



Protected Species Mitigation and Monitoring Report

Mid-Atlantic Survey

9 April 2013- 19 May 2013

R/V Marcus G. Langseth

Prepared for

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for submission to

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Project No.	UME04163	RPS
Cruise ID No.	MGL1305	411 N. Sam Houston Parkway E.
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1. EXECUTIVE SUMMARY

The National Science Foundation (NSF) owned research vessel (R/V), *Marcus G. Langseth*, operated by Lamont-Doherty Earth Observatory (L-DEO), a part of Columbia University, conducted a two-dimensional (2D) marine seismic program in the North Atlantic approximately 200 miles off the coast of the Azores islands. The survey acquired data for a multi-scale seismic investigation of the tectono/magmatic setting of the Rainbow massif. The *Langseth* left Bermuda on 11 April 2013 and began the survey on 17 April 2013. The survey was completed on 19 May 2013 and the *Langseth* went in to port in Ponta Delgada, San Miguel of the Azores on 19 May 2013.

An application was submitted to the National Marine Fisheries Service (NMFS) for a permit to harass marine mammals, incidental to the marine geophysical survey. An Incidental Harassment Authorization (IHA) was granted on 8 April 2013 ([Appendix A](#)). Mitigation measures were implemented to minimize potential impacts to marine mammals, sea turtles and protected seabirds throughout the duration of the survey. Mitigation measures included, but were not limited to, the use of NMFS approved Protected Species Observers (PSOs) for both visual and acoustic monitoring, establishment of safety radii, and implementation of ramp-up, power-down and shut-down procedures.

RPS was contracted by L-DEO to provide continuous protected species observation coverage and to fulfill the environmental regulatory requirements and reporting mandated by NMFS in the IHA. Four PSOs and one dedicated PAM Operator were present on board the *Langseth* throughout the survey in this capacity. PSOs undertook a combination of visual and acoustic watches, conducting a total of 505 hours and 26 minutes of visual observations and 382 hours and 43 minutes of acoustic monitoring over the course of the survey.

This visual monitoring effort produced a project total of 116 protected species detection records, comprised of 83 cetacean and 33 sea turtles records. Detections were made both visually and acoustically on the PAM system with a total of 72 visual sightings and 12 acoustic detections, one event consisted of both a visual sighting and acoustic detection. Of the 83 cetacean records collected, 34 consisted of mysticetes, 27 records were collected for odontocetes, and 22 records for unidentified large whales. All of the sea turtles consisted of chelonid species with the exception of one leatherback sea turtle.

Detections of protected species resulted in a total of 42 mitigation actions being implemented during 37 detection events: one delayed ramp-up, 31 power-downs and ten shut-downs of the acoustic source. There were five sighting events during which two mitigation actions were applied, power-downs followed by shut-downs of the source. Mitigation measures were to be applied to sightings of Bermuda petrels and roseate terns observed submerging below the water surface inside the exclusion zone of the active source however there were no sightings of these species during the survey.

A known 111 cetaceans were exposed to received sound levels equal to or greater than 160 dB of sound from the acoustic source, potentially constituting a level B harassment take as defined by NMFS. Potential cetacean level B harassment takes included 15 fin whale takes, four blue whale takes and 52 common dolphin takes. Additionally, nine unidentified baleen whales, 16 unidentified large whales and 15 unidentified dolphins were observed within the 160 dB safety radius.

A project summary sheet of observation, detection, and operational totals is in [Appendix B](#).

2. INTRODUCTION

The following report details protected species monitoring and mitigation as well as seismic survey operations undertaken as part of the Canales Mid-Atlantic two-dimensional marine seismic survey on board the *R/V Langseth* from 11 April 2013 to 19 May 2013 in the North Atlantic off the coast of the Azores islands.

This document serves to meet the reporting requirements dictated in the IHA, pursuant to the Marine Mammal Protection Act (MMPA), and Incidental Take Statement, pursuant to the Endangered Species Act (ESA), issued to LDEO by NMFS on 8 April 2013. The IHA authorized non-lethal takes of Level B harassment of specific marine mammals incidental to a marine geophysical survey program. NMFS has stated that seismic source received sound levels greater than 160 dB could potentially disturb marine mammals, temporarily disrupting behavior, such that they could be considered as “takes” of these exposed animals. Potential consequences of Level B harassment taking could include effects such as temporary or permanent hearing threshold shifts, behavior modification and other reactions. In order to take a precautionary approach, NMFS requires that provisions such as safety radii, power-downs and shut-downs be implemented to mitigate for these potential adverse effects.

The Endangered Species Act (ESA) also protects avian species. Although unlikely to occur, the endangered Bermuda petrel and the threatened roseate tern were species identified that may occur within the survey area. In compliance with USFWS, precautionary power-downs/shutdowns would be applied upon encountering any of these birds diving below the surface of the water within the 180dB mitigation zone.

2.1. PROJECT OVERVIEW AND LOCATION

The survey occurred in the mid North-Atlantic ocean in International Waters in the area 35.8 to 36.6 ° North, 34.4 to 33.4 ° West (Figure 1). The seismic survey took place in water depths between 1000 meters and 3000 meters. The survey plan included 39 Ocean-bottom seismometer (OBSs) refraction lines survey lines and 19 multi-channel survey (MCS) lines. The *R/V Langseth* was the source/acquisition vessel used throughout the Mid-Atlantic marine seismic survey. The *Langseth's* cruising speed is 10 knots but seismic survey speed varied between 3.5 and 5.5 knots. Acquisition began on 18 April 2013 and continued until 19 May 2013. All except four of the planned OBS survey lines and all of the MCS survey lines plus two additional survey lines were acquired. The *Langseth* acquired a total of approximately 3793.37 kilometres of survey lines over the course of the marine seismic survey program.

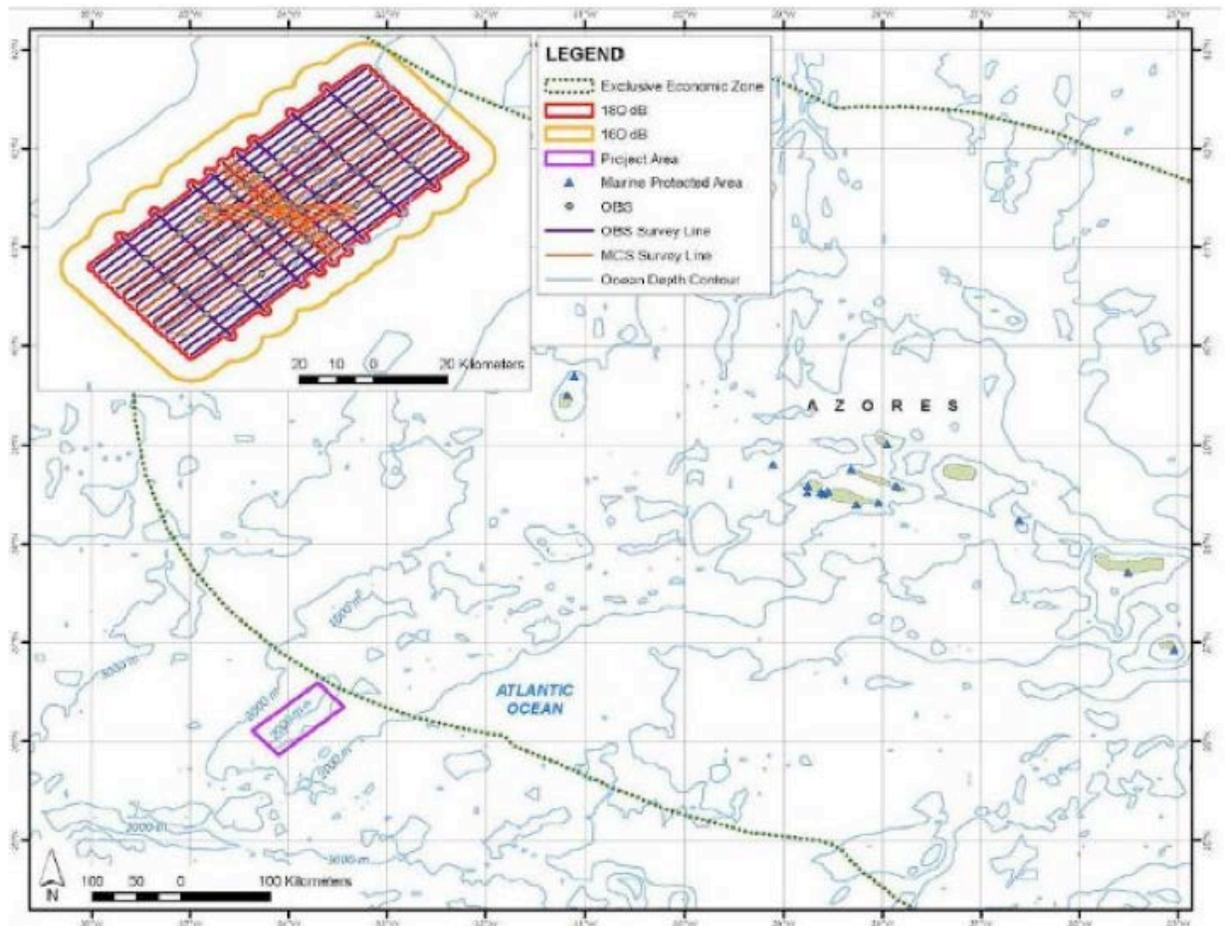


Figure 1. Location of the proposed seismic survey, ensonified areas, and OBSs at the proposed study site on the Mid-Atlantic Ridge during April– May 2013, and marine protected areas in the Azores.

The goals of the proposed research were to conduct a multi-scale seismic investigation of the tectono/magmatic setting of the Rainbow massif, specifically to (1) determine the characteristics of the magma body that supplies heat to the Rainbow hydrothermal field; (2) determine the distribution of the different rock types that form the Rainbow massif; and (3) image large-and small-scale faults in the vicinity of the Rainbow massif, and investigate their role in controlling hydrothermal fluid discharge.

2.1.1. Energy Source

The acoustic source consisted of four towed airgun sub-arrays and one hydrophone streamer cable. The sub-arrays were deployed centrally astern as a single acoustic source with each array separated by six meters. The airguns were towed at a depth of 12 meters and were situated 230 meters astern of the vessel. This placed the source arrays 230 meters from the Navigational Reference Point (NRP), which was located on the PSO observation tower.

Each source array utilized a mixture of Bolt 1500LL and Bolt 1900LLX airguns ranging in volume from the smallest airgun of 40 in³ to 360 in³. Each sub-array contained ten airguns, with

the first and last spaced 16 meters apart. Only nine airguns on each sub-array were firing during survey acquisition, with the tenth gun utilized as a spare. The total volume of each sub-array was 1,650 in³. The full power source of four sub-arrays (36 airguns) had a total discharge volume of 6,600 in³ and a pressure of 1900 psi. Each discharge of the source consisted of a single brief pulse of sound (duration of approximately 0.1 second) with the greatest energy output occurring in the two to 188 hertz frequency range.

The shot point interval for the MCS survey was 37.5 meters, equating to approximately 15 seconds at typical survey speed, but was increased to 450 meters during the acquisition of the OBS refraction survey lines, or approximately 3.5 minutes at typical survey speed. The sound signal receiving system during the acquisition of the MCS transect lines consisted of a single eight kilometer long hydrophone streamer, which received the returning acoustic signals and transferred the data to the processing system located onboard the vessel. Due to the length and placement of the cables, the maneuverability of the vessel was limited to turns of five degrees per minute while the gear was being towed.

Acquisition of the OBS refraction survey lines utilized 46 Scripps Institute of Oceanography LC4X4 OBSs as the receiving system. Each OBS, with a volume of 1 meter³, was deployed along the seafloor with an anchor and retrieved by an acoustic trigger where the OBS was released to float to the surface and be retrieved. All except one of the OBSs deployed were successfully retrieved. Following the completion of acquisition of the survey lines, 15 OBSs were re-deployed to remain in position to collect further data and be retrieved at a future date.

In addition to the operations of the airgun array, a Kongsberg EM 122 multibeam echosounder (MBES), a Knudsen Chirp 3260 sub-bottom profiler (SBP), and a hull-mounted acoustic Doppler current profiler (ADCP) were operated from the *Langseth* continuously throughout the cruise. These sound sources were operated from the *Langseth* simultaneous with the airgun array.

3. MITIGATION AND MONITORING METHODS

The PSO monitoring program on the *Langseth* was established to meet MMPA and ESA requirements that were issued by NMFS and USFWS, including monitoring and mitigation objectives. The survey mitigation program was designed to minimize potential impacts of the *Langseth's* seismic program on marine turtles, marine mammals, and other protected species of interest. The PSO monitoring program was consistent with the NSF-USGS PEIS (2012) and tiered Environmental Analysis prepared for this survey. The following monitoring protocols were followed to meet these objectives:

- Visual observations were established to provide real-time sighting data, allowing for the implementation of mitigation procedures as necessary.
- Operation of a Passive Acoustic Monitoring system to compliment visual observations and provide additional marine mammal detection data.
- Document number and behavior of marine mammals and marine turtles exposed to sound levels constituting a potential “take”.

In addition to executing the monitoring and mitigation measures outlined in the IHA, PSOs collected and analyzed necessary data mandated by the IHA (see Appendix A).

3.1. VISUAL MONITORING SURVEY METHODOLOGY

There were five trained and experienced PSOs on board to conduct the monitoring for marine mammals, record and report on observations, and request mitigation actions in accordance to the IHA. The PSOs onboard were NMFS-approved and held certifications from a recognized Joint Nature Conservation Committee (JNCC) course and/or an approved Bureau of Ocean Energy Management (BOEM) / Bureau of Safety and Environmental Enforcement (BSEE) course. Visual monitoring was primarily carried out from an observation tower (Figure 2) located 18.9 meters above the water surface, which afforded the PSO's a 360-degree viewpoint around the acoustic source.



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

The PSO tower was equipped with Fujinon 7x50 binoculars as well as two mounted 25x150 Big-eye binoculars. Inside the tent located in the middle of the platform was a laptop for data collection as well as a telephone for communication with the PAM station, bridge, or main lab. Also inside the tent was a monitor that displayed current information about the vessel's position, speed, and heading, along with water depth, wind speed and direction, and source activity. Most observations were held from the tower; however, when there was severe weather or poor environmental conditions observations would be performed from the bridge (~12.8m above sea level) or the catwalk (~12.3m above sea level) in front of the bridge. The D-300 Night Vision Monocular was also available to be used to conduct night time observations for nighttime ramp-ups of the acoustic source, but was not used during this survey.

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

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 sunrise, beginning as soon as the safety radii were visible, and continued past sunset until the safety radii became obscured. Start of observation times ranged from 05:50 to 06:30 local time, while end of observation times ranged from 20:00 to 20:30 local time.

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

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.

Observers also conducted visual observations for endangered Bermuda petrels and threatened roseate terns. Mitigation procedures for protected seabirds would include power-downs/shutdowns for seabirds observed diving below the water surface within the exclusion zone. No Bermuda petrels or roseate terns however were sighted throughout the survey.

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, sea turtle, or protected seabird) to determine which safety radius applied to the animal. The visual PSOs would then notify the PAM operator, who was located in the main science lab, that there was an animal inside or outside of the safety radius. If the animal was observed inside the safety radius and a mitigation action was necessary, the PAM operator would relay the message to the seismic technician who was sitting nearby. Table 1 describes the various exclusion zone radii applied to cetaceans and sea turtles, 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 to

enable recordings to be made for possible 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. Exclusion zone (EZ) radii for triggering mitigation.

Source and Volume	Array Tow Depth (m)	Water Depth (m)	EZ for Cetaceans / Sea turtles 180 dB (m)	Level-B Harassment Zone 160 dB (m)
Single bolt airgun (40 in ³)	12	<1000m	100	582
	12	>1,000	100	388
4 strings 36 airguns (6600 in ³)	12	<1000m	1674	10362
	12	>1,000	1116	6908

When a protected species was observed, range estimations were made using reticle binoculars, the naked eye, and by relating the animal to an object at a known distance, such as the acoustic array located 230m from the PSO tower. Specific species identifications were made whenever distance, length of sighting and visual observation conditions allowed. PSOs observed anatomical features of animals sighted with the naked eye and through the big-eyes and reticle binoculars and noted behavior of the animal or group. Photographs were taken during most sightings. Sometimes photographs were not taken due to the brevity of a sighting. The camera used was a Canon EOS 60D with a 300 millimeter telephoto lens. Marine mammal and sea turtle identification manuals were consulted and photos were examined during visual watch breaks to confirm identifications.

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

3.2. ACOUSTIC MONITORING SURVEY METHODOLOGY

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

Two PSOs who were trained and experienced with the use of PAM, were present throughout the cruise. One person was designated as the PAM operator to oversee and conduct the PAM operations. All PSOs completed a PAM training provided by the PAM Operator in the initial days of the hydrophone deployment during which basic PAM system operation was covered. To achieve 24-hours of monitoring, the PSOs and the PAM operator rotated through acoustic monitoring shifts with the PAM operator monitoring many of the night time hours when PSOs were not making visual observations and the PAM was the only system in use for detecting

cetaceans. Monitoring shifts lasted one to five hours maximum. During daylight hours, acoustic operators were in communication with visual PSOs in the tower relaying sighting and seismic activity information. The PAM system was located in the main science lab to provide adequate space for the system, allow a quick exchange of communications with the visual PSOs on watch and seismic technicians, and to provide access to the vessel's instrumentation. The vessel's position, water depth, heading and speed, vessel and airgun activity were recorded every half hour.

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

3.2.1. Passive Acoustic Monitoring Parameters

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

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

The electronic processing unit contained a buffer processing unit with USB output, and an *RME Fireface 800 ADC* processing unit with firewire output. The electronic processing unit, and a rack-mounted computer with two monitors were set-up in the main lab. One of the computer's monitors displays a high frequency range (hereafter referred to as the HF system), using the signal from two hydrophones, and the low frequency range is displayed on the other computer's monitor (LF system), receiving signal from all four hydrophones. A GPS feed of INGA strings was supplied from the ship's Sea PATH navigation system and connected to the computer and routed to the LF system, reading data every 10 seconds.

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

detected animal click trains.

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

3.2.2. Hydrophone Deployment

The vessel had a winch installed on the port stern deckhead of the gun deck for deployment of the PAM hydrophone cable. Two deck cables, the main cable and a spare, were installed along the gun deck deckhead running from the winch to the science lab.

Figure 3 shows the position of the hydrophone deployment in relation to the vessel and seismic equipment. Photos of the hydrophone deployment methods and equipment discussed below can be found in [Appendix D](#).

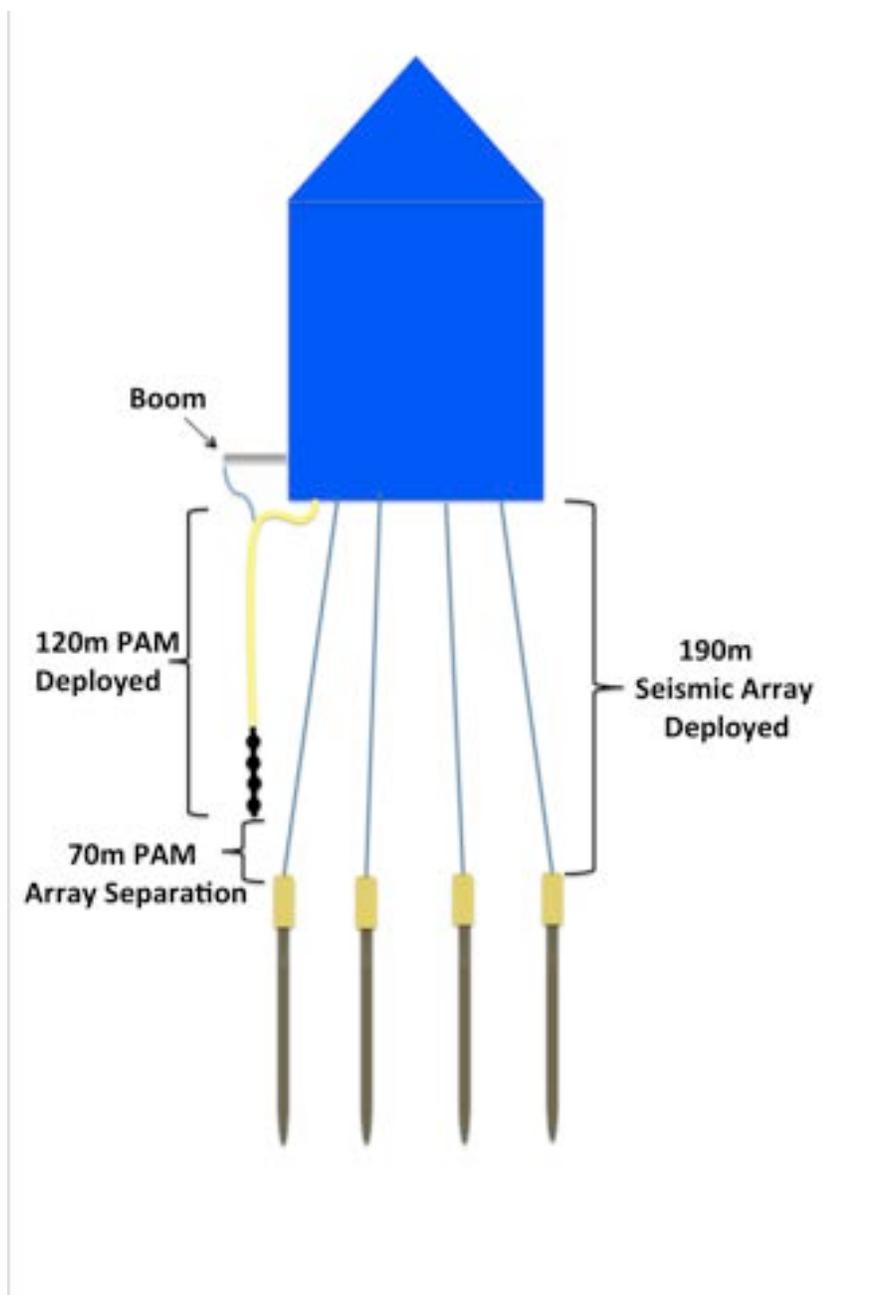


Figure 3. Location of the hydrophone deployment.

4. MONITORING EFFORT SUMMARY

4.1. SURVEY OPERATIONS SUMMARY

The *R/V Langseth* departed the port of Bermuda for the seismic survey site at 19:00 UTC on 11 April 2013. The vessel arrived on the survey site and began deploying ocean bottom seismometers 1t 16:30 UTC on 17 April 2013. Deployment continued until 10:18 on 19 April when deployment of the sources was complete and a ramp-up was initiated. Acquisition of the first survey line began at 10:58 UTC following a ramp-up of the source. Table 2 outlines the dates and times of acquisition for each survey line.

Acquisition of the OBS survey lines was completed first from 10:58 UTC on 19 April until 19:14 UTC on 1 May 2013. The OBSs were retrieved and some were re-deployed before acquisition of the MCS survey lines began at 12:12 UTC on 4 May 2013. Acquisition of the MCS survey lines was completed at 00:43 UTC on 13 May 2013. The vessel remained on the survey site retrieving OBSs, re-deploying the OBSs to remain on site and conducting some multi-beam surveying until 17 May 2013 when it departed for port, arriving in Ponta Delgada on San Miguel island on 19 May 2013.

Table 2. Mid-Atlantic ocean-bottom seismometer and multi-channel survey lines acquired.

Survey Line	Date Acquisition Commenced	Time Acquisition Commenced	Date Acquisition Completed	Time Acquisition Completed
MGL1305OBS01	2013-04-19	10:57	2013-04-19	21:33
MGL1305OBS01T	2013-04-19	21:49	2013-04-19	21:59
MGL1305OBS02	2013-04-19	22:07	2013-04-20	7:51
MGL1305OBS02T	2013-04-20	7:56	2013-04-20	8:17
MGL1305OBS03	2013-04-20	8:25	2013-04-20	18:26
MGL1305OBS03T	2013-04-20	18:34	2013-04-20	18:49
MGL1305OBS04	2013-04-20	18:57	2013-04-21	4:35
MGL1305OBS04T	2013-04-21	4:47	2013-04-21	5:05
MGL1305OBS05	2013-04-21	5:12	2013-04-21	9:38
MGL1305OBS05T	2013-04-21	15:18	2013-04-21	15:37
MGL1305OBS06	2013-04-21	15:39	2013-04-22	1:17
MGL1305OBS06T	2013-04-22	1:27	2013-04-22	1:43
MGL1305OBS07	2013-04-22	1:50	2013-04-22	11:17
MGL1305OBS07T	2013-04-22	11:25	2013-04-22	11:45
MGL1305OBS08	2013-04-22	11:50	2013-04-22	21:08
MGL1305OBS08T	2013-04-22	21:16	2013-04-22	21:33
MGL1305OBS09	2013-04-22	21:41	2013-04-23	07:12
MGL1305OBS010	2013-04-23	07:49	2013-04-23	17:29
MGL1305OBS10T	2013-04-23	17:38	2013-04-23	17:54
MGL1305OBS11	2013-04-23	18:02	2013-04-24	03:27
MGL1305OBS12	2013-04-27	11:03	2013-04-27	21:07
MGL1305OBS12T	2013-04-27	21:15	2013-04-27	21:33
MGL1305OBS13	2013-04-27	21:41	2013-04-28	07:28
MGL1305OBS13T	2013-04-28	07:34	2013-04-28	07:50
MGL1305OBS14	2013-04-28	08:00	2013-04-28	17:47
MGL1305OBS14T	2013-04-28	17:55	2013-04-28	18:13

Survey Line	Date Acquisition Commenced	Time Acquisition Commenced	Date Acquisition Completed	Time Acquisition Completed
MGL1305OBS15	2013-04-28	18:20	2013-04-29	04:13
MGL1305OBS15T	2013-04-29	04:18	2013-04-29	04:38
MGL1305OBS16	2013-04-29	04:42	2013-04-29	14:28
MGL1305OBS16T	2013-04-29	14:37	2013-04-29	14:51
MGL1305OBS17	2013-04-29	15:04	2013-04-30	00:45
MGL1305OBS19	2013-04-30	02:14	2013-04-30	06:02
MGL1305OBS20	2013-04-30	06:06	2013-04-30	06:56
MGL1305OBS21	2013-04-30	07:00	2013-04-30	10:36
MGL1305OBS22	2013-04-30	10:47	2013-04-30	11:30
MGL1305OBS23	2013-04-30	11:36	2013-04-30	15:15
MGL1305OBS24	2013-04-30	15:24	2013-04-30	15:54
MGL1305OBS25	2013-04-30	16:04	2013-04-30	19:43
MGL1305OBS26	2013-04-30	19:51	2013-04-30	20:43
MGL1305OBS29	2013-04-30	21:04	2013-05-01	00:31
MGL1305OBS30	2013-05-01	00:39	2013-05-01	01:32
MGL1305OBS33	2013-05-01	01:36	2013-05-01	05:21
MGL1305OBS34	2013-05-01	05:27	2013-05-01	06:00
MGL1305OBS35	2013-05-01	06:06	2013-05-01	09:46
MGL1305OBS36	2013-05-01	09:57	2013-05-01	10:30
MGL1305OBS37	2013-05-01	10:37	2013-05-01	14:23
MGL1305OBS38	2013-05-01	14:33	2013-05-01	15:20
MGL1305OBS39	2013-05-01	15:27	2013-05-01	19:14
MGL1305MCS101	2013-05-04	12:12	2013-05-04	23:27
MGL1305MCS102	2013-05-05	00:14	2013-05-05	08:59
MGL1305MCS103	2013-05-05	11:45	2013-05-05	23:23
MGL1305MCS104	2013-05-06	00:04	2013-05-06	09:39
MGL1305MCS105	2013-05-06	10:52	2013-05-06	21:43
MGL1305MCS106	2013-05-06	22:25	2013-05-07	08:30
MGL1305MCS107	2013-05-07	09:33	2013-05-07	21:03
MGL1305MCS107T	2013-05-07	22:00	2013-05-08	02:30
MGL1305MCS108	2013-05-08	02:38	2013-05-08	07:31
MGL1305MCS109	2013-05-08	09:13	2013-05-08	14:33
MGL1305MCS110	2013-05-08	16:24	2013-05-08	21:03
MGL1305MCS111	2013-05-08	22:42	2013-05-09	03:49
MGL1305MCS112	2013-05-09	05:37	2013-05-09	11:58
MGL1305M112T	2013-05-09	12:35	2013-05-09	15:27
MGL1305MCS113	2013-05-09	15:31	2013-05-09	21:11
MGL1305MCS114	2013-05-09	22:57	2013-05-10	03:51
MGL1305MCS115	2013-05-10	05:43	2013-05-10	11:27
MGL1305MCS116	2013-05-10	13:05	2013-05-10	17:49
MGL1305MCS117	2013-05-10	19:48	2013-05-11	01:24
MGL1305MCS118	2013-05-11	05:28	2013-05-11	10:08
MGL1305MCS119	2013-05-11	11:54	2013-05-11	17:35
MGL1305MCS119T	2013-05-11	18:05	2013-05-11	18:51
MGL1305MCS119T2	2013-05-11	19:08	2013-05-11	20:54
MGL1305MCS122	2013-05-11	21:09	2013-05-12	03:00

Survey Line	Date Acquisition Commenced	Time Acquisition Commenced	Date Acquisition Completed	Time Acquisition Completed
MGL1305MCS123	2013-05-12	04:18	2013-05-12	09:44
MGL1305MCS123T	2013-05-12	11:15	2013-05-12	12:20
MGL1305MCS151	2013-05-12	12:24	2013-05-12	14:17
MGL1305MCS110R	2013-05-12	15:55	2013-05-12	17:58
MGL1305MCS113R	2013-05-12	19:23	2013-05-13	00:43

The acoustic source was active throughout the survey, with a few periods of source silence, for a total of 422 hours of source activity. This includes ramping-up of the airguns, full power and partial power firing both online and during line changes, and operation of a single 40 in³ mitigation airgun (Figure 4). No source tests were conducted during the survey project. The mitigation source was active during mitigation power-downs initiated for protected species inside the safety radius as well as for mechanical/technical reasons for a total of 8 hours and 15 minutes during the survey. Full power source operations accounted for 97.5% (411 hours and 38 minutes) of airgun activity during the project. Line changes were shot at full power (except in rare instances where arrays were retrieved for maintenance), totalling 41 hours and 24 minutes of array activity. The full volume of the acoustic source (36 airguns firing) ranged from 6520 in³ to 6600 in³, caused by various guns of different sizes being changed out on the arrays.

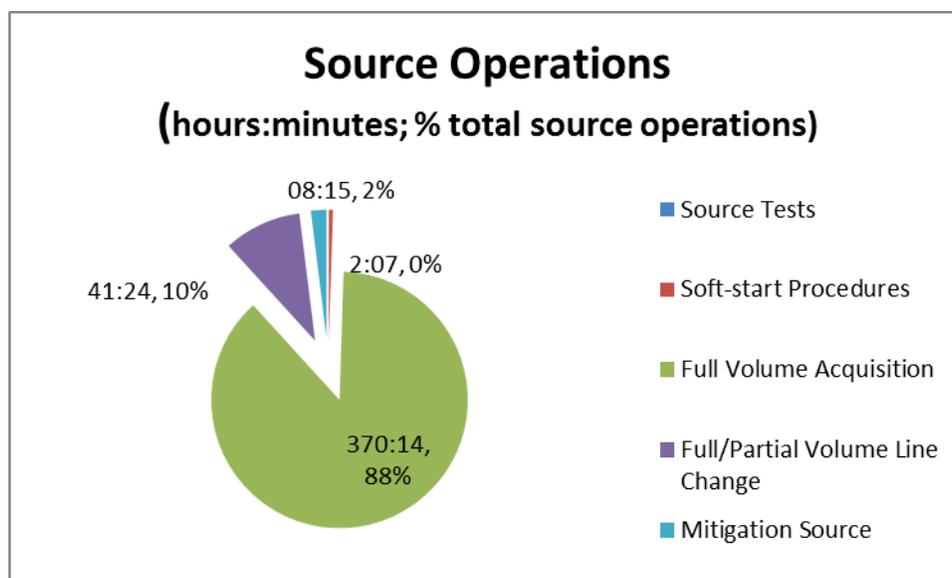


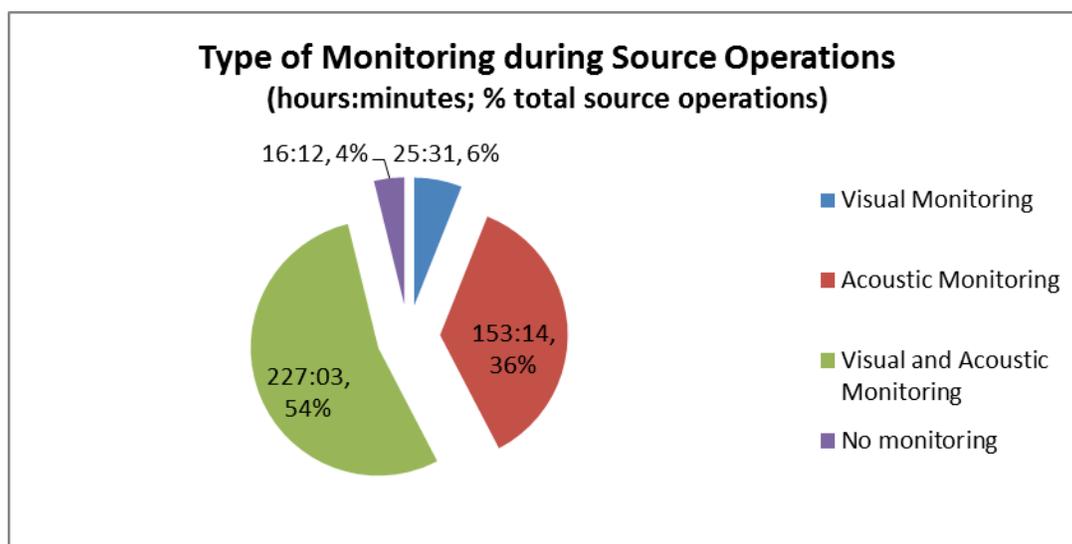
Figure 4. Total acoustic source operations.

The acoustic source was ramped up a total of four times over the course of the survey in order to commence full power survey operations in compliance with the IHA (Table 3). Each ramp-up was conducted over 30 to 34 minutes, where the NMFS approved automated gun controller program DigiShot added guns sequentially to achieve full source over the required period of time. Ramp-ups were only conducted during daylight hours during the survey project. No ramp-ups were conducted at night. All daytime ramp-ups were conducted from airgun silence during the survey.

Table 3. Total acoustic source operations during Mid-Atlantic survey.

Acoustic Source Operations	Number	Duration (hh:mm)
Gun Tests		00:00
Ramp-up	04	02:07
Day time ramp-ups from silence	04	
Day time ramp-ups from mitigation	00	
Night time ramp-ups from mitigation	00	
Full power survey acquisition		370:14
Full/partial power line changes		41:24
Single airgun (40 in³)		08:15
Total time acoustic source was active		422:00

Only 16 hours and 12 minutes (all during the night) of total source operations throughout the entire survey project were undertaken without any monitoring conducted by PSOs or PAM Operators (Figure 5). The majority of source operations, 54% (227 hours and 3 minutes), were undertaken while both visual and acoustic monitoring was being conducted. A total of 25 hours and 31 minutes of day time source operations were undertaken while only visual monitoring and no acoustic monitoring was performed. A total of 153 hours and 14 minutes of night time source operations were undertaken while visual monitoring could not be undertaken due to darkness.

**Figure 5: Source Operations during visual and acoustic monitoring during the Mid-Atlantic survey**

4.2. VISUAL MONITORING SURVEY SUMMARY

The Protected Species Observers (PSOs) began visual observations immediately upon departure and while in transit to the survey site. This was done to collect baseline data about protected species abundance in the area. Visual monitoring began at 10:00 UTC on 12 April 2013 and continued until 20:00 UTC on 18 May 2013 when the vessel transited to San Miguel island at the completion of the survey project. Visual monitoring took place over a period of 35 days and a total of approximately 4209 km of visual effort was completed. Monitoring was

conducted by two PSOs each day between just before dawn until just after dusk, when it was too dark for the entire safety radius to be visible, averaging approximately 14 to 14.5 hours of visual observations per day. Visual observations were suspended on 24 and 26 April due to severe weather, when the seismic gear was brought on board and the vessel moved away from the survey area to wait for the weather to improve.

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

The acoustic source was active during approximately half of visual (49.9%) and during almost all acoustic monitoring, as shown in Figure 5. Once the survey began the acoustic source was only disabled a few time while deploying and retrieving the OBSs, and due to severe weather.

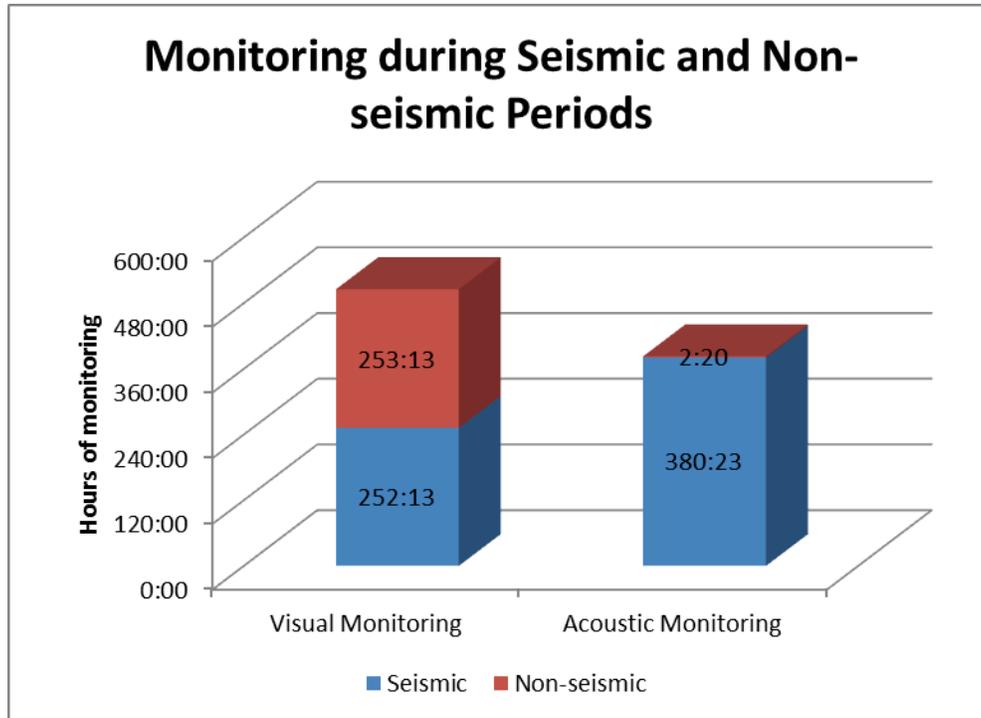


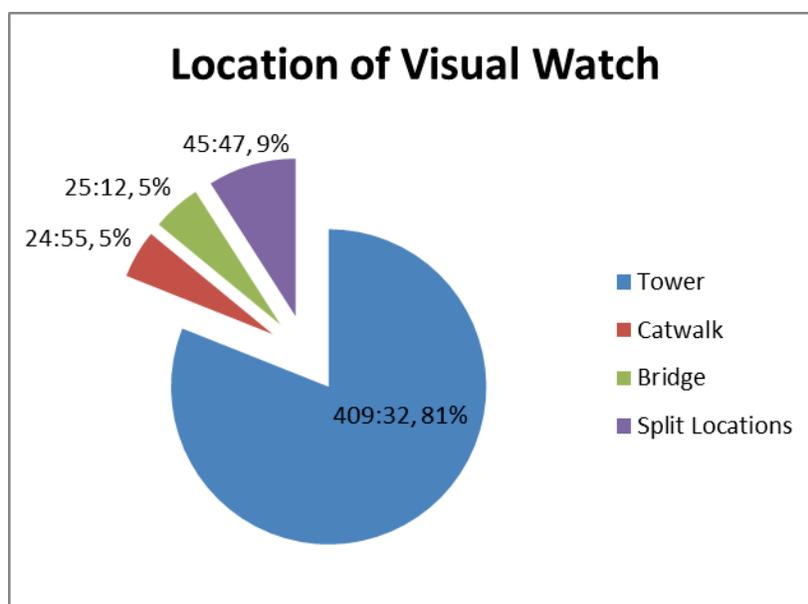
Figure 6. Duration of visual and acoustic monitoring effort while the acoustic source was active vs. silent.

Total visual monitoring effort, divided by monitoring effort while the acoustic source was active and monitoring effort while the source was silent, is listed in Table 4.

Table 4. Total visual monitoring effort.

Visual Monitoring Effort	Duration (hh:mm)
Total monitoring while acoustic source active	252:13
Total monitoring while acoustic source silent	253:13
Total monitoring effort	505:26

The PSOs preferred to conduct visual observations from the PSO tower, which provided the PSOs with a 360° view of the water around the vessel and acoustic source. However, visual watches would be conducted from the catwalk or bridge for any health or safety reason or during periods with high winds, large swells, or heavy rain. As Figure 6 demonstrates approximately 81% of visual monitoring was conducted from the PSO tower during the Mid-Atlantic survey.

**Figure 7. Total visual effort from observation locations on board the R/V Langseth.**

4.3. ACOUSTIC MONITORING SURVEY SUMMARY

The hydrophone cable was deployed for the first time on 16:00 UTC on 19 April 2013 after the vessel had completed deployment of the seismic equipment. Acoustic monitoring began immediately and continued throughout the project with PSOs monitoring the hydrophones aurally and monitoring the *Pamguard* detection software visually both day and night. Acoustic monitoring for the project ended at 00:45 UTC on 13 May 2013 when acquisition of the final survey line was completed and the hydrophone cable was retrieved in preparation for the retrieval of the seismic equipment. Over the course of the project, PSOs conducted 382 hours and 43 minutes of acoustic monitoring, almost all of which occurred while the acoustic source was active (only 2 hours and 20 minutes were undertaken while the source was silent) (Table 5).

Table 5. Total passive acoustic monitoring (PAM) effort.

Passive Acoustic Monitoring Effort	Duration (hh:mm)
Total night time monitoring (no visual observations)	154:19
Total day time monitoring (simultaneous visual observations ongoing)	228:24
Total monitoring while acoustic source active	380:23
Total monitoring while acoustic source silent	02:20
Total acoustic monitoring	382:43

There were several periods of time over the course of the survey project when acoustic monitoring was suspended but visual monitoring continued. These periods of acoustic monitoring downtime, totaling 178 hours and 47 minutes, were attributed to normal survey operations, severe weather and entanglements of the hydrophone cable with seismic equipment (Table 6).

Acoustic monitoring was suspended and the cable retrieved during periods of bad weather to prevent the cable from entangling with seismic gear and being damaged. This weather downtime, 109 hours and 06 minutes, accounted for the greatest portion of acoustic monitoring downtime during the survey. The cable also remained on board throughout OBS retrieval and deployment and source and streamer cable deployment to protect the cable during these operations and allow for increased maneuverability of the vessel. A very small amount of downtime, 2 hours and 22 minutes, resulted from entanglements of the PAM cable with gun umbilicals requiring monitoring to cease so that the cable could be retrieved and untangled and re-deployed. An additional 40 minutes of down-time resulted from retrievals of the cable to make adjustments to the towing configuration of the cable and reduce future entanglements. The configuration adjustments were successful and no further entanglements were experienced. A description of each instance of acoustic monitoring downtime is located in [Appendix E](#).

Table 6. Passive acoustic monitoring (PAM) downtime.

Passive Acoustic Monitoring Downtime	Duration (hh:mm)
Adjustments to PAM cable towing configuration	00:40
OBS/Streamer/Sources Deployment & Retrieval	66:49
Weather	109:06
PAM cable entanglement	02:22
Total Passive Acoustic Monitoring Downtime	178:47

4.4. SIMULTANEOUS VISUAL AND ACOUSTIC MONITORING SUMMARY

While visual observations began on 12 April acoustic observations began on 19 April, due to the hydrophone cable needing to be deployed after the airgun arrays to avoid entanglement. Of the total observation effort performed by PSOs during this survey, visual monitoring accounted for 57% (505 hours and 26 minutes) while acoustic monitoring accounted for 43% (382 hours and 43 minutes). As displayed in Figure 8 there were 228 hours and 24 minutes of simultaneous visual and acoustic observations conducted during this survey. Simultaneous visual and acoustic monitoring accounted for 60% of total acoustic monitoring and 45% of the total visual observation.

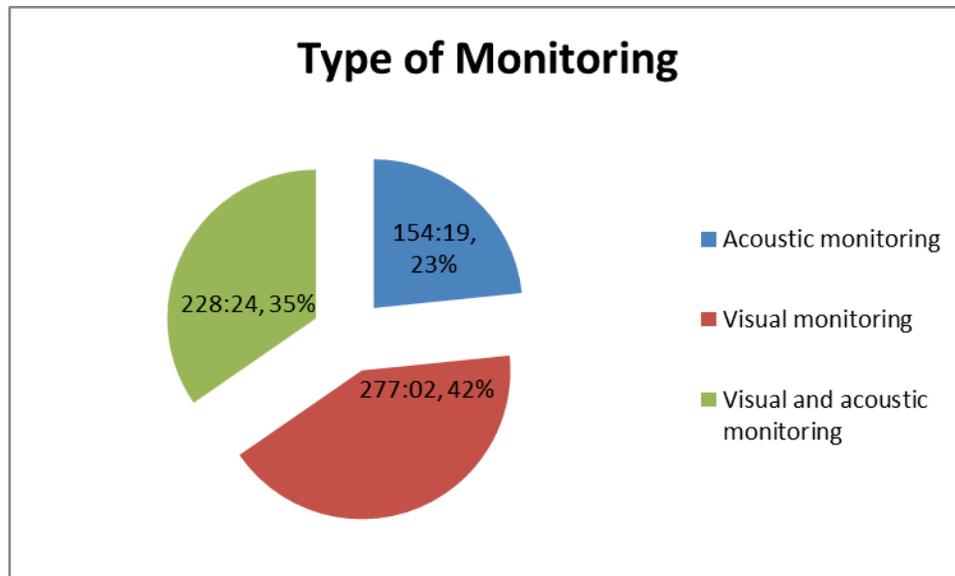


Figure 8. Total PAM and visual monitoring effort.

4.5. ENVIRONMENTAL CONDITIONS

Environmental conditions varied greatly during the mid-Atlantic survey.

Visibility was generally good, extending to 10 kilometers throughout the majority of visual observations undertaken (90%) (Figure 9). Visibility decreased to less than five kilometers for only 2.65% (11 hours and 6 minutes) of the monitoring undertaken. Visibility was reduced by squalls for one hour and 40 minutes and by fog for two hours and 45 minutes. Periods of light and heavy rain were also experienced, accounting for 9% (47 hours and 36 minutes) of the visual monitoring hours completed during the survey. During periods of sunshine narrow portions of the field of view were obstructed by glare. Severe glare was experienced in some directions for 25% of visual monitoring undertaken and moderate glare was experienced for 19% of observations undertaken.

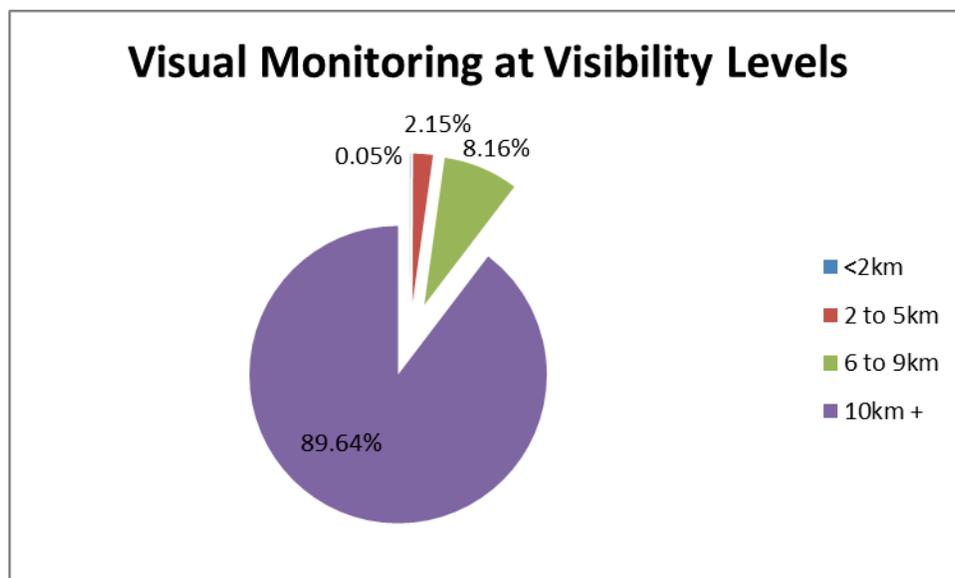


Figure 9. Visibility during visual monitoring over the Mid-Atlantic Survey.

Wind force varied between level 1 (1 to 3 knots) and level 7 (28 to 33 knots) during the mid-Atlantic survey. These extremes were not experienced frequently however, Wind Force 1 levels were only experienced during week one and week four for a total of 3% of the visual monitoring undertaken during the survey and Wind Force 7 levels were only experienced during weeks one, two and four for a total of 6% of visual observations undertaken during the survey. The majority of visual monitoring effort was undertaken at wind force levels four (11 to 16 knots) and five (17 to 21 knots), 28% and 26% of monitoring hours respectively (Figure 10).

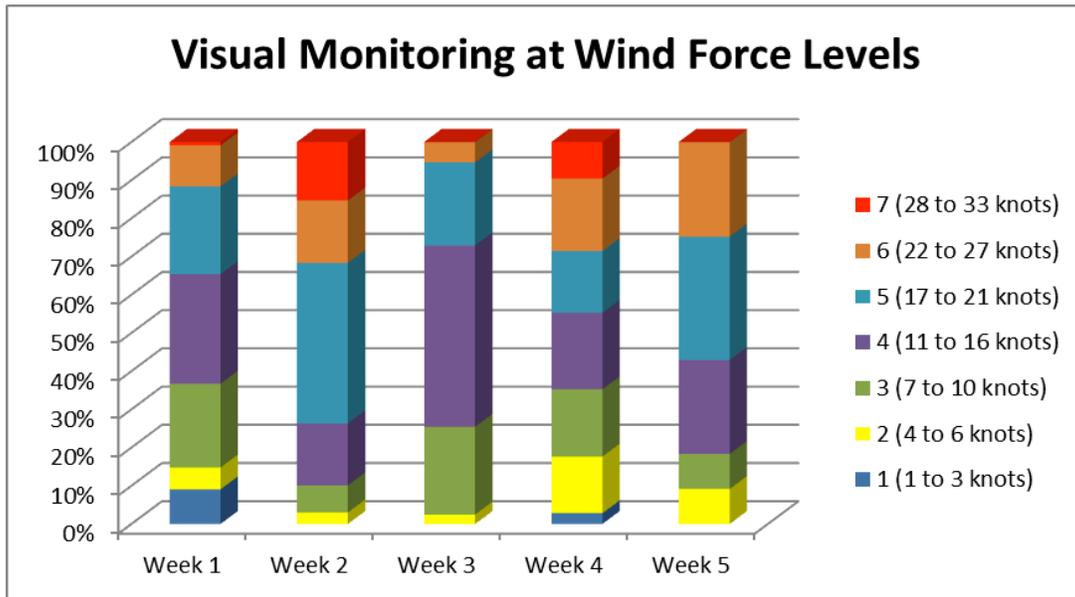


Figure 10. Average wind force each week during visual monitoring.

The Beaufort sea state varied between level 2 and level 7 during the mid-Atlantic survey. The fewest visual monitoring hours were undertaken at level 7 (11 hours and 12 minutes), level 2 (56 hours and 16 minutes) and level 6 (61 hours and 39 minutes). Over one hundred hours of monitoring were conducted at each of levels 3 (32% of total visual effort), level 4 (21% of total visual effort) and level 5 (22% of visual effort) (Figure 11).

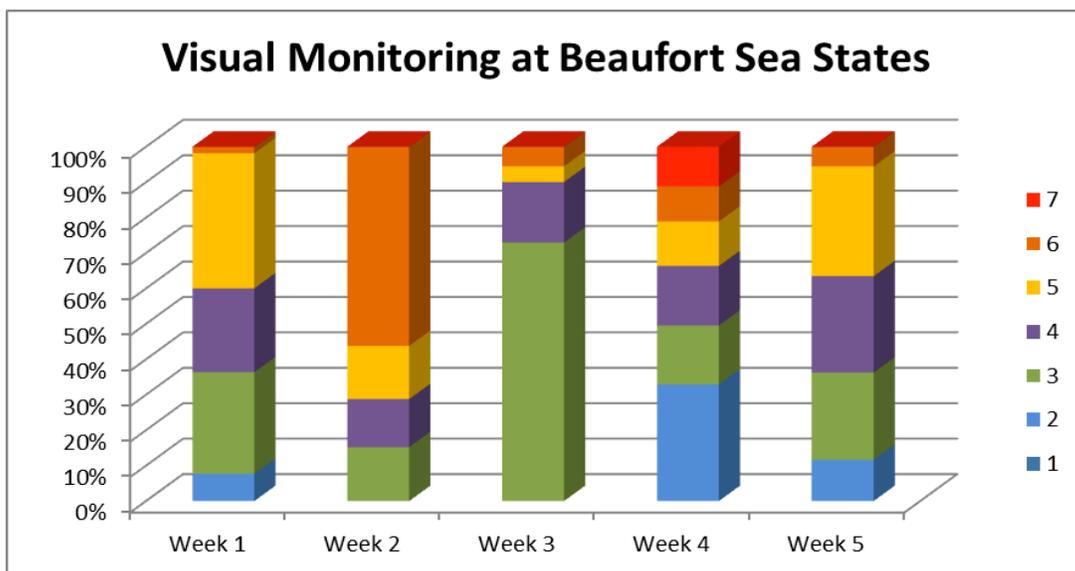


Figure 11. Beaufort sea state each week during visual monitoring.

Swell remained below four meters for the majority of visual monitoring periods with only 23 hours and 5 minutes of visual effort undertaken while swells were greater than four meters. Swells were below two meters for 46% of the visual monitoring undertaken during the mid-Atlantic survey and were between two and four meters for 50% of the effort undertaken (Figure 12).

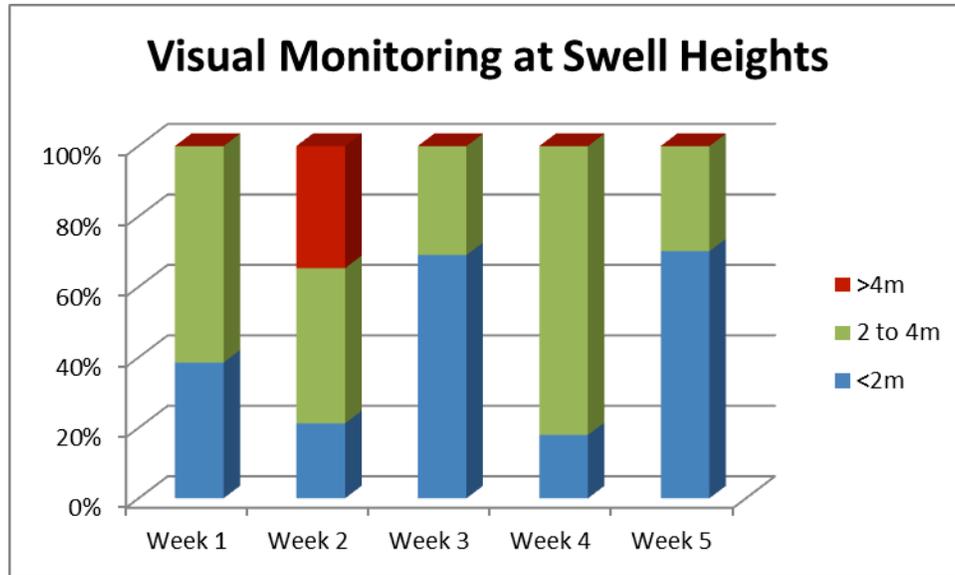


Figure 12: Swell height each week during visual monitoring.

5. MONITORING AND DETECTION RESULTS

5.1. VISUAL DETECTIONS

Visual monitoring conducted during the Mid-Atlantic marine seismic survey resulted in the collection of 116 records of detection for protected species (summarized in [Appendix F](#)), 83 marine mammals and 33 sea turtles. Four species of marine mammals, all cetaceans, were identified in addition to several unidentified baleen whales, unidentified dolphins and unidentified whales. Two species of sea turtle were observed. The total number of detection events and total number of animals recorded by species is described in Table 7. As visual observations began when the vessel departed Bermuda, some detections were made at a great distance from the survey site in the middle of the North Atlantic (Figure 13). The spatial distribution of marine mammal and sea turtle detections made on the survey site can be seen in Figures 14 and 15.

No Bermuda petrels or roseate terns were sighted throughout the survey. A complete list of bird species observed and identified in addition to the approximate number of individuals observed and the number of days on which they were observed can be found in [Appendix G](#).

Table 7. Number of detection records collected for each protected species.

	Total Number of Detection Records	Total Number of Animals Recorded
Cetaceans		
Unidentifiable whale	23	33
Mysticetes		
Blue whale	4	4
Fin whale	12	30
Unidentifiable baleen whale	17	26
Odontocetes		
Atlantic spotted dolphins	1	3
Short beaked common dolphins	11	129
Unidentified dolphins	4	26
Unidentified dolphins (acoustic detection)	11	N/A
Sea turtles		
Loggerhead sea turtles	27	27
Leatherback sea turtle	1	1
Unidentified chelonid species	5	5
Total Marine Mammals	83	251
Total Sea Turtles	33	33
TOTAL PROTECTED SPECIES	116	284

The number of protected species detections each day varied greatly over the course of the survey (Figure 16) including several days where no protected species were observed. The greatest number of detections in one day occurred on 6 May 2013 with nine records of detection.

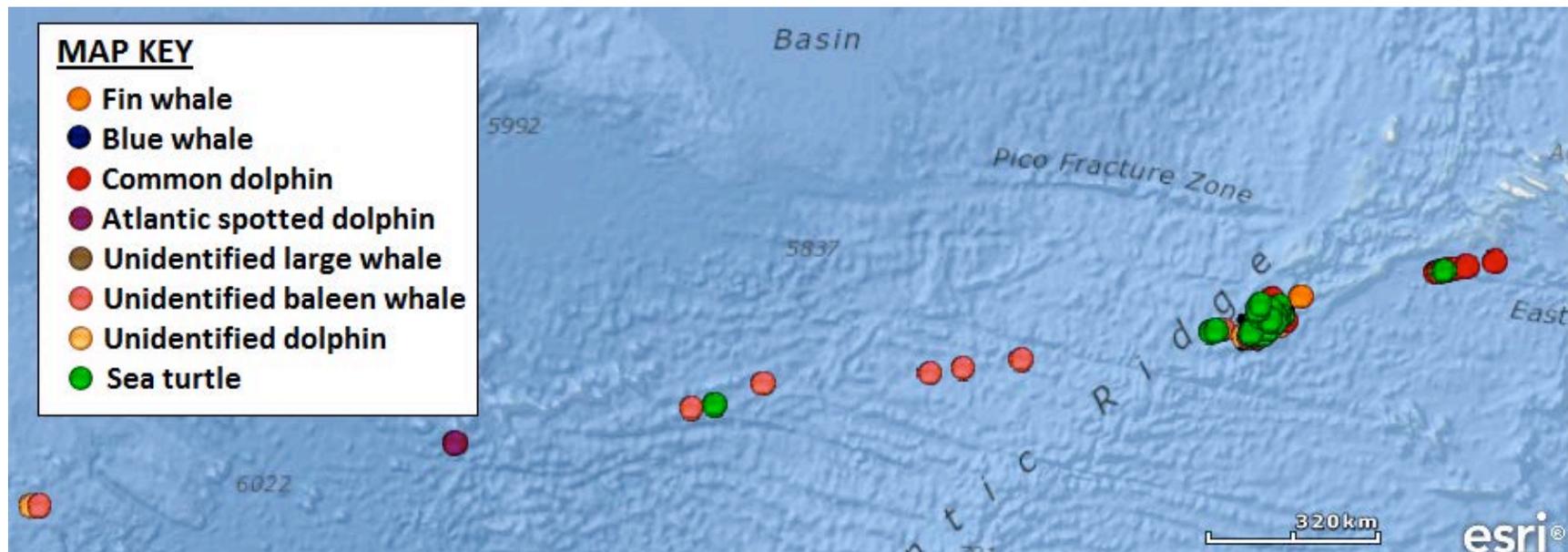


Figure 13: Location of protected species detections made while the vessel was in transit from Bermuda and on the survey site

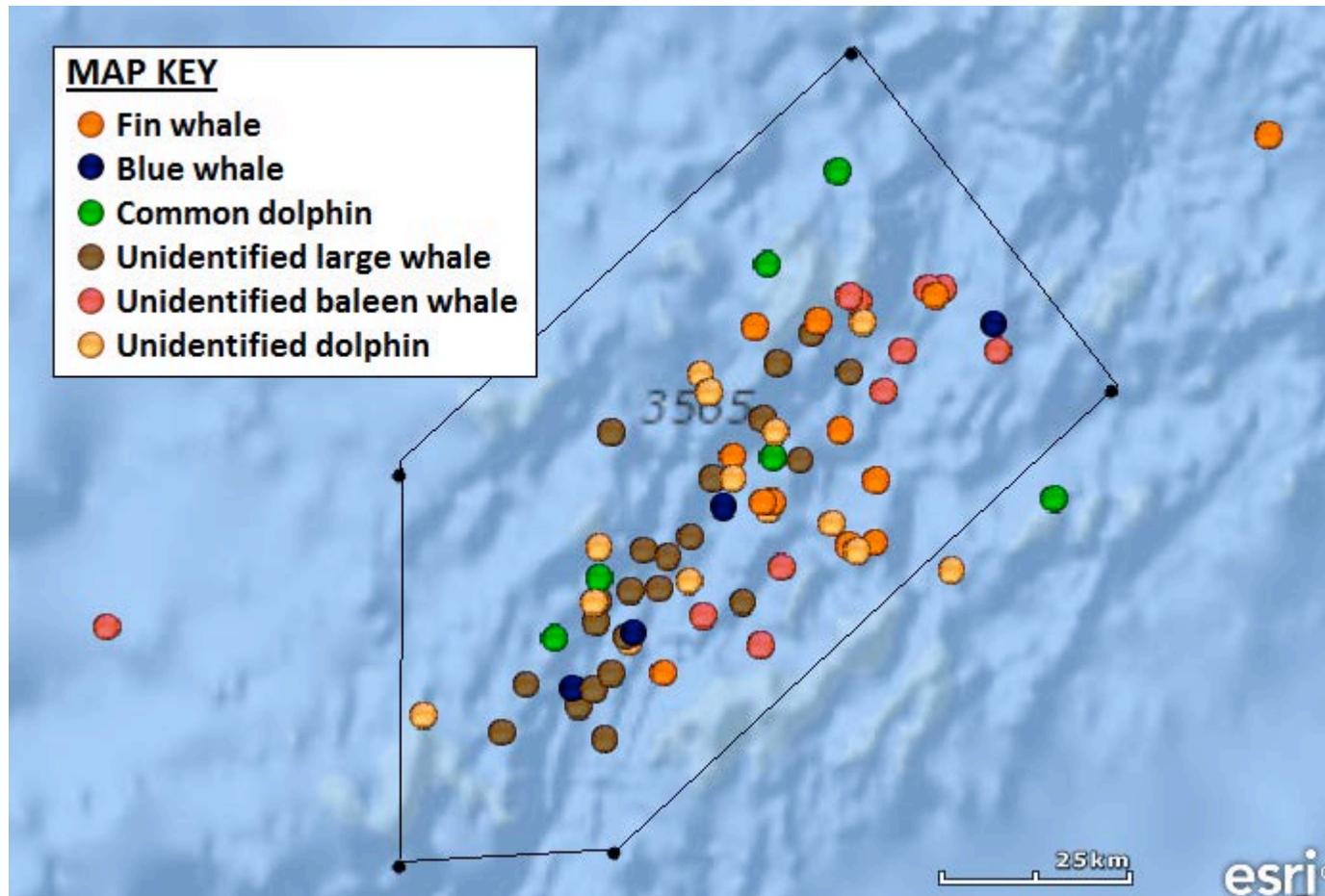


Figure 14: Marine mammals spatial distribution during mid-Atlantic survey

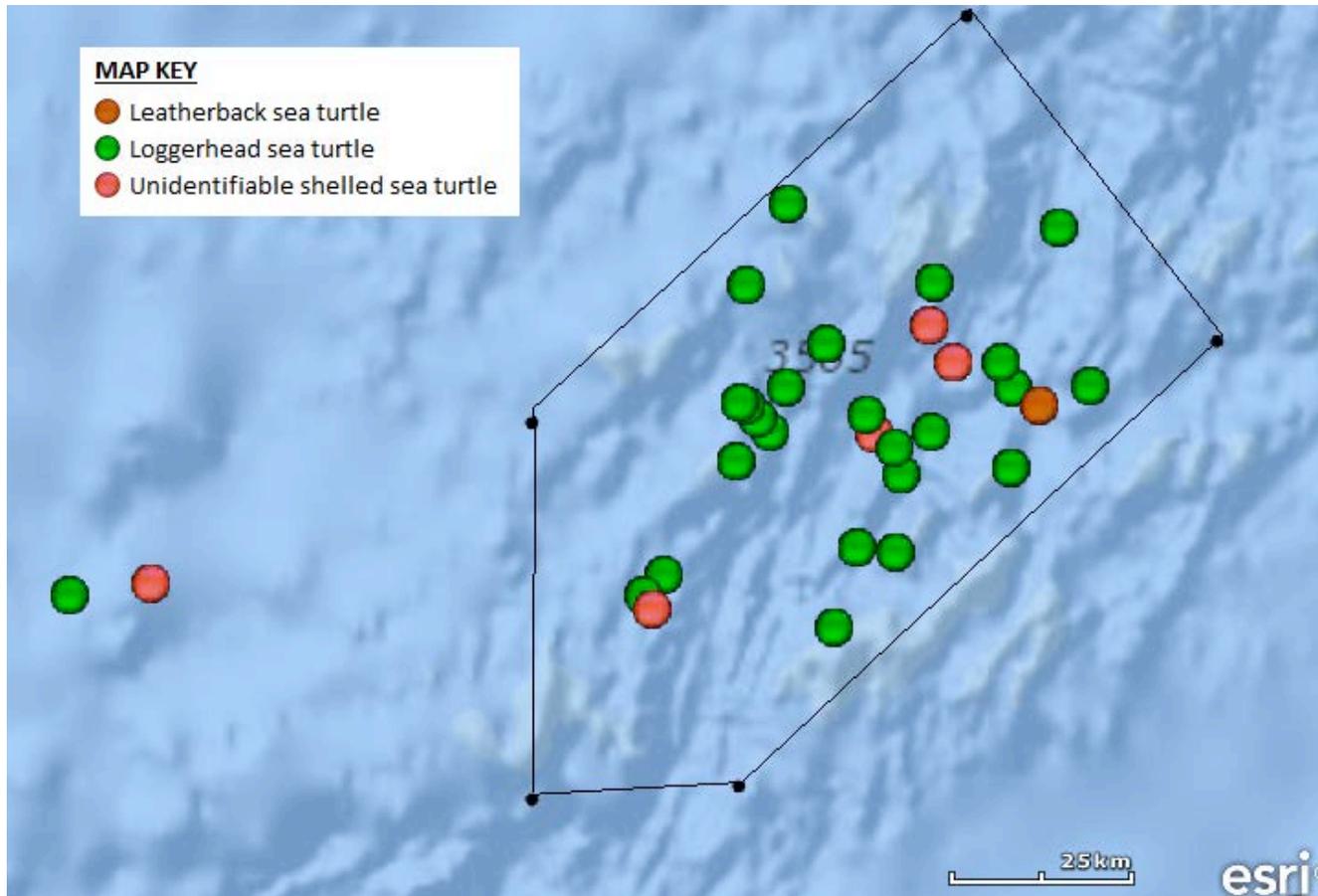


Figure 15: Sea turtle spatial distribution during mid-Atlantic survey

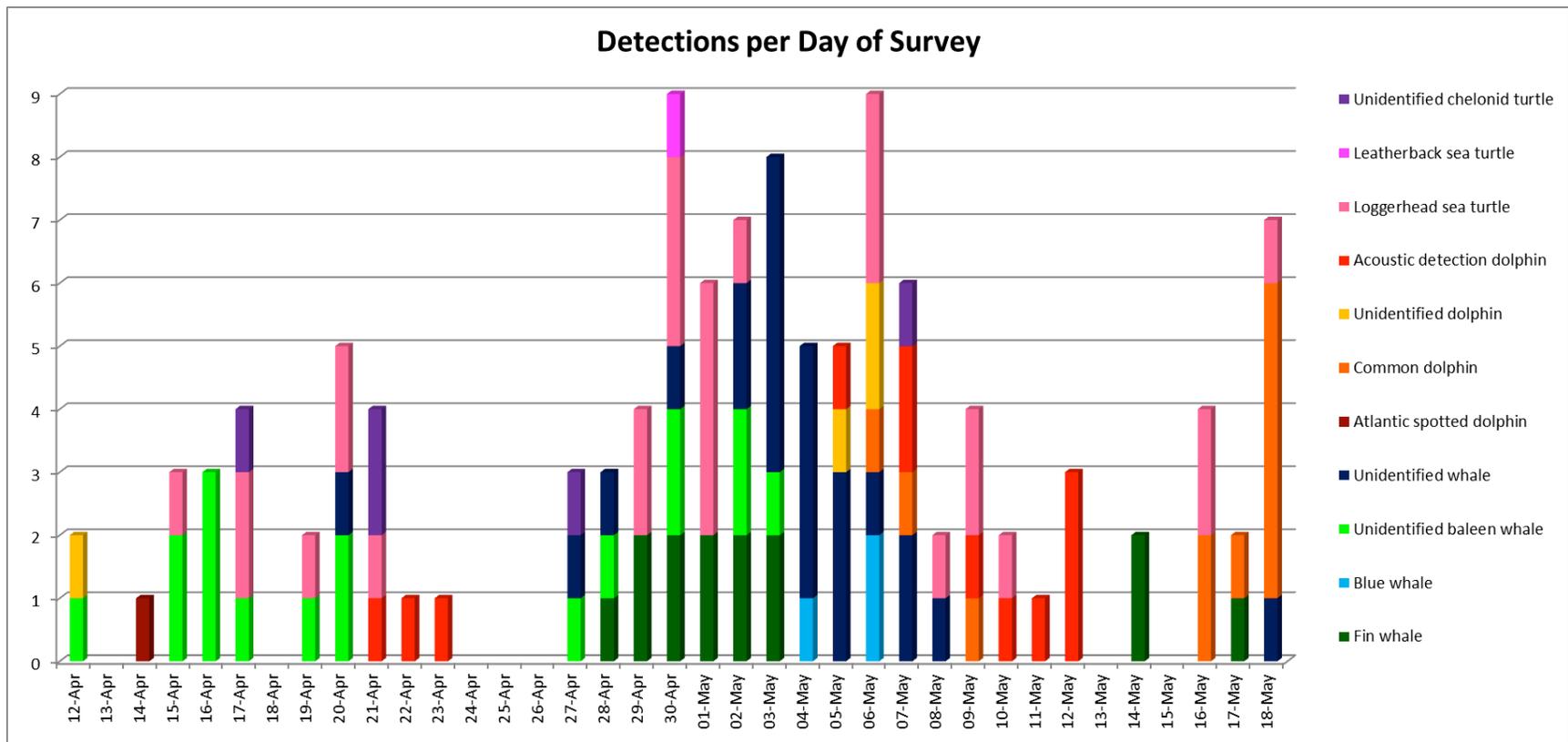


Figure 16: Number of detections per day of the mid-Atlantic survey

Of the 116 protected species detection events during the survey, 47 detections (41 %) occurred while the acoustic source was active (35 visual sightings and 12 acoustic detections) and 69 detections (59 %) occurred while the acoustic source was silent (all visual sightings, no acoustic detections).

Table 8 demonstrates the average closest approach of marine mammal species to the source at various volumes (source volume at initial sighting). Acoustic detections are not included unless accompanied by a visual sighting with which to confirm the closest approach of the animals to the source. All acoustic detections occurred while the source was at full volume. Marine turtle sightings are not included as it is assumed that the vessel, traveling at higher speeds than sea turtles, will approach turtles where they are located as opposed to marine mammals that can attain greater speeds and either approach or move away from the vessel. When the source was not deployed, the closest distance of the animal to the vessel was used instead of the closest distance of the animal to the source.

Table 8. Average closest approach of protected species to the acoustic source at various operating volumes at first sighting

Species Sighted	Full Power (6520-6600 in ³)		Single Airgun 40 in ³		Ramp-up		Not Firing	
	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)
Blue whale	4	475	0	-	0	-	0	-
Fin whale	5	1195	0	-	0	-	7	1263
Unidentifiable baleen whale	6	2493	0	-	1	2100	10	2955
Unidentifiable whale	15	2894	0	-	0	-	8	3316
Atlantic spotted dolphins	0	-	0	-	0	-	0	1
Common dolphins	3	1133	0	-	0	-	8	21
Unidentified dolphins	2	3014	0	-	0	-	2	250

Figure 17 demonstrates the total number of animals observed, per species, during the detection events. Short-beaked common dolphins were the most commonly detected protected species during the survey, accounting for 11 detection events and totaling 129 animals. The most next most frequently observed marine mammal species was the fin whale, accounting for 12 detection events and 30 individual animals.

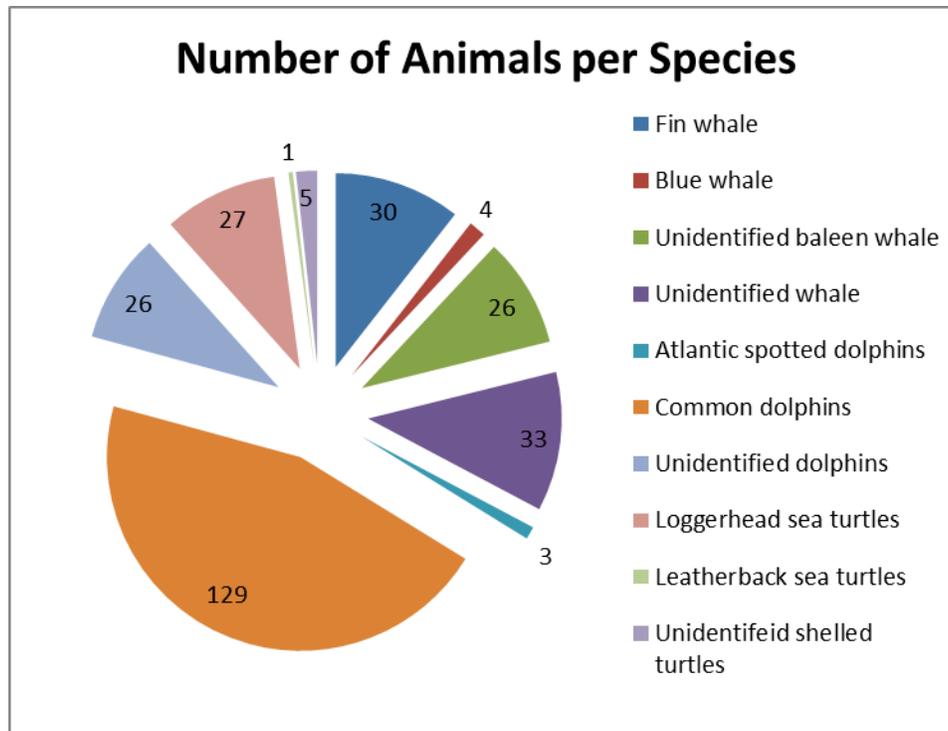


Figure 17: Number of individuals per species detection

5.1.1. Cetacean Detections

5.1.1.1. Blue whale

There were four sightings of blue whales during the mid-Atlantic survey, each consisting of a single blue whale observed while the source was active on full volume, each resulting in a power-down of the source (and in one instance, also a shut-down of the source). One whale was observed to be a sub-adult while all others appeared to be adults. The distance at which the animals were first sighted ranged from 1500 meters to 4000 meters and the closest approach of the whales to the source ranged from 75 meters to 845 meters. In each case the whales were observed blowing at the surface for one to four minutes followed by submerging during which time they would travel large distances, often hundreds of meters and frequently changing directions. Two sighting events had a duration of approximately 30 minutes (27 minute and 32 minutes) while the other two lasted just over one hour (one hour and five minutes and one hour and ten minutes).

5.1.1.2. Fin whale

There were 12 sightings of fin whales during the survey during which 30 animals were observed including two juvenile fin whales (Sighting #28 and Sighting #98). Pods varied in size from one animal to six whales. Five sightings occurred while the source was active at full volume and six occurred while the source was silent. Sighting events varied in duration from ten minutes to two hours and 41 minutes with the average fin whale sighting lasting one hour and six minutes. The distance to the animal(s) at the first sighting ranged from 1000 to 6000 meters and the average closest approach of the whale(s) to the source/vessel was 1235 meters (distance was measured to the vessel during sighting events where the source was not deployed). The most

frequently observed behaviour were blowing at the surface followed by submerging in dives where the flukes were not shown. In two instances whales were observed bubble-blowing and one sighting event appeared to involve lunge feeding. The whales were most frequently observed to be traveling at a moderate or vigorous pace. Only one sighting event involved a whale moving at a sedate pace for part of the event in addition to a vigorous pace for the rest of the event.

5.1.1.3. Atlantic spotted dolphins

A pod of three Atlantic spotted dolphins was observed while the vessel was in transit at 34.01 N and 51.71 W. They were approaching the vessel, swimming fast, displaying surface active behaviour like jumping and porpoising. They approached to within 20 meters of the vessel before departing, the entire sighting event lasting four minutes. Atlantic spotted dolphins were not observed on the survey prospect.

5.1.1.4. Common dolphins

There were 11 sightings of 129 common dolphins during the survey project, three sightings of which occurred while the source was on full volume and eight of which occurred while the source was silent. Pods varied in size from two animals to 40 animals with the average pod size consisting of 11 animals. During four sighting events juvenile dolphins were observed in the pod. All the pods observed were seen to be traveling at a vigorous pace and in all except one sighting event they were seen jumping and/or porpoising. During five sighting events, four of which occurred while the source was silent, the dolphins approached the bow or sides of the vessel to ride in the waves. The average distance to the pods when first sighted was 560 meters. The average closest approach of the pods to the source on full volume was 1133 meters and the average closest approach to the source/vessel while the source was silent was 20 meters.

5.1.1.5. Unidentified baleen whale

There were 17 sighting events with a total of 26 unidentified baleen whales during the mid-Atlantic survey. No juvenile whales were observed. Three pods of three whales and three pods of pairs of whales were observed and all remaining sighting events consisted of a single unidentified baleen whale. Ten sighting events occurred while the source while silent, one while the source was being ramped up and the remaining six occurred while the source was on full volume. The average distance to the whale(s) at first detection was 2673 meters and the whales did not approach much closer throughout the sighting event, with the average closest approach to the source/vessel 2471 meters. The only behaviours observed were blowing except one sighting where the whale was also observed bubble-blowing.

5.1.1.6. Unidentified whale

There were 23 sightings of 33 unidentified whales during the survey project, 15 sightings occurring while the source was at full volume and eight while the source was silent. Four pairs of whales were observed: one pod of three whales, one pod of five whales including a juvenile and all remaining sightings consisted of single unidentified whales. The average distance to the whale(s) at first detection was 3684 meters and the whales did not approach much closer throughout the sighting event, with the average closest approach to the source/vessel 3146 meters. The only behaviours observed were blowing except one sighting where the whale was also observed breaching.

5.1.1.7. Unidentified dolphins

There were four sightings of pods of unidentified dolphins of approximately 26 animals during the survey project. There were an additional 11 acoustic detections of unidentified dolphins were estimates of the number of dolphins present were not made as these detections were not accompanied by a visual sighting. Two of the sighting occurred while the source was at full volume and the other two occurred while the source was silent. These sightings were either very brief (one lasting one minute, one lasting two minutes) or occurred at a large distance (approximately 2000 meters, 4000 meters).

5.1.2. Sea Turtle Detections

5.1.2.1. Loggerhead sea turtles

There were 27 sightings each of a single loggerhead sea turtle during the mid-Atlantic survey, 16 of which consisted of juvenile sea turtles. Six sightings occurred while the source was silent, one occurred while the source was already powered down and mitigation firing and the remaining 20 sightings all occurred while the source was firing on full volume. The average distance to the turtle when first sighted was 72 meters due to the small size of the animals and the relatively high swell and Beaufort sea state in the North Atlantic during the survey project. All sightings occurring while the source was on full volume resulted in power downs, shut-downs or power-downs followed by shut-downs. Behaviors observed included floating, normal swimming, vigorous swimming, and diving.

5.1.2.2. Leather back sea turtle

One leatherback sea turtle was observed during the survey project on 30 April 2013 while the source was operating on full volume. The turtle was first observed inside the 180dB safety radius at a distance of 50 meters to the vessel, swimming perpendicular, towards the vessel. A power-down was implemented immediately. The turtle continued at it's fast pace, swimming between the vessel and sources where it was observed to become momentarily caught between two sub-arrays, appearing to flip sideways. A shut-down was implemented before the turtle entered the 180dB radius of the single source so there were no airguns active when this occurred. The turtle was not sighted again after it was seen between the two sub-arrays.

5.1.2.3. Unidentified chelonids

Five unidentified shelled sea turtle sightings, each of a single turtle, were made during the survey project, four occurring while the source was on full volume and one occurred while the source was silent. Three of the five turtles were moving at a sedate pace while two were swimming vigorously or diving.

5.2. ACOUSTIC DETECTIONS

There were a total of 12 acoustic detections made on the PAM system during the Mid-Atlantic survey (see Appendix F), all of dolphin species and all but three occurring during night time acoustic monitoring periods when no PSOs were undertaking visual observations.

Detection events were frequently very brief, with several detection events lasting only a few minutes each. The longest acoustic detection occurred on 22 April 2013 (Detection #2) and lasted for one hour and 46 minutes.

Detection events consisted of a combination of:

- Whistles detected aurally by the Operator
- Whistles detected visually on the Pamguard Spectrogram
- Whistles detected visually on the Spectrogram and by the Whistle Moan Detector
- HF Clicks detected visually on the High-frequency Click Detector

Vocalizations were only detected aurally by the Operators during Detection #2 where the Operator estimated from the strength of the acoustic signal present that the animals were within 100 meters of the PAM hydrophones. PSOs were informed of the detection and went to the bridge with night vision devices to scan for the animals but no visual sighting was made. The background noise on the *Langseth* is particularly loud from a number of sources at a wide range of frequencies (propellers, thrusters, Echosounder, multi-beam, towed seismic equipment) and masks many vocalizations that are visible on Pamguard but not audible to the Operators.

Whistles were detected on the Spectrogram during six of the 12 detection events (Detections 1, 3, 5, 7, 8 and 10). The Whistle Moan Detector also detected whistles during four of the five detections where whistles were present on the Spectrogram. Examples of whistles on the Spectrogram can be seen in Figures 18 (not high-lighted by the Whistle Detector) and figure 19 (highlighted by the Whistle Detector).

High frequency clicks were present during all but two of the detection events (Detections 1 and 5). Click trains varied from a few clicks grouped together to long chains of clicks made up of many individual clicks. An example of clicks trains on the High-frequency Click Detector can be seen in Figure 20.

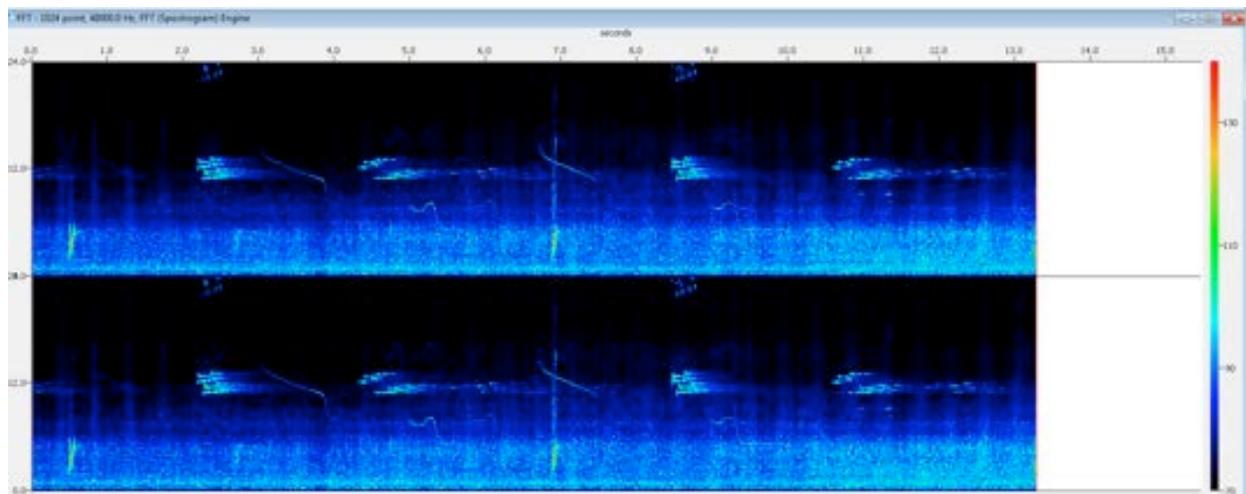


Figure 18: Whistles during Detection 2 (22 April 2013) on the Pamguard Spectrogram but not detected and highlighted by the Whistle Moan Detector



Figure 19: Whistles during Detection 5 on 7 May 2013 displayed on the Pamguard Spectrogram and highlighted by the Whistle Moan Detector. Large numbers of “false whistles” also high-lighted by the Whistle Detector for the multi-beam and Knudsen Echosounder noises

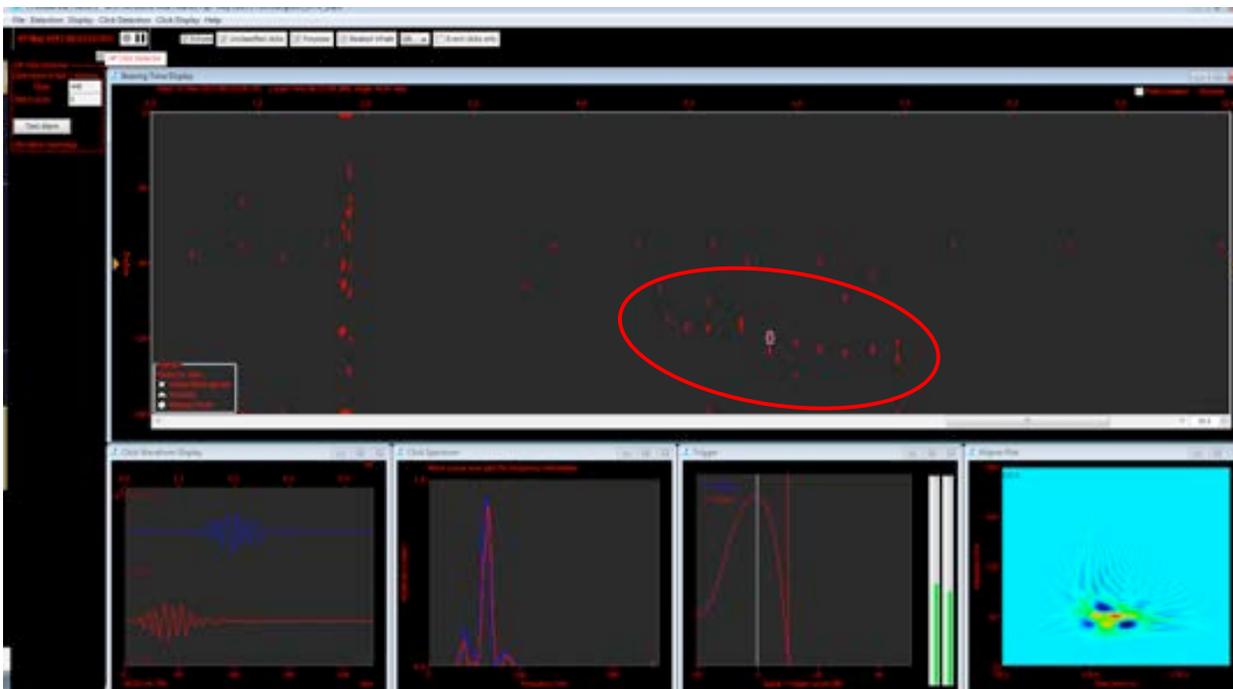


Figure 20: High frequency click train shown astern of the PAM hydrophones on the Pamguard High-frequency Click Detector during Detection 6 on 7 May 2013

5.3. CORRELATED VISUAL SIGHTINGS AND ACOUSTIC DETECTIONS

There was one instance of a simultaneous visual sighting event with an acoustic detection on the PAM system during the Mid-Atlantic survey. On 9 May 2013 whistles were detected visually on the Spectrogram and by the Pamguard Whistle Moan Detector at 18:00 UTC (Acoustic Detection #7). Then at 18:19 PSOs on visual watch observed a pair of common dolphins bow-riding for less than one minute (Sighting #89). A power-down of the source was implemented and the last visual sighting of the animals occurred at 18:20 UTC. Throughout the visual sighting even HF Clicks were detected on the Pamguard HF Click Detector continuing until 18:23 UTC (Figure 21).

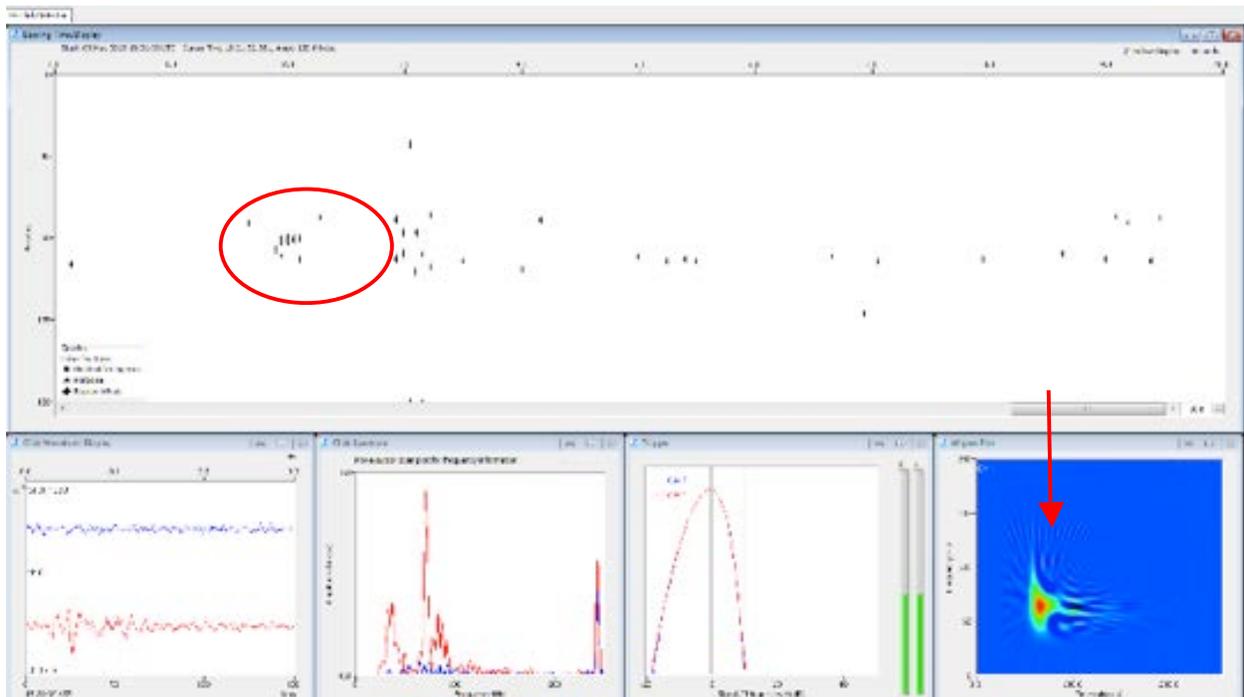


Figure 21: High frequency dolphin clicks (Acoustic Detection #7) from a pair of common dolphins sighted on 9 May 2013 (Sighting #89), resulting in a power-down of the source

6. MITIGATION ACTION SUMMARY

There were 42 mitigation actions implemented during 37 sighting events of the source of the Mid-Atlantic survey. Power-downs of the acoustic source for protected species inside the 180 dB safety radii were implemented more frequently (31 times) than shut-downs of the acoustic source (ten times) or delays to ramp-up of the source. Only one delay to ramp-up was undertaken throughout the entire survey, for a pod of common dolphins observed inside the 180dB safety radius of the source (Figure 22).

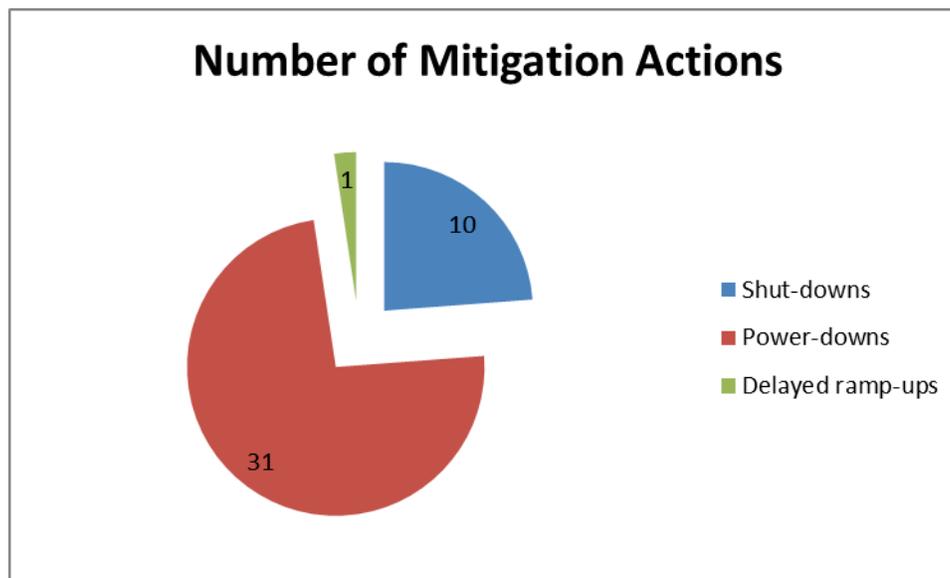


Figure 22: Number of power-downs, shut-downs and delays to ramp-up implemented during the mid-Atlantic survey

Mitigation actions caused a total duration of downtime of 8 hours and 04 minutes during the survey. The number and duration of mitigation actions is summarized in Table 9.

Table 9. Number and duration of mitigation actions implemented during the Mid-Atlantic survey.

Mitigation Action	Cetaceans		Sea Turtles		Total	
	Number	Duration	Number	Duration	Number	Duration
Delayed Ramp-up	01	00:21	00	00:00	01	00:21
Power-down	12	04:15	19	03:11	31	07:26
Shut-down	01	00:06	09	00:11	10	00:17
Total	14	04:42	28	03:22	42	08:04

The majority of mitigation actions implemented during the survey were for sea turtles. Sea turtle detections resulted in 19 power-downs and nine of the ten shut-downs implemented throughout the entire survey project. Four of the nine shut-downs for sea turtles were preceded by power-downs of the source where the shut-down followed a minute or two later when the turtle then approached the 180dB safety radius of the single airgun. The other five shut-downs were implemented without first powering down the source as the turtle was sighted within a few hundred meters of the source and would be within the 180dB safety radius of the single airgun by the time the mitigation action could be undertaken.

The one shut-down of the source implemented for a marine mammal inside the 180dB safety radius of the source was undertaken for a blue whale.

Although sea turtles accounted the largest number of mitigation power-downs and mitigation shut-downs, the average duration of a mitigation action for a sea turtle was shorter than mitigation actions undertaken for marine mammals (Table 10). Mitigation actions for loggerhead sea turtles still made up the greatest percentage of mitigation time of any one species over the course of the survey at 33% of total mitigation downtime (Figure 23).

Table 10. Mitigation actions and downtime duration by species.

Species	Number of Mitigation Actions	Duration of Downtime	Percentage of Total Mitigation Downtime
Fin whales	03	01:18	16%
Blue whales	05	01:22	17%
Unidentified whales/ Unidentified baleen whales	03	01:11	15%
Common dolphins	02	00:39	8%
Unidentified dolphins	01	00:21	4%
Loggerhead sea turtles	22	02:38	33%
Leatherback sea turtle	02	00:10	2%
Unidentified chelonid	04	00:34	7%

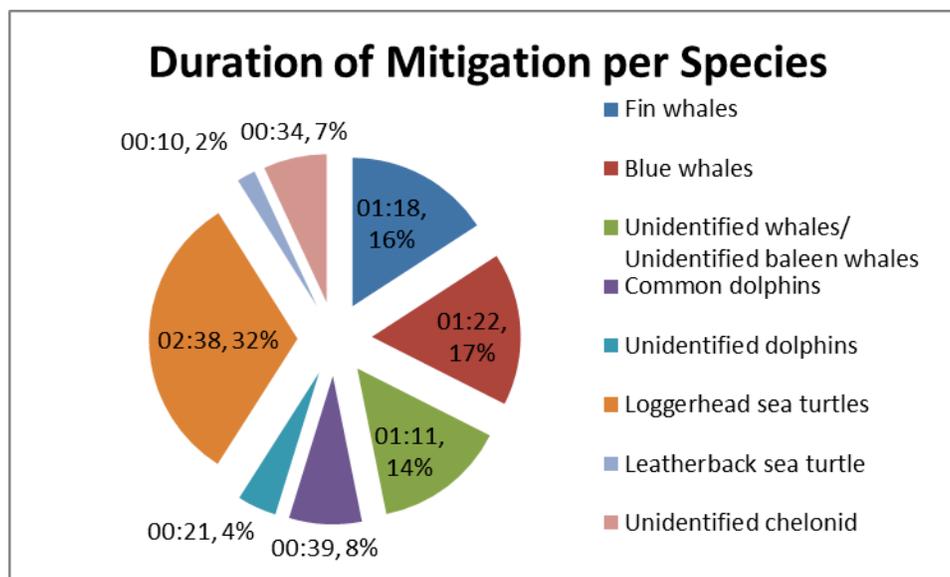


Figure 23: Duration of mitigation downtime attributed to each species during the Mid-Atlantic survey

Each mitigation action that was implemented during the survey is summarized in Table 11.

Table 11. Summary of each mitigation action implemented during the Mid-Atlantic Survey.

Date	Visual Sighting Number	Species	Group Size	Source Activity (initial detection)	Closest Approach to Firing Source / Power Level	Mitigation Action	Total Duration Mitigation Action	Comments
20-Apr	17	Unidentified baleen whale	1	Full volume	1050 / Full volume	Power-down	00:30	Whale surfaced already inside 180dB EZ. Full volume resumed when whale was observed leaving the EZ
20-Apr	18	Loggerhead sea turtle	1	Full volume	230 / Full volume	Power-down	00:08	Observed inside 180dB zone of full source .Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots).
20-Apr	19	Loggerhead sea turtle	1	Full volume	30 / Mitigation firing	Power-down	00:10	A shut-down was not implemented d/t confusion over procedures. No shots were fired while turtle was inside single airgun EZ d/t large shot interval.
21-Apr	21	Unidentified Chelonid sp	1	Full volume	230 / Full volume	Power-down	00:09	Observed inside 180dB zone of full source .Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots).
21-Apr	22	Unidentified Chelonid sp	1	Full volume	80 / Full volume	Power-down	00:09	Observed inside 180dB zone of full source .Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots).
21-Apr	23	Loggerhead sea turtle	1	Full volume	30 / Full volume	Shut-down	00:08	Observed inside 180dB zone of single source.). After one minute, calculated to be outside 180dB of small airgun and single airgun was enabled. Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots).
27-Apr	25	Unidentified Chelonid sp	1	Full volume	200 / Full volume	Power-down	00:08	Observed inside 180dB zone of full source. Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots)
28-Apr	27	Unidentified baleen whale	2	Full volume	845 / Full volume	Power-down	00:11	Whale surfaced inside 180dB EZ of full source. Whale was observed leaving mitigation zone and full volume resumed
28-Apr	29	Unidentified whale	1	Full volume	1089 / Full volume	Power-down	00:30	Whale surfaced inside 180dB EZ of full source. Whale was not observed leaving EZ; 30 mins after last sighting inside EZ, full volume resumed
29-Apr	30	Fin whale	2	Full volume	1070 / Full volume	Power-down	00:22	Whales surfaced inside EZ of full source. Both were observed leaving EZ; full volume resumed

Date	Visual Detection Number	Species	Group Size	Source Activity (initial detection)	Closest Approach to Firing Source / Power Level	Mitigation Action	Total Duration Mitigation Action	Comments
29-Apr	31	Loggerhead sea turtle	1	Full volume	530 / Full volume	Power-down	00:07	Juvenile turtle; Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots)
29-Apr	32	Loggerhead sea turtle	1	Full volume	200 / Mitigation firing	Shut-down	00:08	Juvenile turtle; Inside EZ of single gun; single gun enabled when turtle was calculated to be outside EZ and full volume resumed when turtle was outside full source EZ
29-Apr	33	Fin whale	4	Full volume	990 / Mitigation firing	Power-down	00:39	Two separate pairs of whales entered EZ, one pair observed leaving EZ but other pair was not seen leaving; 30 mins following last sighting inside EZ, full volume resumed
30-Apr	36	Loggerhead sea turtle	1	Full volume	200 / Mitigation firing	Shut-down	00:08	Approaching EZ of single gun immediately after first sighting; single gun enabled when turtle was calculated to be outside EZ and full volume resumed when turtle was outside full source EZ
30-Apr	37	Leatherback sea turtle	1	Full volume	200 / Mitigation firing	Power-down / Shut-down	00:10	Approaching EZ of single gun shortly after first sighted; single gun enabled when turtle was calculated to be outside EZ and full volume resumed when turtle was outside full source EZ .Appeared to have been struck by sources as it swam perpendicularly towards vessel, crossing between stern of vessel and sources
30-Apr	38	Loggerhead sea turtle	1	Full volume	200 / Mitigation firing	Power-down / Shut-down	00:10	Approaching EZ of single gun shortly after first sighted; single gun enabled when turtle was calculated to be outside EZ and full volume resumed when turtle was outside full source EZ
30-Apr	41	Loggerhead sea turtle	1	Full volume	400 / Full volume	Power-down	00:08	Observed inside 180dB zone of full source .Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots)
30-Apr	42	Fin whale	1	Full volume	845 / Mitigation firing	Power-down	00:17	Whale surfaced inside 180dB EZ. Full volume resumed when whale was observed exiting EZ.

Date	Visual Detection Number	Species	Group Size	Source Activity (initial detection)	Closest Approach to Firing Source / Power Level	Mitigation Action	Total Duration Mitigation Action	Comments
01-May	43	Loggerhead sea turtle	1	Full volume	230 / Mitigation firing	Power-down	00:08	Observed inside 180dB zone of full source .Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots)
01-May	44	Loggerhead sea turtle	1	Full volume	200 / Mitigation firing	Power-down	00:08	Observed inside 180dB zone of full source .Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots)
01-May	45	Loggerhead sea turtle	1	Full volume	250 / Full volume	Power-down	00:05	Observed inside 180dB zone of full source .Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots)
01-May	46	Loggerhead sea turtle	1	Mitigation firing	200 / Mitigation firing	Shut-down	00:10	Observed while source was already powered-down for previous turtle sighting (#46). Source shut down for two mins while turtle was inside EZ of single gun
04-May	66	Blue whale	1	Full volume	1089 / Full volume	Power-down / Shut-down	00:18	Source powered down when whale entered full volume EZ then shut-down when whale entered single gun EZ. Single gun re-enabled when whale left small EZ and full source resumed when whale was observed leaving full volume EZ
05-May	67	Unidentified dolphins	8	Silent	N/A	Delayed ramp-up	00:21	Ramp-up delayed for dolphins observed inside 180dB EZ. Ramp-up begun when dolphins observed leaving EZ
06-May	71	Common dolphins	40	Full volume	320 / Mitigation firing	Power-down	00:23	Power-down for dolphins detected already inside 180dB. Resume full volume when observed exiting EZ
06-May	72	Loggerhead sea turtle	1	Full volume	230 / Mitigation firing	Power-down	00:08	Power-down for turtle detected inside 180dB EZ. Resume full volume using vessel speed to calculate time required for turtle to clear EZ.
06-May	73	Loggerhead sea turtle	1	Full volume	200 / Full volume	Shut-down	00:10	Shut-down for turtle detected inside 180dB EZ. Resume full volume using vessel speed to calculate time required for turtle to clear EZ.
06-May	75	Blue whale	1	Full volume	845 / Mitigation firing	Power-down	00:11	Blue whale observed outside EZ then surfaced inside EZ, source powered down. Resume full volume when whale observed exiting EZ.

Date	Visual Detection Number	Species	Group Size	Source Activity (initial detection)	Closest Approach to Firing Source / Power Level	Mitigation Action	Total Duration Mitigation Action	Comments
06-May	76	Blue whale	1	Full volume	580 / Mitigation firing	Power-down	00:20	Blue whale observed outside EZ then surfaced inside EZ, source powered down. Resume full volume when whale observed exiting EZ.
06-May	79	Loggerhead sea turtle	1	Full volume	250 / Mitigation firing	Power-down	00:08	Power-down for turtle detected inside 180dB EZ. Resume full volume using vessel speed to calculate time required for turtle to clear EZ.
07-May	81	Unidentified Chelonid sp	1	Full volume	250 / Mitigation firing	Power-down	00:08	Power-down for turtle detected inside 180dB EZ. Resume full volume using vessel speed to calculate time required for turtle to clear EZ.
07-May	84	Blue whale	1	Full volume	400 / Mitigation firing	Power-down	00:33	Blue whale observed outside EZ at 1500m then surfaced inside EZ, source powered down. Resume full volume when whale observed exiting EZ.
08-May	86	Loggerhead sea turtle	1	Full volume	80 / Full volume	Power-down / Shut-down	00:09	Power-down the shut-down for turtle detected inside 180dB EZ. Resume full volume using vessel speed to calculate time required for turtle to clear EZ.
09-May	87	Loggerhead sea turtle	1	Full volume	230 / Mitigation firing	Power-down	00:08	Power-down for turtle detected inside 180dB EZ. Resume full volume using vessel speed to calculate time required for turtle to clear EZ.
09-May	88	Loggerhead sea turtle	1	Full volume	175 / Mitigation firing	Power-down	00:08	Power-down for turtle detected inside 180dB EZ. Resume full volume using vessel speed to calculate time required for turtle to clear EZ.
09-May	89	Common dolphin	2	Full volume	280 / Mitigation firing	Power-down	00:16	Correlated visual sighting and acoustic detection. Whistles detected first followed by visual sighting of dolphins on bow. Power-down implemented. Last sighting at 18:20, last acoustic detection at 18:23. Full volume resumed 15 mins from last sighting.
10-May	90	Loggerhead sea turtle	1	Full volume	200 / Full volume	Power-down / Shut-down	00:08	Power-down the shut-down for turtle detected inside 180dB EZ. Resume full volume using vessel speed to calculate time required for turtle to clear EZ.

6.1. MARINE MAMMALS KNOWN TO HAVE BEEN EXPOSED TO 160 DB OF RECEIVED SOUND LEVELS

NMFS granted an IHA for a marine seismic survey allowing Level B harassment takes (exposure to 160 dB received sound) for 18 marine mammal species: six mysticetes and 12 odontocete species. Direct visual observations recorded by PSOs of species of marine mammals for which takes were granted in the IHA provide a minimum estimate of the actual number of animals exposed to received sound levels of 180 dB and 160 dB.

During the Mid-Atlantic survey 15 fin whales, four blue whales and 52 common dolphins were observed within the 160 dB predicted distances where Level B harassment is expected to occur while the acoustic source was active (Table 12). An additional nine unidentified mysticetes, 16 unidentified large whales and 15 unidentified dolphins were also observed inside the 160dB safety radius of the full volume source.

Table 12. Level B Harassment Takes authorized by NMFS IHA for the Atlantic and number of known individuals exposed to 160 dB and 180 dB through visual observations.

Species	IHA Authorized Takes	Number of animals exposed to 180 dB ()	Number of animals exposed to 160 dB
Unidentified large whale	N/A	01	16
Mysticetes			
Blue whale	66	04	04
Bryde's whale	1	00	00
Fin whale	198	07	15
Humpback whale	50	00	00
Minke whale	3	00	00
Sei whale	9	00	00
Unidentified mysticete	N/A	03	09
Odontocetes			
Atlantic spotted dolphin	112	00	00
Bottlenose dolphin	47	00	00
Cuvier's beaked whale	7	00	00
False killer whale	7	00	00
Killer whale	5	00	00
Mesopodopdon spp.	39	00	00
Northern bottlenose whale	4	00	00
Risso's dolphin	21	00	00
Short-beaked common dolphin	2,115	50	52
Short-finned pilot whale	674	00	00
Sperm whale	164	00	00
Striped dolphin	1,034	00	00
Unidentified dolphins	N/A	0	15

These numbers are very likely to be an underestimate and provide the absolute minimum number of animals actually exposed. There were 11 acoustic detections of dolphins that were not confirmed with visual sightings to identify the species present, but it is certain that these animals were inside the 6908 meter 160dB harassment radius of the source while it was operating at full volume. It is also possible that estimated numbers of animals recorded during each sighting event were underestimates, some animals not being seen or having moved away before they were observed. Table 13 describes the behavior of all animals, including unidentified species, which were exposed to 160 dB for the duration they were observed.

Table 13. Behavior of species exposed to 160 dB.

Species	Detection No.	No. of Animals	Initial behavior	Initial direction in relation to vessel	Final behavior	Final direction in relation to vessel
Fin whale	28	4	Blowing	Parallel, opposite direction to vessel	Blowing	parallel in same direction as vessel
	30	2	Blowing	Parallel, opposite direction to vessel	Blowing	Away from vessel
	33	4	Blowing	crossing ahead of vessel	Blowing	Parallel, opposite direction to vessel
	40	4	Blowing	Parallel, opposite direction to vessel	Diving	Parallel, opposite direction to vessel
	42	1	Blowing	Parallel, opposite direction to vessel	Diving	Away from vessel
Blue whale	66	1	Blowing	Parallel, opposite direction to vessel	Blowing	Parallel, opposite direction to vessel
	75	1	Blowing	Parallel, opposite direction to vessel	Diving	Away from vessel
	76	1	Blowing	crossing ahead of vessel	Fast travel	Away from vessel
	84	1	Blowing	Unknown	Diving	Parallel, opposite direction to vessel crossing astern; toward vessel
Common dolphin	71	40	Swimming fast underwater	Toward vessel	Leaping	Parallel, opposite direction to vessel
	80	10	Swimming fast underwater	Toward vessel	Feeding; porpoising	Crossing astern, away from vessel
Unid. baleen whale	15	1	Blowing	Unknown	Blowing	Unknown
	17	1	Blowing	Parallel, opposite direction to vessel	Blowing	Parallel, opposite direction to vessel
	20	1	Blowing	Away from vessel	Diving	Away from vessel
	24	1	Blowing	Unknown	Blowing	Unknown
	27	1	Blowing	Crossing ahead	Blowing	Crossing ahead
	34	1	Blowing	Unknown	Blowing	Unknown
	35	3	Blowing	Away from vessel	Blowing	Away from vessel
Unid. dolphins	77	5	Porpoising	Parallel, opposite direction to vessel	Jumping	Parallel, opposite direction to vessel
	78	10	Porpoising	Crossing ahead	Porpoising	Crossing ahead

Species	Detection No.	No. of Animals	Initial behavior	Initial direction in relation to vessel	Final behavior	Final direction in relation to vessel
Unid. whale	16	3	Blowing	parallel in same direction as vessel	Blowing	Parallel, opposite direction to vessel
	26	1	Blowing	Parallel, opposite direction to vessel	Blowing	Unknown
	29	1	Blowing	Parallel, opposite direction to vessel	Blowing	Unknown
	39	1	Blowing	Unknown	Blowing	Parallel, opposite direction to vessel
	62	1	Blowing	Unknown	Blowing	Parallel, opposite direction to vessel
	63	1	Blowing	Parallel, opposite direction to vessel	Blowing	Unknown
	64	1	Blowing	Parallel, opposite direction to vessel	Blowing	Unknown
	65	1	Blowing	Unknown	Blowing	Unknown
	68	1	Blowing	Unknown	Breaching	Parallel, opposite direction to vessel
	69	1	Blowing	Unknown	Blowing	unknown
	70	1	Blowing	Parallel, opposite direction to vessel	Blowing	Parallel, opposite direction to vessel
	82	1	Blowing	unknown	Blowing	unknown
	83	1	Blowing	Parallel, opposite direction to vessel	Blowing	Parallel, opposite direction to vessel
	85	1	Blowing	unknown	Blowing	Unknown

6.1.1. Fin whale

There were five sightings of fin whales totalling 15 animals observed within the 160 dB safety radius during the mid-Atlantic survey; seven (three sighting events) of which were observed to be exposed to received sound pressure levels of 180 dB or greater. Of the five sightings events, one consisted of a pair of whales, one consisted of a single animal and three sightings were of pods of four fin whales.

On 28 April 2013 (Sighting #28) a group of four whales including one juvenile were observed traveling parallel to the vessel in the opposite direction at a distance of two kilometres. The group came as close as 1500 meters close to the source operating on full volume but remained outside the 180dB mitigation zone. They were observed blowing and diving without showing flukes, traveling at a moderate pace for almost an hour, occasionally blowing bubbles. As they dropped astern of the vessel, they changed heading slightly but continued away from the vessel.

On 29 April (Sighting #30) a pair of fin whales were observed six kilometres ahead of the vessel blowing in cycles of several blows followed by five to seven minutes where whales were submerged below the surface. Whales appeared to be traveling toward the vessel and at a moderate to rapid pace. Last observed ahead of the vessel two kilometres away, one whale

surfaced 845 meters away off the starboard side and the source was powered down. A couple minutes later the second whale surfaced off the port side 1500 meters away. Both whales continued on what appeared to be their original heading, now parallel in the opposite direction to the vessel, continuing to blow at the same intervals. The entire sighting event lasted 46 minutes and the source was powered down for 22 minutes, full volume resumed after animals were both observed surfacing outside the 180dB EZ.

On 29 April 2013 (Sighting #33) four fin whales were observed entering first the 160dB radius followed by the 180dB EZ. First two whales were observed blowing 4000 meters ahead of the vessel, both surfacing simultaneously, blowing several times followed by diving without showing flukes and remaining submerged for five to seven minutes. Both whales were on a heading where they were crossing ahead of the vessel. One of the two whales changed course and began moving towards the vessel, then surfaced inside the 180dB EZ, now traveling parallel in the same direction as the vessel, and the source was powered down. This whale eventually returned to its original course, re-joining the first whale astern of the vessel and moving away. At the same time, a second pair of fin whales surfaced inside the 180dB full source EZ (while the source was still powered down) off the port stern, blowing several times in three different cycles. The first pair of whales were observed departing the 180dB EZ but the second pair were not sighted again so full source operations were not resumed until 30 minutes had passed following the last sighting of the second pair of whales inside the EZ. The source remained powered down for 39 minutes and the entire sighting event lasted 31 minutes.

On 30 April 2013 (Sighting #40) a pod of four fin whales was observed traveling parallel to the vessel in the opposite direction at a distance of approximately 1500 meters to the source. They remained on the same heading throughout the sighting, blowing and diving without showing flukes, traveling at a moderate pace, never entering within the 180dB exclusion zone. The entire sighting event lasted one hour and 40 minutes.

On 30 April 2013 (Sighting #42) a single fin whale was observed two kilometres off the bow of the vessel blowing in cycles of two to five blows followed by approximately six minutes below the surface. The whale appeared to be traveling parallel to the vessel in the opposite direction and entered the 180dB EZ after surfacing several times just outside of it at which time the source was powered down. The whale's pace appeared to change, slowing down and it continued to surface alongside the vessel, inside the EZ for 15 minutes. When the whale was observed surfacing off the stern outside the EZ the source was returned to full volume after 17 minutes of mitigation firing. The entire sighting lasted 42 minutes.

6.1.2. Blue whale

There were four sightings of blue whales consisting of a single animal each time observed within the 160 dB safety radius during the mid-Atlantic survey; all of which were also observed to be exposed to received sound pressure levels of 180 dB or greater. Each blue whale sighting occurred while the source was operating on full volume resulting in a power-down of the source and in one case, a power-down followed by a shut-down when the whale entered the 180dB EZ of the single airgun.

On 4 May 2013 a blue whale was observed 1500 meters ahead of the vessel off the bow while the boat was on a survey line. The whale was surfacing, blowing, traveling at a vigorous pace parallel to the vessel and in the opposite direction. It was covering large distances while under the surface between blow cycles and submerged at 1500 meters, re-surfacing at 1000 meters inside the 180dB EZ when a power-down was implemented. Its pace slowed and it remained

alongside the vessel, coming close to the 180dB EZ of the single source so the single airgun was shut-down. The source remained shut down for five minutes until the whale was observed surfacing outside the EZ of the single gun so one gun was re-enabled. The whale continued on its original heading and when it was observed exiting the EZ 17 minutes after the power-down had been initiated, the source returned to full volume. The entire sighting event lasted 27 minutes.

A single whale blue whale was sighted twice on 6 May 2013, once from 11:30 to 11:32 UTC (Sighting #75) and again from 12:13 until 13:18 (Sighting #76). The first whale appeared to be a sub-adult of approximately 20 meters in length while the second whale appeared to be larger, and therefore a different animal. Both sightings resulted in power-downs of the source. During the first sighting, the whale was observed approximately 2600 meters off the bow traveling towards the vessel, parallel in the opposite direction to the vessel at a moderate pace. The whale surfaced, blowing several times for one to two minutes before submerging without showing its flukes for five to seven minutes. It surfaced several times off the side of the vessel, surfacing inside the EZ 17 minutes into the sighting event and a power-down was implemented. The whale approached the airguns while they were mitigation firing to within 850 meters. After 11 minutes the whale was observed continuing away from the vessel outside of the EZ and the source resumed full volume. The sighting lasted 32 minutes.

During the second sighting on 6 May 2013 (Sighting #76), a single blue whale was sighted 4000 meters ahead of the vessel, blowing in regular cycles of 4-5 blows for a minute followed by 5-7 mins submerged below the surface. First the animal appeared to be traveling toward the vessel, parallel to it but in the opposite direction but when it approached to within 2000 meters it crossed ahead of the vessel, surfacing off the starboard bow inside the 180dB at 800 meters and a power-down was implemented. For approximately 15 minutes the whale remained off the starboard side of the vessel within 1000 meters, sometimes traveling towards the vessel, away from the vessel and parallel to the vessel in the same direction. It was occasionally seen lunging through the water at the surface. The source remained powered down for 20 minutes and full volume resumed when the whale was eventually seen moving away from the vessel, traveling parallel in the opposite direction. This sighting event lasted one hour and five minutes.

On 7 May 2013 (Sighting #84) a blue whale was observed directly ahead of the bow at 4000 meters distance. It was surfacing every five to six minutes, blowing four times but no direction of travel could be determined. This continued for 20 minutes where the last sighting of the whale outside the 180dB EZ occurred at a distance of 1500 meters and the next sighting occurred seven minutes later when the whale was 450 meters away off the port bow. The source was powered down immediately and the whale surfaced once more off the port side where it was observed to be traveling parallel to the vessel in the opposite direction. It then crossed under the vessel, surfacing off the starboard stern, and continued to be seen blowing as it continued to move away. As it dropped astern, it changed heading to cross astern of the vessel, moving perpendicular to the vessel. When it surfaced outside of the EZ 33 minutes after the power-down, the source returned to full volume. Within a minute of the source's return to full volume, the whale surfaced again, this time traveling at a vigorous pace directly towards the vessel, moving closer to the vessel with each blow observed. It submerged again after one minute and when it resurfaced it had returned to its original heading, moving perpendicular to the vessel.

6.1.3. Unidentified baleen whale

There were seven sightings of unidentified baleen whales totalling nine animals observed within the 160 dB safety radius during the mid-Atlantic survey; three (one animal during each of three

sighting events) of which were also observed to be exposed to received sound pressure levels of 180 dB or greater.

In each sighting event, including the three resulting in mitigation power-downs for unidentified baleen whales observed inside the 180dB safety radius of the source, the whale(s) were observed to maintain their direction of travel relative to the vessel throughout the sighting events. Two sighting events (Sightings #20 and #35 on 20 and 30 April respectively) consisted of whales moving away from the vessel throughout the detection, one whale in the first sighting and three whales in the second sighting. One sighting (Sighting #17 on 20 April 2013) consisted of a single whale traveling parallel to the vessel in the opposite direction. One sighting (Sighting #27 on 28 April 2013) consisted of one whale crossing ahead of the vessel. The direction of travel relative to the vessel could not be determined in three sighting events (Sightings #15, 24 and 34 on 19, 27 and 30 April 2013) of single whales.

In each of the seven sighting events the only behaviour observed was blowing and the whales pace varied from sedate to vigorous travel.

The range at which unidentified baleen whales exposed to 160dB sound pressure levels were first detected varied from 1050 meters to 6000 meters and the closest approach to the source during the sighting events varied from 845 meters to 6000 meters.

6.1.4. Unidentified whale

There were 14 sightings of unidentified baleen whales totalling 16 animals observed within the 160 dB safety radius during the mid-Atlantic survey; only one of which was also observed to be exposed to received sound pressure levels of 180 dB or greater. Each sighting event consisted of one whale with the exception of a sighting of three whales (Sighting #16). Sighting events varied in duration from one minute to 1 hour and 49 minutes.

In every sighting event where the direction of travel of the whale relative to the vessel could be determined, the direction remained consistent throughout the detection event. Direction of travel could not be determined in seven of the sighting events. Six sightings consisted of single whales traveling parallel to the vessel in the opposite direction and one sighting consisted of three whales traveling parallel to the vessel in the same direction.

In every sighting event, the only behaviour observed was blowing. When the pace of travel could be determined, it was most frequently observed to be moderate with only one animal observed to be moving at a sedate pace.

The average range to unidentified whales observed inside the 160dB EZ when first detected was 3874 meters and the average closest approach of these whales to the source was 3100 meters.

6.1.5. Common dolphins

There were three sightings of short-beaked common dolphin pods totalling 52 animals observed within the 160 dB safety radius during the mid-Atlantic survey; 42 of which were also observed to be exposed to received sound pressure levels of 180 dB or greater.

On 5 May 2013 (Sighting #71) a pod of 40 common dolphins was observed swimming towards the bow of the vessel while online with the source operating at full volume. The pod remained mostly below the surface and occasionally an animal would jump all the way out of the water.

No acrobatic behaviour was exhibited. The dolphins appeared to be feeding, changing directions rapidly, remaining off the starboard side of the vessel for approximately 20 minutes. The pod departed, traveling fast with some animals seen porpoising, all moving away from the vessel, parallel in the opposite direction and then changing course to cross astern. Full volume operations resumed as the pod departed the 180dB EZ. Both the sighting event and the power down lasted 23 minutes.

On 6 May 2013 (Sighting #80) a pod of ten common dolphins were observed approximately 4000 meters off the port side of the vessel, swimming mostly below the surface but occasionally jumping. The animals appeared to be milling and remained alongside, approaching no closer than 2800 meters, for 44 minutes. No other behaviours were observed. The source remained on full volume throughout the sighting.

On 9 May 2013 (Sighting #89 and Acoustic Detection #7) whistles were detected acoustically at 18:00 and 19 minutes later a pair of dolphins including a juvenile were observed bow-riding. The pair were only observed for one minute and the source was powered down immediately. The acoustic detection of high-frequency clicks continued for another three minutes following the last sighting. No other behaviours were observed and because the animals were not observed departing the 180dB EZ, full volume was not resumed until 15 minutes following the last sighting of the dolphins inside the safety radius.

6.1.6. Unidentified dolphins

There were two sightings of unidentified dolphin pods totalling 15 animals observed within the 160 dB safety radius during the mid-Atlantic survey. None of the unidentified dolphins observed were exposed to received sound pressure levels of 180 dB or greater.

Two pods of unidentified dolphins were observed on 6 May 2013. One pod was traveling at a moderate pace, parallel in the opposite direction to the vessel at a distance of over 4000 meters. They did not approach any closer, or change behaviour or direction of travel throughout the sighting, which lasted ten minutes. The second pod was observed for one minute only crossing ahead of the vessel 2000 meters away. The animals were jumping and traveling fast and did not alter behaviour or course during the brief sighting.

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

In order to minimize the Level-B incidental taking of marine mammals and sea turtles during the Mid-Atlantic marine seismic survey, mitigation measures were implemented whenever these protected species were seen near or within the safety radii designated in the IHA. Power-downs were implemented for mysticetes, odontocetes and sea turtles.

Additional mitigation measures specific to the Mid-Atlantic survey required that if a North Atlantic right whale (*Eubalaena japonica*) was sighted, the airgun array would be shut-down regardless of the distance of the animal(s) to the sound source and that the array would not resume firing until 30 minutes after the last documented sighting of the whale. While this species was not positively identified during the Mid-Atlantic survey, numerous large unidentified baleen whales were observed. Therefore this species may have been in the area without its specific mitigation implemented because of the uncertainty of identification.

7. ACKNOWLEDGEMENTS

The Protected Species Observers on board Langseth during the Mid-Atlantic survey would like to thank the National Science Foundation, Lamont-Doherty Earth Observatory for the opportunity to work on this project. It was a pleasure to work with Drs. Juan Pablo Canales and Robert Dunn, and Meagan Cummings, Marine Environmental Safety Coordinator for L-DEO. We would also like to thank the marine crew and science team on board the *R/V Langseth* for their assistance and hospitality.

We would like to thank the following individuals for their considerable help in making the program a success.

- Meagan Cummings and Jeff Rupert from L-DEO for their assistance, planning and preparation for the cruise.
- Rebecca Snyder from RPS and Chris Pierpoint from Seiche for their support and assistance with the PAM system.
- Matthew Dellinger from RPS for providing logistical support for the project.

8. LITERATURE CITED

LGL Ltd., Environmental Research Associates, 2011. "Environmental Assessment of a Marine Geophysical Survey by the R/V Marcus G. Langseth on the mid-Atlantic Ridge, December 2012".

APPENDIX A: Incidental Harassment Authorization for Mid-Atlantic Marine Seismic Survey

APPENDIX B: Basic Summary Data Form

BASIC DATA FORM			
LDEO Project Number	MGL1305		
Seismic Contractor	Lamont-Doherty Earth Observatory of Columbia University		
Client	Juan Pablo Canales		
Area Surveyed During Reporting Period	Mid-Atlantic, Azores Islands		
	Approximately °N and °W		
Survey Type	2D marine seismic		
Vessel and/or Rig Name	<i>R/V Marcus G. Langseth</i>		
Permit Number	IHA granted by NMFS on 8 April 2013		
Location / Distance of Airgun Deployment	230m		
Water Depth	Min	1000m	
	Max	3000m	
Dates of project	11 April 2013	THROUGH	19 May 2013
Total time airguns operating – all power levels:	422:00		
Time airguns operating at full power on survey lines:	370:14		
Time airguns operating at full/partial power on line changes:	41:24		
Amount of time mitigation gun (40 in³) operations:	08:15		
Amount of time in ramp-up:	02:07		
Number daytime ramp-ups:	04		
Number of night time ramp-ups:	00		
Number of ramp-ups from mitigation source:	00		
Amount of time conducted in airgun testing:	00:00		
Duration of visual observations:	505:26		
Duration of observations while airguns firing:	252:13		
Duration of observation during airgun silence:	253:13		
Duration of acoustic monitoring:	382:43		
Duration of acoustic monitoring while airguns firing:	380:23		
Duration of acoustic monitoring during airgun silence:	02:20		
Duration of simultaneous acoustic and visual monitoring:	228:24		
Lead Protected Species Observer:	Stephanie Milne		
Protected Species Observers:	Meghan Piercy		
	Katelyn Morrell		
	Leslie Curran		
Acoustic Observer:	Dara Cameron		
Number of Marine Mammals Visually Detected:	72		
Number of Marine Mammals Acoustically Detected:	12		
Number of simultaneous visual sightings/acoustic detections:	01		
Number of Sea Turtles detected:	33		
List Mitigation Actions (eg. Power-downs, shut-downs, ramp-up delays)	1 Delayed ramp-up, 31 Power-downs, 10 Shut-downs		
Duration of operational downtime due to mitigation:	08:04		

APPENDIX C: Passive Acoustic Monitoring System Specifications

Passive Acoustic Monitoring System Specifications

Main cable and spare cable:

1.1 Outline Array

Array serial number SM.2997

Mechanical Information

Length 20m

Diameter 14mm over cable 32mm over mouldings 45mm over connectors

Weight 10kg

Connector Seiche 36 pin

Hydrophone elements

Hydrophone 1 Sphere 1 Broad band 200Hz to 200kHz (3dB points)

Hydrophone 2 Sphere 2 Broad band 200Hz to 200 kHz (3dB points)

Hydrophone 3 Sphere 3 Standard 2 kHz to 200 kHz (3dB points)

Hydrophone 4 Sphere 4 Standard 2 kHz to 200 kHz

Depth Capability 100m

Spacing between elements 1 & 2 (for HF / LF detection) 2.0m 1.28mSecs

Spacing between elements 2 & 3 (for HF / LF detection) 13.0m 8.32mSecs

Spacing between elements 3 & 4 (for HF detection) 0.25m 0.16mSecs

Interface unit Array 1 outputs

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

Standard channel sensitivity -166dB re 1V/uPa

1.2 Heavy tow cable

Tow serial number SM.2998

Mechanical Information

Length 230m

Diameter 17mm over cable 32mm over mouldings

Connector Tail end Seiche 36 pin 45mm over connectors

Head end ITT 19 pin 65mm over connectors

Weight 100kg

1.3 Deck cable

Deck serial number SM.2933

Mechanical Information

Length 100m

Diameter 14mm

Connectors ITT 19 pin 65mm over connectors

Weight 25kg

APPENDIX D: PAM Hydrophone Deployment on the *R/V Marcus Langseth*

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

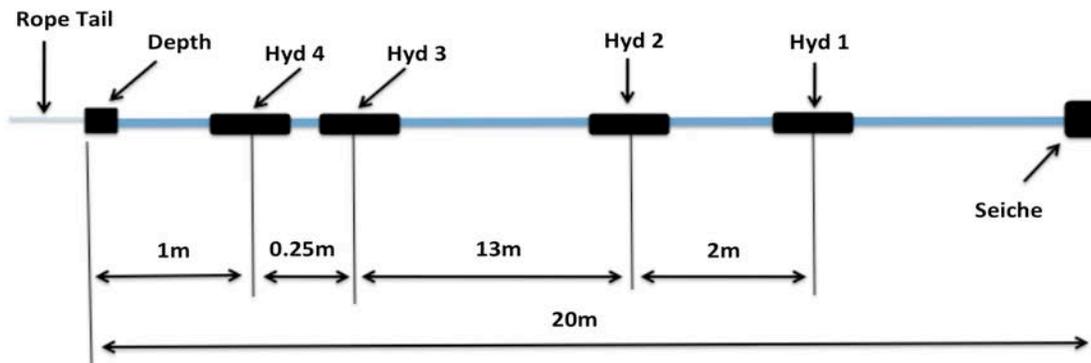


Figure 1: Diagram of the hydrophone array cable indicating the position and separation of the individual hydrophone elements.

The hydrophone array cable, connected to the tow cable, is spooled onto a port hydrolytic winch (Figure 2, right). The cables are deployed directed off the stern of the vessel. The streamer deck, (one deck above the deployment location), has a steel pole secured to the deck that protrudes 3m off the port side (Figure 2, left). This pole acts as a makeshift boom and allows 3m of additional separation to avoid entanglement with the umbilicus of array four. The extending end of the pole has a rope that hangs down with a shackle. The hydrophone tow cable, with a looped rope attached via tape, connects to the shackle and this is the towing point of the PAM cable system, this is highlighted in Figure 3.

Three sections of chain were bound by tape and added to the hydrophone tow cable to weigh down the PAM cable system. In total, 12.3kg was added to ensure a lower

placement of the PAM cable in the water column then the adjacent gun cables. At 3 and 10 meters ahead of the hydrophone cable are 3kg of chain, and at 80 meters ahead of the hydrophone cable 6.3kg was added.



Figure 2: Makeshift boom extending off port streamer deck, with attachment rope (left). Winch with PAM cable (right).

When deployed 120 meters of the PAM cable system is dispensed, (100 meters of tow cable and the 20 meter hydrophone cable). The gun array is placed 190 meters astern of the vessel, this places the separation between the end of the hydrophone cable and the array at 70 meters. The PAM cable is off set to port due to the deployment location.

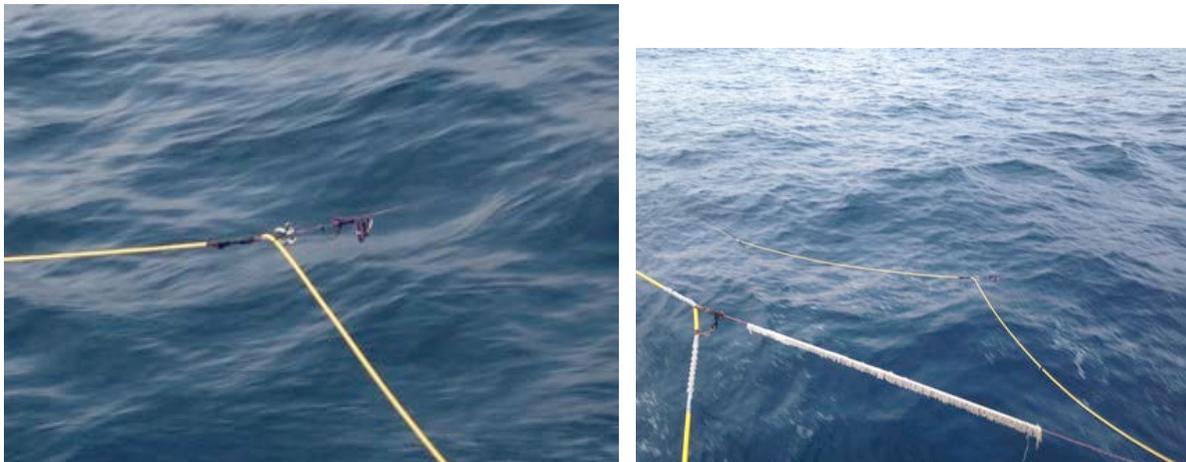


Figure 3: Left close up; PAM tow cable connecting to shackle and rope leading to makeshift boom (Figure 2). Right is PAM's tow point and its proximity to array four umbilicus.

Pre-Deployment Tasks

The PAM data processing unit, and monitors were setup and secured for rough weather in the instrument room (Figure 5). A GPS feed (GPGGA string) was supplied by the ships navigation system Seapath 200.

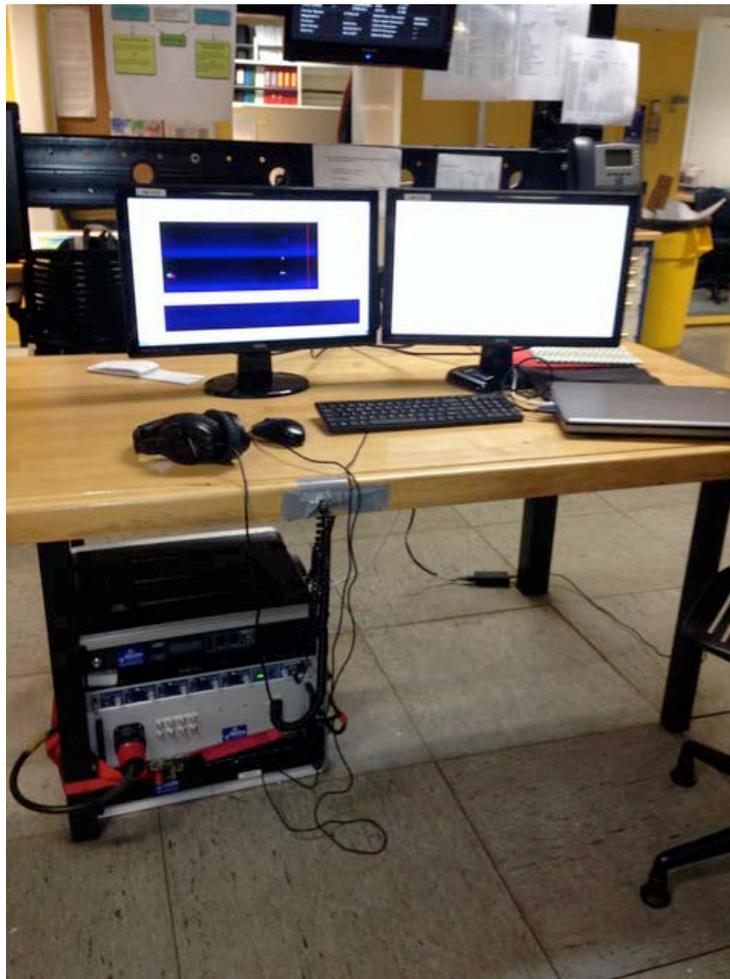


Figure 5: Passive acoustic monitoring station located in the instrument room.

Two 100-meter deck cables are routed from the instrument room to the port gun deck winch, one of which acts as a spare for ease of replacement at sea.

The hydrophone tow cable was measured and marked in 10-meter increments for the first 120 meters from the hydrophone array-tow cables' connection point.

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

Deployment

- Ensure that the PAM electronics unit is powered down.
- Alert the bridge of pending hydrophone deployment.
- Ensure the deck cable is disconnected from the hydrophone tow cable.
- Power on winch.
- Pay out 120m of the hydrophone cable from the winch, dispensing the cable into the water on port side of gun umbilicus.
- Attach the hydrophone cable to rope with towing shackle leading to the improvised boom.
- Add a Zip-tie to secure the shackle from coming undone.
- Continue to unwind from the winch for desired amount of slack from tow point to the stern.
- Power off winch.
- Connect the deck cable to the hydrophone cable.
- Power up electronics in the instrument room.

Retrieval

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

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

HSE

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

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

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

APPENDIX E: Passive Acoustic Monitoring Downtime**Passive Acoustic Monitoring Downtime**

Date	Time Watch Suspended (UTC)	Date	Time Watch Resumed (UTC)	Duration acoustic monitoring suspended	Comments
20 April	01:20	20 April	02:40	1:20	PAM cable wrapped around a gun umbilical. Retrieved, inspected for damage and re-deployed.
20 April	21:45	20 April	22:47	1:02	High following seas resulted in cable wrapped around an umbilical multiple times. Attempted to retrieve cable but bights were too tight. Cable unwrapped by itself when vessel made turn at end of line.
21 April	11:22	21 April	11:36	0:14	PAM cable chafing against gun umbilical. Cable retrieved a few metres in add a weight to the Chinese finger attaching the cable to the vessel, pulling the cable away from the umbilical
21 April	13:22	21 April	13:48	00:26	Deploying a few more meters of hydrophone cable to change towing configuration slightly in an attempt to prevent further tangles with gun umbilicals
21 April	15:08	22 April	2:40	11:32	Bringing PAM in to adjust towing configuration. Cable remained on board for the remainder of line due to following seas, as weather was too rough to allow cable to be deployed.
24 April	03:26	28 April	05:00	97:34	Retrieval of all gear, down for weather
1 May	17:35	4 May	12:19	66:49	After several days of retrieving OBSs, shooting was resumed with a streamer and PAM was deployed

APPENDIX F: Summary of detections of protected species during Mid-Atlantic survey

Movement Codes: **TV:** towards vessel; **AV:** away from vessel; **PV/SD:** parallel vessel, same direction; **PV/OD:** parallel vessel, opposite direction; **CR AH/BH:** 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	2013-04-12	14:03	Unidentifiable dolphin	3	32.87100°N 060.97750°W	Silent	VA	SBS	100 / Not active	None	Observed during transit. Possible short-beaked common dolphins but sighting was brief
2	2013-04-12	11:47	Unidentifiable large whale	1	32.87100°N 060.81033°W	Silent	PV/OD	BV	2000 / Not active	None	Observed during transit. Probable unidentified baleen whale but could not rule out sperm whale from blows observed
3	2013-04-14	11:38	Atlantic spotted dolphin	3	34.01067°N 051.70983°W	Silent	TV	SA NS	20 / Not active	None	Observed during transit.
4	2013-04-15	10:38	Unidentifiable baleen whale	1	34.64000°N 046.52867°W	Silent	PE/AH	BV	2000 / Not active	None	Observed during transit.
5	2013-04-15	10:55	Loggerhead sea turtle	1	34.70233°N 046.01233°W	Silent	PV/OD	NS	50 / Not active	None	Observed during transit.
6	2013-04-15	16:10	Unidentifiable baleen whale	1	35.08350°N 044.95533°W	Silent	PV/SD; PE/AH	BV OT	200 / Not active	None	Observed during transit.
7	2013-04-16	10:01	Unidentifiable baleen whale	2	35.26950°N 041.30400°W	Silent	PE/AH	BV	1000 / Not active	None	Observed during transit.
8	2013-04-16	11:22	Unidentifiable baleen whale	1	35.35683°N 040.57367°W	Silent	OT	BV	5664 / Not active	None	Observed during transit.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
9	2013-04-16	18:57	Unidentifiable baleen whale	1	35.50978°N 039.29768°W	Silent	PV/OD	BV	4000 / Not active	None	Observed during transit.
10	2013-04-17	12:56	Loggerhead sea turtle	1	36.00335°N 035.15892°W	Silent	PV/OD	NS DI	20 / Not active	None	Observed during transit.
11	2013-04-17	13:27	Unidentifiable Chelonid sp	1	36.01800°N 035.03450°W	Silent	PV/OD	NS	500 / Not active	None	Probable loggerhead sea turtle
12	2013-04-17	14:04	Unidentifiable baleen whale	3	36.03633°N 034.88150°W	Silent	PV/SD	BV DI	690 /Not active	None	
13	2013-04-17	17:52	Loggerhead sea turtle	1	36.16883°N 034.13767°W	Silent	PV/OD	NS	20 / Not active	None	
14	2012-04-19	11:33	Loggerhead sea turtle	1	35.96333°N 033.98750°W	Full volume	PV/OD	NS OT	50 / Full volume	None	An error resulted in no mitigation action being performed, however the shot interval of 3.5 minutes and vessel speed of 5.2 knots meant that the turtle was exposed to a maximum of one full volume shot inside the exclusion zone
15	2013-04-19	14:38	Unidentifiable baleen whale	1	36.01450°N 033.91750°W	Full volume	UK	BV	4096 / Full volume		
16	2013-04-20	07:53	Unidentified large whale	3	35.90257°N 034.14757°W	Full volume	PV/SD	BV	2614 /Full volume		
17	2013-04-20	10:45	Unidentified baleen whale	1	36.04983°N 034.00233°W	Full volume	PV/OD	BV	1050 / Full volume	Power-down	Whale surfaced already inside 180dB EZ. Full volume resumed when whale was observed leaving the EZ

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
18	2013-04-20	12:40	Loggerhead sea turtle	1	36.15267°N 033.88400°W	Full volume	AV	NS DI	230 / Full volume	Power-down	Observed inside 180dB zone of full source .Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots).
19	2013-04-20	15:12	Loggerhead sea turtle	1	36.26000°N 033.71383°W	Full volume	PV/OD	NS DI	30 / Mitigation firing	Power-down	A shut-down was not implemented d/t confusion over procedures. No shots were fired while turtle was inside single airgun EZ d/t large shot interval.
20	2013-04-20	17:28	Unidentified baleen whale	1	36.36533°N 033.56785°W	Full volume	AV	BV	1535 / Full volume	None	
1-A	2013-04-21	03:21	Unidentified dolphins	Unknown	36.01892° N 34.11095° W	Full volume	-	-	Undetermined / Full volume	None	Whistles on LF Spectrogram. Night time detection.
21	2013-04-21	09:47	Unidentified chelonid sp	1	36.20283°N 033.92550°W	Full volume	SA	ST	230 / Full volume	Power-down	Observed inside 180dB zone of full source .Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots).
22	2013-04-21	11:28	Unidentified chelonid sp	1	36.29050°N 033.80433°W	Full volume	SA	ST	80 / Full volume	Power-down	Observed inside 180dB zone of full source .Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots).

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
23	2013-04-21	16:13	Loggerhead sea turtle	1	36.45660°N 033.64237°W	Full volume	SA	ST	30 / Full volume	Shut-down / Power-down	Observed inside 180dB zone of single source.). After one minute, calculated to be outside 180dB of small airgun and single airgun was enabled . Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots.
2-A	2013-02-22	03:28	Unidentified dolphins	Unknown	36.13153° N 34.15592° W	Full volume	-	-	100 / Full volume	None	Night time detection lasting 1 hr 46 mins. PSOs were called when vocalizations became very loud but could not make a visual confirmation. Recordings made.
3-A	2013-04-23	02:33	Unidentified dolphins	Unknown	36.33790° N 34.00607° W	Full volume	-	-	Undetermined / Full volume	None	Night time detection. HF Clicks on HF Click Detector
24	2013-04-27	09:39	Unidentified baleen whale	1	36.43833°N 033.64717°W	Ramp-up	UN	BV	2000 / Ramp-up	None	Only a single blow visible, outside EZ
25	2013-04-27	14:44	Unidentified chelonid sp	1	36.33650°N 033.84150°W	Full volume	PV/OD	NS	200 / Full volume	Power-down	Observed inside 180dB zone of full source. Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots)
26	2013-04-27	15:47	Unidentified baleen whale	1	36.28393°N 033.91380°W	Full volume	PV/OD	BV	2000 / Full volume	None	
27	2013-04-28	10:29	Unidentifiable baleen whale	2	36.31683°N 033.73583°W	Full volume	PE/AH	BV	845 / Full volume	Power-down	Whale surfaced inside 180dB EZ of full source. Whale was observed leaving mitigation zone and full volume resumed

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
28	2013-04-28	11:39	Fin whale	4	36.27033°N 033.79983°W	Full volume	PV/OD	BV	1535 / Full volume	None	
29	2013-04-28	18:15	Unidentified large whale	1	35.94233°N 034.18567°W	Full volume	PV/OD	BV	1089 / Full volume	Power-down	Whale surfaced inside 180dB EZ of full source. Whale was not observed leaving EZ; 30 mins after last sighting inside EZ, full volume resumed
30	2013-04-29	08:24	Fin whale	2	36.21150°N 033.74717°W	Full volume	PV/OD	BV	1070 / Full volume	Power-down	Whales surfaced inside EZ of full source. Both were observed leaving EZ; full volume resumed
31	2013-04-29	11:26	Loggerhead sea turtle	1	36.06215°N 033.95238°W	Full volume	PV/OD	NS	530 / Full volume	Power-down	Juvenile turtle; Observed inside 180dB zone of full source. Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots)
32	2013-04-29	18:21	Loggerhead sea turtle	1	36.05650°N 033.89313°W	Full volume	PV/OD	FL	10 / Not active	Shut-down	Juvenile turtle; Inside EZ of single gun; single gun enabled when turtle was calculated to be outside EZ and full volume resumed when turtle was outside full source EZ
33	2013-04-29	20:03	Fin whale	4	36.13350°N 033.78783°W	Full volume	PE/AH	BV	990 / Mitigation firing	Power-down	Two separate pairs of whales entered EZ, one pair observed leaving EZ but other pair was not seen leaving; 30 mins following last sighting inside EZ, full volume resumed
34	2013-04-30	07:45	Unidentifiable baleen whale	1	36.42350°N 033.77400°W	Full volume	UN	BV	6000 / Full volume	None	
35	2013-04-30	08:49	Unidentifiable baleen whale	3	36.36483°N 033.70850°W	Full volume	AV	BV	1200 / Full volume	None	

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
36	2013-04-30	10:38	Loggerhead sea turtle	1	36.26200°N 033.59517°W	Full volume	AV	BA SBS	50 / Not active	Shut-down	Approaching EZ of single gun immediately after first sighting; single gun enabled when turtle was calculated to be outside EZ and full volume resumed when turtle was outside full source EZ
37	2013-04-30	11:57	Leatherback sea turtle	1	36.23817°N 033.67267°W	Full volume	TV	FS	1 / Not active	Power-down / Shut-down	Approaching EZ of single gun shortly after first sighted; single gun enabled when turtle was calculated to be outside EZ and full volume resumed when turtle was outside full source EZ .Appeared to have been struck by sources as it swam perpendicularly towards vessel, crossing between stern of vessel and sources
38	2013-04-30	12:49	Loggerhead sea turtle	1	36.29067°N 033.73117°W	Full volume	PV/SD	FL DI	90 / Not active	Power-down / Shut-down	Approaching EZ of single gun shortly after first sighted; single gun enabled when turtle was calculated to be outside EZ and full volume resumed when turtle was outside full source EZ
39	2013-04-30	12:46	Unidentified whale	1	36.33967°N 033.78633°W	Full volume	UN	BV	2100 / Full volume	None	
40	2013-04-30	15:50	Fin whale	4	36.39360°N 033.92605°W	Full volume	PV/OD	BV DI	1535 / Full volume	None	
41	2013-04-30	19:57	Loggerhead sea turtle	1	36.16100°N 033.71667°W	Full volume	PV/SD	FL DI	400 / Full volume	Power-down	Observed inside 180dB zone of full source .Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots)

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
42	2013-04-30	20:28	Fin whale	1	36.13717°N 033.74900°W	Full volume	PV/OD	BV DI	845 / Mitigation firing	Power-down	Whale surfaced inside 180dB EZ. Full volume resumed when whale was observed exiting EZ.
43	2013-05-01	09:07	Loggerhead sea turtle	1	36.20533°N 034.08567°W	Full volume	PV/OD	NS	230 / Mitigation firing	Power-down	Observed inside 180dB zone of full source .Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots)
44	2013-05-01	09:24	Loggerhead sea turtle	1	36.22167°N 034.10367°W	Full volume	AV	NS	200 / Mitigation firing	Power-down	Observed inside 180dB zone of full source .Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots)
45	2013-05-01	09:41	Loggerhead sea turtle	1	36.23733°N 034.12133°W	Full volume	PV/OD	FL	250 / Full volume	Power-down	Observed inside 180dB zone of full source .Full volume resumed after 8 mins when turtle was calculated to be outside EZ (vessel speed 4.5 knots)
46	2013-05-01	09:46	Loggerhead sea turtle	1	36.24117°N 034.13167°W	Mitigation firing	PV/SD	NS	20 / Not active	Shut-down	Observed while source was already powered-down for previous turtle sighting (#46). Source shut down for two mins while turtle was inside EZ of single gun
47	2013-05-02	10:04	Unidentified large whale	1	36.35033°N 033.89250°W	Silent	CR/AH	BV	4000 / Not active	None	Observed during OBS retrieval
48	2013-05-02	10:47	Unidentified large whale	1	36.38533°N 033.84217°W	Silent	PV/OD	BV	4096 / Not active	None	Observed during OBS retrieval
49	2013-05-02	11:10	Loggerhead sea turtle	1	36.38967°N 033.83383°W	Silent	PV/OD	NS	30 / Not active	None	Observed during OBS retrieval
50	2013-05-02	12:05	Fin whale	1	36.40000°N 033.83283°W	Silent	PV/OD	BV	1000 / Not active	None	Observed during OBS retrieval

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
51	2013-05-02	13:16	Unidentifiable baleen whale	2	36.42997°N 033.78658°W	Silent	UK	BV	4000 / Not active	None	Observed during OBS retrieval
52	2013-05-02	14:53	Unidentifiable baleen whale	1	36.43885°N 033.67102°W	Silent	UK	BV FF	6000 / Not active	None	Observed during OBS retrieval
53	2013-05-02	16:12	Fin whale	2	36.43033°N 033.65967°W	Silent	PE/AH	BV	800 / Not active	None	Observed during OBS retrieval
54	2013-05-03	07:48	Unidentifiable baleen whale	3	36.10783°N 033.88667°W	Silent	UK	BV	4000 / Not active	None	Observed during OBS retrieval
55	2013-05-03	09:33	Unidentified large whale	1	36.06583°N 033.94450°W	Silent	UK	BV	3500 / Not active	None	Observed during OBS retrieval
56	2013-05-03	11:43	Fin whale	2	35.98205°N 034.06060°W	Silent	UK	BV	4096 / Not active	None	Observed during OBS retrieval
57	2013-05-03	13:36	Unidentified large whale	2	36.02533°N 034.11567°W	Silent	UK	BV	4096 / Not active	None	Observed during OBS retrieval
58	2013-05-03	14:47	Unidentified large whale	2	36.06750°N 034.15717°W	Silent	UK	BV	6000 / Not active	None	Observed during OBS retrieval
59	2013-05-03	16:28	Unidentified large whale	2	36.12762°N 034.09018°W	Silent	AV	BV	1535 / Not active	None	Observed during OBS retrieval
60	2013-05-03	17:06	Unidentified large whale	2	36.21333°N 033.98833°W	Silent	PV/OD	BV	2600 / Not active	None	Observed during OBS retrieval
61	2013-05-03	17:27	Fin whale	6	36.23933°N 033.95868°W	Silent	PV/OD	BV DI FF	445 / Not active	None	Observed during OBS retrieval Many animals all around vessel, changing directions many times, appeared to be feeding
62	2013-05-04	14:42	Unidentified large whale	1	36.04267°N 034.15983°W	Full volume	UK	BV	5859 / Full volume	None	

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
63	2013-05-04	15:22	Unidentified large whale	1	36.07950°N 034.10933°W	Full volume	PV/OD	BV	1932 / Full volume	None	
64	2013-05-04	16:08	Unidentified large whale	1	36.12042°N 034.05405°W	Full volume	PV/OD	BV	2000 /Full volume	None	
65	2013-05-04	16:31	Unidentified large whale	1	36.14407°N 034.02102°W	Full volume	UK	BV	4096 / Full volume	None	
66	2013-05-04	17:15	Blue whale	1	36.17983°N 033.97200°W	Full volume	PV/OD	BV	75 / Not active	Power-down / Shut-down	Source powered down when whale entered full volume EZ then shut-down when whale entered single gun EZ. Single gun re-enabled when whale left small EZ and full source resumed when whale was observed leaving full volume EZ
4-A	2013-05-05	02:03	Unidentifiable dolphin	-	36.39847°N 033.76677°W	Full volume	-	-	Undetermined / Full volume	None	Night time detection. HF Clicks.
67	2013-05-05	10:28	Unidentifiable dolphin	8	35.93100°N 034.41483°W	Not active	TV	FS SBS	400 /Not active	Delayed ramp-up	Ramp-up delayed for dolphins inside 180dB EZ. Ramp-up began when dolphins observed exiting EZ.
68	2013-05-05	12:19	Unidentified large whale	5	35.91067°N 034.29917°W	Full volume	UK	BV SA	1932 / Full volume	None	
69	2013-05-05	15:30	Unidentified large whale	1	36.08233°N 034.06733°W	Full volume	UK	BV	4000 / Full volume	None	
70	2013-05-05	18:29	Unidentified large whale	1	36.23540°N 033.85980°W	Full volume	PV/OD	BV	4096 / Full volume	None	

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
71	2013-05-06	07:27	Common dolphin	40	36.09493°N 034.15558°W	Full volume	TV	NS SA	320 / Mitigation firing	Power-down	Power-down for dolphins detected already inside 180dB. Resume full volume when observed exiting EZ
72	2013-05-06	09:09	Loggerhead sea turtle	1	36.02800°N 034.24867°W	Full volume	PV/S D	NS DI	230 / Mitigation firing	Power-down	Power-down for turtle detected inside 180dB EZ. Resume full volume using vessel speed to calculate time required for turtle to clear EZ.
73	2013-05-06	09:38	Loggerhead sea turtle	1	36.00333°N 034.27950°W	Full Volume	AV	FL SBS	100 / Not active	Shut-Down	Shut-down for turtle detected inside 180dB EZ. Resume full volume using vessel speed to calculate time required for turtle to clear EZ.
74	2013-05-06	10:12	Unidentified large whale	1	35.96817°N 034.26317°W	Full Volume	PV/O D	BV	4096 /Full volume	None	
75	2013-05-06	11:00	Blue whale	1	35.96352°N 034.19460°W	Full Volume	PV/O D	BV DI	845 / Mitigation firing	Power-down	Blue whale observed outside EZ then surfaced inside EZ, source powered down. Resume full volume when whale observed exiting EZ.
76	2013-05-06	12:13	Blue whale	1	36.02950°N 034.10550°W	Full Volume	PE/A H	BV DI SA	580 / Mitigation firing	Power-down	Blue whale observed outside EZ then surfaced inside EZ, source powered down. Resume full volume when whale observed exiting EZ.
77	2013-05-06	13:34	Unidentifiable dolphin	5	36.09100°N 034.02267°W	Full Volume	PV/O D	PO	4096 /Full volume	None	
78	2013-05-06	15:35	Unidentifiable dolphin	10	36.17753°N 033.90583°W	Full Volume	PE/A H	PO	1932 /Full volume	None	

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
79	2013-05-06	15:47	Loggerhead sea turtle	1	36.18548°N 033.89500°W	Full Volume	PV/SD	FL	250 / Mitigation firing	Power-down	Power-down for turtle detected inside 180dB EZ. Resume full volume using vessel speed to calculate time required for turtle to clear EZ.
5-A	2013-05-07	03:55	Unidentifiable dolphin	-	36.21347°N 033.95863°W	Full volume	-	-	Undetermined /Full volume	None	Night time detection. Whistles.
6-A	2013-05-07	06:49	Unidentifiable dolphin	-	36.06577°N 034.16267°W	Full volume	-	-	Undetermined /Full volume	None	Night time detection. HF Clicks
80	2013-05-07	07:44	Common dolphin	10	36.02333°N 034.22150°W	Full Volume	UK	SA SBS	2800 /Full volume	None	
81	2013-05-07	08:30	Unidentifiable Cheloniid sp	1	35.98629°N 034.26628°W	Full Volume	AV	DI	250 / Mitigation firing	Power-down	Power-down for turtle detected inside 180dB EZ. Resume full volume using vessel speed to calculate time required for turtle to clear EZ.
82	2013-05-07	10:04	Unidentified large whale	1	35.96267°N 034.16300°W	Full Volume	UK	BV	2614 /Full volume	None	
83	2013-05-07	10:25	Unidentified large whale	1	35.98117°N 034.13800°W	Full volume	PV/OD	BV	1535 /Full volume	None	
84	2013-05-07	19:46	Blue whale	1	36.39650°N 033.57433°W	Full volume	PV/SD	BV DI	400 / Mitigation firing	Power-down	Blue whale observed outside EZ at 1500m then surfaced inside EZ, source powered down. Resume full volume when whale observed exiting EZ.
85	2013-05-08	07:41	Unidentified large whale	1	36.26833°N 034.13733°W	Full volume	UK	BV	3300 /Full volume	None	

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
86	2013-05-08	19:06	Loggerhead sea turtle	1	36.22633°N 033.93783°W	Full volume	PV/OD	NS	50 / Not active	Power-down / Shut-down	Power-down the shut-down for turtle detected inside 180dB EZ. Resume full volume using vessel speed to calculate time required for turtle to clear EZ.
87	2013-05-09	09:39	Loggerhead sea turtle	1	36.26000°N 034.06117°W	Full volume	PV/OD	NS	230 / Mitigation firing	Power-down	Power-down for turtle detected inside 180dB EZ. Resume full volume using vessel speed to calculate time required for turtle to clear EZ.
88	2013-05-09	16:24	Loggerhead sea turtle	1	36.31305°N 033.99957°W	Full volume	PV/OD	FL	175 / Mitigation firing	Power-down	Power-down for turtle detected inside 180dB EZ. Resume full volume using vessel speed to calculate time required for turtle to clear EZ.
89 7-A	2013-05-09	18:18 18:00	Common dolphin	2	36.22230°N 033.88137°W	Full volume	TV PE/AH	NS	280 / Mitigation firing	Power-down	Correlated visual sighting and acoustic detection. Whistles detected first followed by visual sighting of dolphins on bow. Power-down implemented. Last sighting at 18:20, last acoustic detection at 18:23. Full volume resumed 15 mins from last sighting.
90	2013-05-10	09:13	Loggerhead sea turtle	1	36.20500°N 033.83890°W	Full volume	PV/SD	FL SBS DI	50 / Not active	Power-down / Shut-down	Power-down the shut-down for turtle detected inside 180dB EZ. Resume full volume using vessel speed to calculate time required for turtle to clear EZ.
8-A	2013-05-10	22:00	Unidentifiable dolphin	-	36.26875°N 033.89567°W	Full volume	-	-	Undetermined / Full volume	None	Night time detection. HF Clicks and whistles.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
9-A	2013-05-11	18:02	Unidentifiable dolphin	-	36.10383°N 033.63600°W	Full volume	-	-	Undetermined /Full volume	None	Day time detection, no visual sighting. HF Clicks.
10-A	2013-05-12	19:18	Unidentified dolphins	-	36.31558°N 033.99312°W	Full volume	-	-	Undetermined /Full volume	None	Day time detection. No visual sighting by PSOs
11-A	2013-05-12	22:55	Unidentified dolphins	-	36.15988°N 033.81212°W	Full volume	-	-	Undetermined /Full volume	None	Night time detection. HF Clicks
12-A	2013-05-12	23:40	Unidentified dolphins	-	36.12710°N 033.77520°W	Full volume	-	-	Undetermined /Full volume	None	Night time detection. HF Clicks
91	2013-05-14	16:34	Fin whale	1	36.18542°N 033.90013°W	Not active	PV/OD CR/BH	BV FT	700 / Not active	None	Observed while retrieving OBSs
92	2013-05-14	18:06	Fin whale	2	36.18480°N 033.91457°W	Not active	CR/AH CR/BH	BV	1000 / Not active	None	Observed while retrieving OBSs
93	2013-05-16	07:19	Common dolphins	8	36.46767°N 033.90783°W	Not active	V	SA FT NS	10 / Not active	None	Observed during multi-beam survey
94	2013-05-16	09:13	Common dolphins	14	36.57783°N 033.80367°W	Not active	V	SA FT NS	100 / Not active	None	Observed during multi-beam survey
95	2013-05-16	11:38	Loggerhead sea turtle	1	36.38633°N 034.12200°W	Not active	PV/OD	FL NS	60 / Not active	None	Observed during multi-beam survey
96	2013-05-16	18:21	Loggerhead sea turtle	1	36.48617°N 034.05817°W	Not active	AV	NS	10 / Not active	None	Observed during multi-beam survey
97	2013-05-17	12:29	Common dolphins	12	36.18910°N 033.48453°W	Not active	TV	BR	10 / Not active	None	Observed during multi-beam survey
98	2013-05-17	18:36	Fin whale	1	36.62000°N 033.16900°W	Not active	TV PV/SD	FF FT BV	700 / Not active	None	Observed while in transit to Azores

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
99	2013-05-18	08:45	Common dolphins	3	37.04482°N 030.22212°W	Not active	TV V	SA NS	10 / Not active	None	Observed while in transit to Azores
100	2013-05-18	09:13	Unidentified whale	1	37.05850°N 030.12650°W	Not active	UK	BV	20 / Not active	None	Observed while in transit to Azores
101	2013-05-18	09:39	Loggerhead turtle	1	37.07183°N 030.03333°W	Not active	PV/SD	NS	700 / Not active	None	Observed while in transit to Azores
102	2013-05-18	09:55	Common dolphins	10	37.08100°N 029.97050°W	Not active	PV/SD	SA BR FT	10 / Not active	None	Observed while in transit to Azores
103	2013-05-18	10:37	Common dolphins	5	37.10483°N 029.80400°W	Not active	TV	SA BR FT	10 / Not active	None	Observed while in transit to Azores
104	2013-05-18	11:57	Common dolphins	10	37.14318°N 029.53752°W	Not active	TV	SA FT BR	5 / Not active	None	Observed while in transit to Azores
105	2013-05-18	14:51	Common dolphins	15	37.23218°N 028.91722°W	Not active	TV	SA FT BR	5 / Not active	None	Observed while in transit to Azores

APPENDIX G: Species of birds observed during the Mid-Atlantic survey**Species of birds observed during the survey**

Common Name	Family	Genus	Species	Approximate Number of Individuals Observed	Approximate Number of Days Species Was Observed
Cory's shearwater	Procellariidae	<i>Calonectris</i>	<i>diomedea</i>	115	25
Sooty shearwater	Procellariidae	<i>Puffinus</i>	<i>griseus</i>	3	2
Pomarine jaeger	Stercorariidae	<i>Stercorarius</i>	<i>pomarinus</i>	7	7
Long-tailed jaeger	Stercorariidae	<i>Stercorarius</i>	<i>longicaudus</i>	1	1
Parasitic jaeger	Stercorariidae	<i>Stercorarius</i>	<i>parasiticus</i>	4	2
Arctic tern	Sternidae	<i>Sterna</i>	<i>paradisea</i>	2	1
Herring gull	Lariidae	<i>Larus</i>	<i>argentatus</i>	3	2
Yellow-legged gull	Laridae	<i>Larus</i>	<i>michahellis</i>	10	7
Peregrine falcon	Falconidae	<i>Falco</i>	<i>pergrinus</i>	1	1
Barn swallow	Hirundinidae	<i>Hirundo</i>	<i>rustica</i>	7	4
Red phalaropes	Scolopacidae	<i>Phalaropus</i>	<i>fulicaria</i>	3	1
Unidentified shearwater	Procellariidae	-	-	12	6
Unidentified tern	Sternidae	-	-	24	7
Unidentified gull	Lariidae	-	-	2	2
Unidentified storm petrel	Hydrobatidae	-	-	10	8
Unidentified jaeger	Stercorariidae	-	-	4	2