Observed	Approximate Number of Days Species Was Observed
Barn swallow	Hirundinidae	*Hirundo*	*rustica*	13	8
Brown-headed cowbird	Icteridae	*Molothrus*	*ater*	3	3
Canada goose	Anatidae	*Branta*	*canadensis*	1	1
Common tern	Laridae	*Sterna*	*hirundo*	44	7
Caspian tern	Laridae	*Sterna*	*caspia*	2	1
Cory's shearwater	Procellariidae	*Calonectris*	*diomedea*	18	8
Double-crested cormorant	Phalacrocoracidae	*Phalacrocorax*	*auritus*	112	7
Gray Catbird	Mimidae	*Dumetella*	*carolinensis*	2	2
Greater black-backed gull	Laridae	*Larus*	*marinus*	48	6
Greater shearwater	Procellariidae	*Puffinus*	*gravis*	112	14
Herring gull	Laridae	*Larus*	*argentatus*	45	8
Laughing gull	Laridae	*Larus*	*atricilla*	22	5
Little Egret	Ardeidae	*Egretta*	*garzetta*	1	1
Osprey	Accipitridae	*Pandion*	haliaetus	2	1
Ring-billed gull	Laridae	*Larus*	*delawarensis*	1	1
Royal tern	Laridae	*Sterna*	*maxima*	7	2
Sooty shearwater	Procellariidae	*Puffinus*	*griseus*	10	4
Sooty tern	Laridae	*Sterna*	*fuscata*	1	1
Unidentified gull	Laridae	*N/A*	*N/A*	16	3
Unidentified jaeger	Laridae	*N/A*	*N/A*	1	1
Unidentified shearwater	Procellariidae	*N/A*	*N/A*	219	31
Unidentified storm petrel	Hydrobatidae	*N/A*	*N/A*	16	3
Unidentified tern	Laridae	*N/A*	*N/A*	35	6

Common Name	Family	Genus	Species	Approximate Number Individuals Observed	Approximate Number of Days Species Was Observed
Blue shark	Carcharhinidae	*Prionace*	*glauca*	1	1
Green lacewing	Crysopidae	*N/A*	*N/A*	1	1
Hammerhead shark	Sphyrnidae	*N/A*	*N/A*	2	2
Mahi mahi	Coryphaenidae	*Coryphaena*	*hippurus*	4	1
Oceanic sunfish	Molidae	*Mola*	*Mola*	4	2
Pilot fish	Carangidae	*Naucrates*	*ductor*	17	1
Portuguese Man-o-War	Physaliidae	*Physalia*	*physalis*	3	2
Red Admiral Butterfly	Nymphalidae	*Vanessa*	*atalanta*	1	1
Scalloped Hammerhead shark	Sphyrnidae	*Sphyrna*	*lewini*	2	2
Unidentified butterfly	N/A	*N/A*	*N/A*	2	2
Unidentified moth	N/A	*N/A*	*N/A*	1	1
Unidentified sea chub	Kyphosidae	*Kyhosus*	*N/A*	4	1
Unidentified shark	N/A	*N/A*	*N/A*	10	4
Unidentified tuna	Scombridae	*N/A*	*N/A*	-	2