

Protected Species Observer Report

Prepared for: TerraSond

On behalf of Ørsted and Bay State Wind LLC

Bay State Wind LLC

BOEM Lease No.: OCS-A 0500

Massachusetts, U.S.A

26 October 2018 to
30 January 2019



Final Report

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Executive Summary

The report covers the protected species mitigation and monitoring efforts aboard the *Gerry Bordelon* vessel from 26 October 2018 through 30 January 2019. This is the final report for the Bay State Wind Offshore Wind APE Geophysical Survey, which was conducted within state and federal waters off the coast of New Bedford, Massachusetts, by Ørsted, the offshore engineering, procurement, and construction contractor for the project. High resolution bathymetry and geophysical survey data acquisition was conducted by TerraSond within the parameters defined in the Bay State Wind Offshore Wind Farm Geophysical Survey Plan. These survey parameters utilized a single survey vessel (M/V *Gerry Bordelon*) to complete data acquisition within export and inter-array cable construction corridors, wind turbine generator [WTG] foundation and installation areas, and the offshore substation [OSS] foundations and installation areas. Protected species monitoring was conducted in accordance with Bureau of Ocean Energy Management (BOEM) and National Marine Fisheries Service (NMFS) standards, as well as Geophysical Survey Plan Approval Conditions for Lease Outer Continental Shelf (OCS)-A 0500 and an Incidental Harassment Authorization (IHA) issued for the survey program.

The Survey was conducted using a towed magnetic gradiometer, a shallow-penetration Innomar sub-bottom profiler, a dual-head multi-beam echo sounder, towed sidescan sonar, and Ultra Short Baseline (USBL) sub-surface positioning sonar. Protected species mitigation measures, as specified in the IHA issued by NMFS, were required for all devices transmitting below frequencies of 200 kHz.

Four protected species observers (PSOs) and two Passive Acoustic Monitoring (PAM) Operators, provided by RPS, were on board the *Gerry Bordelon* to undertake visual and acoustic observations and implement mitigation protocols in accordance with Lease OCS-A 0500, IHA protected species mitigation protocols and Geophysical Survey Plan Approval Conditions for the Bay State Wind Survey. Mitigation protocols for this survey included establishment of exclusion zones (EZ) for marine mammals and other protected species including sea turtles and Atlantic sturgeon, visual and acoustic monitoring, and strike avoidance mitigation measures.

The high resolution geophysical (HRG) survey equipment was active for a total of 456 hours and 41 minutes over the course of the survey. Of total source activity, sources emitting frequencies of less than 200 kHz were active for a total of 282 hours.

Visual observations were conducted by PSOs for a total of 758 hours and 21 minutes. Acoustic monitoring by PAM operators was conducted for 190 hours and 46 minutes during darkness and periods of low visibility during the project.

There were a total of 76 detections of marine mammals made visually by PSOs and/or acoustically by PAM operators during the Survey. Visual detections of cetaceans consisted of common dolphins, humpback whales, minke whales, unidentified whales and unidentified delphinids. Acoustic detections consisted of common dolphins and unidentified delphinids. There were also visual sightings of a harbor seal and an unidentified seal. Descriptions of these detections can be found in Section 4.1 and Section 4.2.

In accordance with the IHA protected species mitigation protocols, stipulations set forth in BOEM Lease OCS-A 0500, and Geophysical Survey Plan Approval Conditions, a total of 27 mitigation actions were implemented including three delays to the initiation of source activities and 24 shut-downs of source operations. There were no potential non-compliance issues noted. Please see Section 5 for a detailed account of these mitigation actions.

NMFS issued an IHA authorizing potential Level B exposures for 8,534 marine mammals from 13 Species (seven dolphin species, four whale species, two seal species and the harbour porpoise) for the survey in its entirety.

During acoustic source operations, no marine mammals were observed within the predicted radius at which there is potential for auditory injury (based upon each species hearing range and how that overlaps with the frequencies produced by the sound source), constituting potential Level A exposure. A total of 182 marine mammals, all common dolphins, were observed within the predicted 160 decibel radius (where there is a potential for a behavioural response), constituting potential Level B exposures.

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1 Introduction

The following report details protected species monitoring and mitigation, as well as HRG survey operations, undertaken for Bay State Wind Offshore Wind Geophysical Survey and performed by TerraSond, using the vessel *Gerry Bordelon*. The survey area was within Lease No. Outer Continental Shelf (OCS-A 0500) offshore New Bedford, Massachusetts, USA, and the survey was conducted from 26 October 2018 through 30 January 2019.

The objective of this survey was to acquire data within export and inter-array cable construction corridors, wind turbine generator foundation and installation areas, and the offshore substation foundations and installation areas, building upon and infilling from three previous HRG reconnaissance surveys (2016-2017) for site characterization, export cable route, and Phase I Development Area.

This document serves to meet the reporting requirements dictated in the IHA issued to Bay State Wind LLC by NMFS on 24 July 2018. The IHA outlined authorized potential Level A and Level B sound exposures of specific marine mammals' incidental to the survey program. NMFS has stated that seismic source-received sound levels equal to or greater than 160 dB re 1 μ Pa (root mean square (rms)) could potentially disturb marine mammals, temporarily disrupting behavior, such that they could be considered non-lethal 'takes' (Level B harassment).

In July 2016, NMFS released new technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing, which established new thresholds for permanent threshold shift (PTS) onset or Level A harassment (auditory injury) for marine mammal species. Predicted distances to Level A harassment vary based on marine mammal hearing groups – low frequency cetaceans, mid frequency cetaceans, high frequency cetaceans, phocid pinnipeds and otariid pinnipeds – and how each group's hearing range overlaps with the frequencies produced by the sound source. For sea turtles, per the Endangered Species Act (ESA), NMFS has stated that received sound levels equal to or greater than 175 dB re 1 μ Pa rms represents the current best understanding of the threshold at which they exhibit behavioral responses, and that received sound levels equal to or greater than 195 dB re 1 μ Pa rms represents the current best understanding of the threshold at which they experience PTS.

NMFS requires that provisions such as exclusion zones (EZ), delayed operations, ramp-ups, power-downs and shut-downs be implemented to mitigate for potentially adverse effects of the acoustic source sounds on protected species.

1.1 Project Overview and Location

The *Gerry Bordelon* began data acquisition for the survey on 26 October 2018. Over the course of the survey, the *Gerry Bordelon* returned to port in New Bedford, Massachusetts, on several occasions, each of which are documented in Section 3.1.1 of this report. The survey was suspended on 30 January 2019, at which time the vessel was at port in New Bedford, MA.

The survey areas were located between one and 85 kilometers east of New Bedford, Massachusetts, with export cable routes in approximately one to 55 meters of water. The survey consisted of 1110 survey lines in five survey lots, which were acquired primarily in a West to East direction (Figure 1). Two export cable routes were surveyed with each route split into two lots reflecting the border between Federal and Massachusetts state waters; export corridor survey widths were 500m (Lots 1 and 5) and 1,000m (Lots 2

and 4) in state and federal waters, respectively. Lot 1 and Lot 2 contained the export cable route to Somerset, MA, with a total survey trackline length of approximately 1,650 kilometers. Lot 4 and Lot 5 contained the export cable route to Falmouth, MA, with a total survey trackline length of approximately 2,360 kilometers. Lot 3 contained the Phase 1 Development Area with a total survey trackline length of 2,845 kilometers; surveys were conducted within a 200-meter radius of the planned locations for OSS, within a 150-meter radius of the planned locations for the WTGs, and within a 75-meter radius of planned locations for inter-array cable segments. Survey activities in Lots 1 and 5 were to be conducted using daytime operations only, whereas survey activities in Lots 2, 3, and 4 were to be conducted on a 24-hour basis.

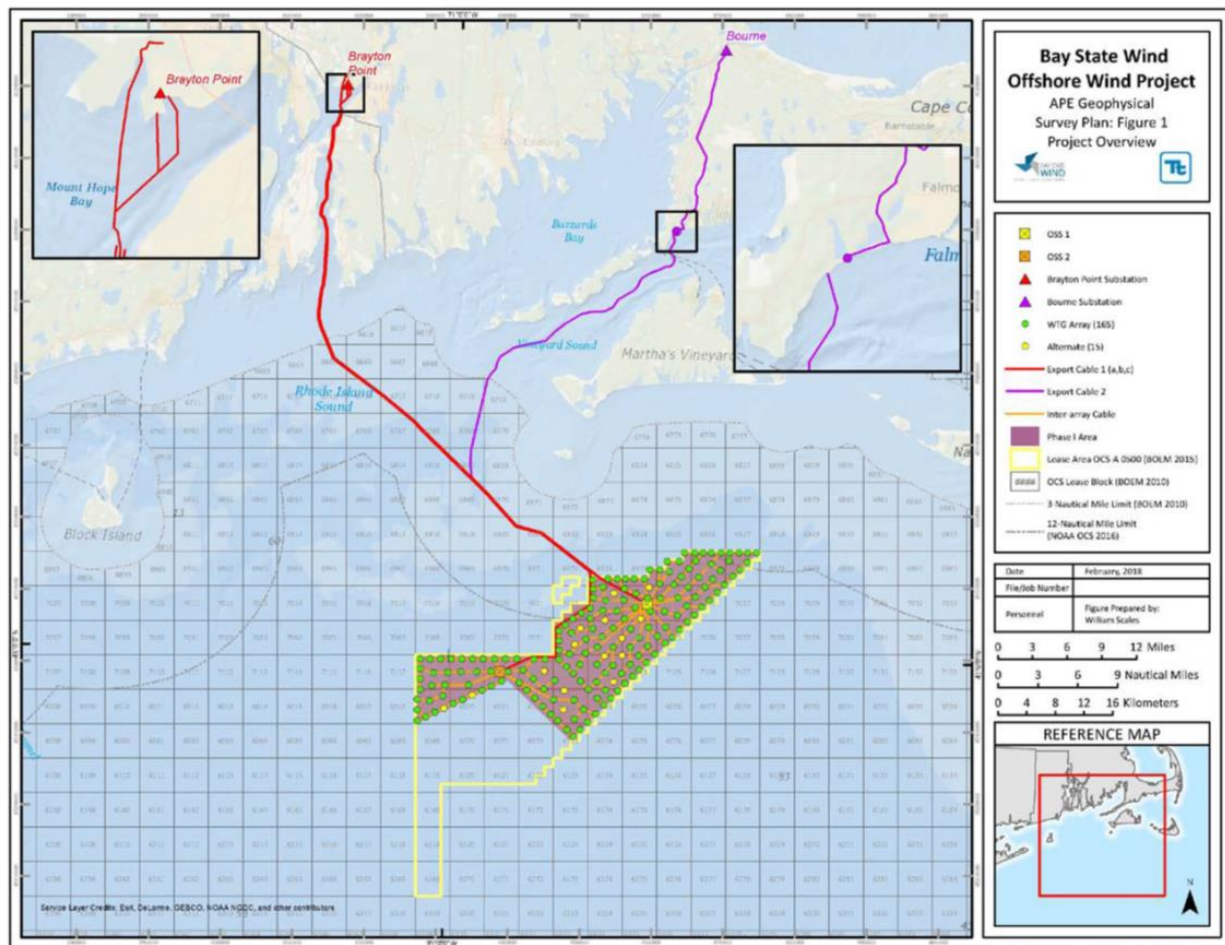


Figure 1: General location of the Bay State Wind survey and survey blocks

1.2 Vessel and Energy Sources Specifications

All HRG survey operations were conducted solely from the *Gerry Bordelon* (Figure 2). The *Gerry Bordelon* measures 51.8 meters in length with a beam of 11 meters. The *Gerry Bordelon*'s cruising speed was less than 10 knots during transits and varied between three to five knots during the surveys. Survey data acquisition was conducted between 26 October 2018 and 30 January 2019.



Figure 2: The survey vessel *Gerry Bordelon*

The vessel was outfitted with an A-frame on the stern of the vessel to assist in survey equipment deployment. The A-frame was situated on the back deck and utilized for towing the side-scan and the magnetometer. The survey equipment consisted of a differential GNSS positioning system, a dual-head multibeam echosounder (MBES), an Innomar medium parametric sub-bottom profiler (SBP), and ultra-short baseline (USBL) sub-surface positioning sonar. In addition to these vessel mounted components, a dual-frequency sidescan sonar (SSS), and four cesium-vapor magnetometers (MAGs) were deployed from the stern of the vessel. Both of these towed systems were equipped with an altimeter and depth sensor. An overview of the towing configuration of the survey equipment is provided in Figure 3. The operating frequencies of the survey equipment are summarized in Table 1.

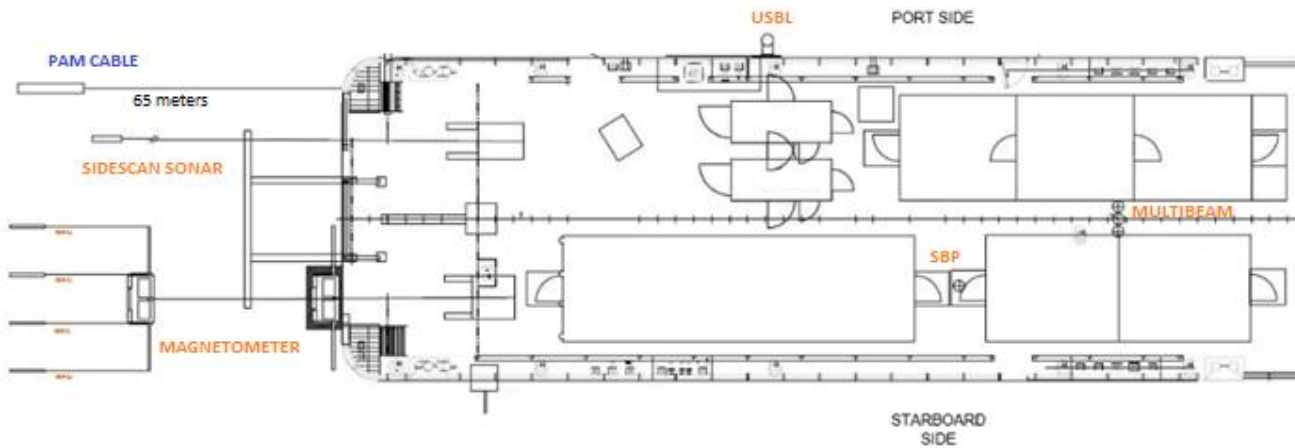


Figure 3: Bird's eye view of the *Gerry Bordelon* with towing gear location

Table 1: Acquisition Parameters Summary Table

General Specifications	
General Location:	1 to 85 kilometers east of New Bedford, Massachusetts
Prospect Size (km ²):	514
Survey Blocks	5
Survey Lines	1110
Vessel / Vessel Length (m):	<i>Gerry Bordelon</i> / 51.8 meters
Energy Source Specifications (frequency range)	
Multibeam	170-450 kHz
Sidescan sonar	400 / 900 kHz
Sub-bottom profiler	0-22 kHz
USBL	200-2500 Hz
Magnetometer	500 kHz

2 Mitigation and Monitoring Methods

The PSO monitoring program on the *Gerry Bordelon* was established to meet the standards approved by BOEM in the Geophysical Survey Plan as well as the IHA issued by NMFS. Survey mitigation measures were designed to minimize potential impacts of the survey activities on marine mammals, sea turtles, and other protected species of interest. The following monitoring protocols were implemented to meet these objectives.

- Visual observations were conducted day and night to provide real-time sighting data, allowing for the implementation of mitigation procedures as necessary.
- A PAM system was operated continuously during periods of reduced visibility to augment visual observations and provide additional marine mammal detection data.
- Effects of marine mammals and sea turtles exposed to sound levels constituting a potential “take” were observed and documented. The nature of the probable consequences was discussed when possible.

In addition to the mitigation objectives outlined in the above-referenced documents, PSOs collected and analyzed necessary data mandated by the IHA (see Appendix A).

2.1 Mitigation Methodology

Mitigation actions were implemented for visual and acoustic detections of protected species, including marine mammals and sea turtles as outlined in the Geophysical Survey Plan and the IHA, including:

- Establishment of Exclusion Zones around energy sources with operating frequencies below 200 kHz
 - 500-meter exclusion zone (EZ) for North Atlantic right whales.
 - 135-meter EZ for all marine mammal species for which no Level B potential exposure allowances were permitted in the project IHA.
 - 100-meter EZ was implemented for Endangered Species Act (ESA) listed animals.
 - 75-meter EZ was used for harbor porpoise.
 - 50-meter EZ was implemented for sea turtles.
 - 5-meter EZ was used for all other marine mammal species with Level B potential exposure allowances in the project IHA.
- Search periods of 60 minutes conducted visually (daytime) or visually and acoustically (all periods of reduced visibility, including night) prior to the initiation of the sound sources from silence
- Delays to the initiation of the sound sources if marine mammals or sea turtles were detected inside their respective exclusion zones during the search period prior to the initiation of the source
- Shut-down of the active source upon detection of marine mammals or sea turtles inside their respective exclusion zones while a sound source with an operating frequency below 200 kHz was active and a subsequent search period of the exclusion zones
- Once the sound source had been shut down for a protected species detection, operations would not resume until a specific time had passed following the last detection of the animal(s) or once the animal had exited the EZ: 15 minutes for small delphinoid cetaceans and pinnipeds, 30 minutes for non-delphinoid cetaceans, 30 minutes for North Atlantic right whales, and 60 minutes for sea turtles.

2.2 Visual Monitoring Survey Methodology

There were six trained and experienced PSOs on board the *Gerry Bordelon* during the program to conduct the monitoring for protected species, record and report detections, and request mitigation actions in accordance with the IHA and Geophysical Survey Plan Approval Conditions. The PSOs on board were NMFS approved and held certifications from an accepted BOEM PSO course. Visual monitoring was primarily carried out from the bridge wings of the *Gerry Bordelon* located approximately eight meters above the surface of the water, which allowed a 360-degree viewpoint around the vessel and acoustic sources.

The PSOs were equipped with 7x50 reticle binoculars, as well as two mounted 25x50 Big-eye binoculars and DSLR cameras (Nikon and Canon) with 200mm and 300mm zoom lens to aid in visual monitoring watches conducted during the day. Reticle binoculars were calibrated weekly to ensure accuracy of distance data. Tables of the reticle calibrations can be found in Appendix B.

At night, PSOs were equipped with infrared LED handheld spotlights and night vision goggles with head mounts and thermal clip-ons. Specifications for the night monitoring equipment can be found in Appendix C.

A monitor inside the bridge displayed current information about the vessel (e.g. position, speed, heading, etc.), sea conditions (e.g. water depth, sea temperature, etc.), weather (e.g. wind speed and direction, air temperature, etc.), and source activity (e.g. survey line number, total number of active elements, volume, etc.). Environmental conditions, along with vessel and acoustic source activity, were recorded at least once an hour, or every time there was a change of one or more of the variables.

Most observations were held from the bridge wings such that the exclusion zones around the sound sources and the strike avoidance exclusion zone could be simultaneously monitored; however, during severe weather or during transits when the sound sources were not active, observations of the vessel strike avoidance zone could be conducted from the bridge.

Visual monitoring methods were implemented in accordance with the survey requirements outlined in the IHA and Geophysical Survey Plan Approval Conditions. One PSO visually monitored for protected species always during daylight hours and two PSOs visually monitored during all periods of reduced visibility throughout the survey, from the moment the vessel departed the dock at the beginning of the survey until the vessel returned to dock at the end of the survey, regardless of acoustic source activity. Visual monitoring during periods of acoustic source silence were conducted to gather baseline data on the presence and abundance of protected species in the areas.

A visual monitoring schedule was established by the PSOs where each person completed visual watches of varying lengths throughout the day. Scheduled watches were no more than four hours in duration and were each followed by at least two hours of scheduled break time.

Visual observations were conducted around the entire area of the vessel and acoustic sources. PSOs searched for blows, fins, splashes or disturbances of the sea surface, large flocks of feeding sea birds, and other sighting cues indicating the possible presence of a protected species. Upon the visual detection of a protected species, PSOs would first identify the animals' range to the vessel and acoustic source. Range estimations were made using reticle binoculars, the naked eye, and by relating the animal(s) to an object at a known distance. PSOs would also identify the animals' species, if possible upon initial detection, to ensure that the proper mitigation measures were implemented, should any be required.

PSOs recorded the following information for each protected species detection:

- I. Date, time of first and last sighting, observers on duty during the detection, location of the observers, vessel information (e.g. position, speed, heading), water depth, acoustic source activity (e.g. volume and number of active elements), and environmental conditions (e.g. Beaufort sea state, wind force, swell height, visibility and glare).
- II. Species, detection cue, group size (including number of adults and juveniles), visual description (e.g. overall size, shape of the head, position and shape of the dorsal fin, shape of the flukes, height and direction of the blow), observed behaviors (e.g. porpoising, logging, diving, etc.), and the initial and final pace, heading, bearing, and direction of travel in relation to both the vessel and the source (e.g. towards, away, parallel, perpendicular, etc.).
- III. Initial and final distance to the vessel and the source, time and distance of the closest distance to the source, time when entering and exiting the exclusion zones, type of mitigation action implemented, total time of the mitigation action and any production loss, description of other vessels in the area, and any avoidance maneuvers conducted.

During or immediately after each sighting event, the PSOs recorded the detection details per the requirements of the IHA and Geophysical Survey Plan Approval Conditions in a provided detection datasheet. Each sighting event was linked to an entry on an effort datasheet where specific environmental conditions and vessel activity were logged.

Species identifications were made whenever the distance of the animal(s), length of the sighting, and visual observation conditions allowed. Whenever possible during detections, photographs were taken with Canon and Nikon SLR cameras that had 200 and 300-millimeter telephoto lenses. Marine mammal identification manuals were consulted, and photos were examined during observation breaks to confirm identifications.

2.3 Passive Acoustic Monitoring Survey Methodology

Passive Acoustic Monitoring (PAM) was used to augment visual monitoring efforts in the detection, identification, and locating of marine mammals. PAM was particularly beneficial during periods of darkness or low visibility when visual monitoring was not as effective. Acoustic monitoring was conducted continuously during all survey operations and to the maximum extent possible during periods of acoustic source silence. When the acoustic source was activated following any period of silence, acoustic monitoring and visual monitoring were conducted for 60 minutes prior to the activation of the sound source.

Acoustic monitoring was undertaken by trained PAM Operators each of whom had completed a BOEM accepted PSO training course and an RPS in-house PAM training course, which includes use of the PAM systems on board a vessel offshore. PAM monitoring shifts were no longer than four hours in duration followed by at least a one-hour break.

The PAM system was in the main survey lab, which provided space for the system, allow for quick communication with the visual PSOs and survey technicians, and provided access to the vessel's instrumentation screens. Information about the vessel (e.g. position, heading, and speed), water depth, source activity (e.g. line number, total volume, number of active elements), and the PAM system (e.g. cable deployments/retrievals, changes to the system, background noise score) were recorded at least once an hour, or whenever any of the parameters changed.

Acoustic monitoring for marine mammals was conducted aurally, utilizing Sennheiser headphones, and visually with the *Pamguard* software program. Low to mid-frequency delphinid whistles, clicks, and burst pulses, as well as sperm whale clicks and baleen whale vocalizations, could be visualized in *Pamguard*'s spectrogram modules. Sperm whale, beaked whale, Kogia species, and delphinid clicks could also be visualized in low and high frequency click detector modules. Settings adjustments to amplitude range, amplitude triggers, and spectral content filters, among others, could be made in *Pamguard*'s spectrogram and click detector modules to maximize the distinction between cetacean vocalizations and ambient signal. The map module within *Pamguard* could be utilized to attempt localizing the position and range of vocalizing marine mammals. Sound recordings could be made using the high and low frequency sound recording modules when potential marine mammal vocalizations were detected, or when the operator noted unknown or unusual sound sources.

PAM operators recorded the following information during acoustic detections of protected species:

- I. Date, time of first and last detection, operator on duty, if the detection was linked to a visual sighting, vessel information (e.g. position, speed, heading), water depth, and acoustic source activity (e.g. volume and number of active elements).
- II. Species (if determinable), group size, methods/modules on which vocalizations were detected during the event, and vocalization characteristics (e.g. signal type, frequency and amplitude range, inter-click interval, patterns, etc.)
- III. Determinable bearings (to the hydrophones, vessel and source), estimated and/or attempted localizations and any ranges determined, type and time of any implemented mitigation actions and any resulting production loss.

2.3.1 Passive Acoustic Monitoring Parameters

A passive acoustic monitoring system designed to detect most species of marine mammals was installed on board the *Gerry Bordelon*. The system was developed by *Seiche Measurements Limited* and consisted of the following main components: a 250 meter hydrophone cable (configured as a separate 230 meter steel-reinforced tow cable and detachable 20 meter hydrophone array); a 100 meter deck cable; a rack-mounted electronic processing unit (EPU) that incorporated a buffer unit, a RME Fireface 800 unit, and a computer; two desktop monitors; acoustic analysis software package; and headphones for aural monitoring. A spare hydrophone cable, deck cable, rack-mounted DPU and computer, monitors, and headphones were also present on board in the event the main system components became damaged or inoperable. The diagram in Figure 4 is a simplified depiction of the PAM system installed on the *Gerry Bordelon*. Further PAM system specifications can be found in Appendix D.

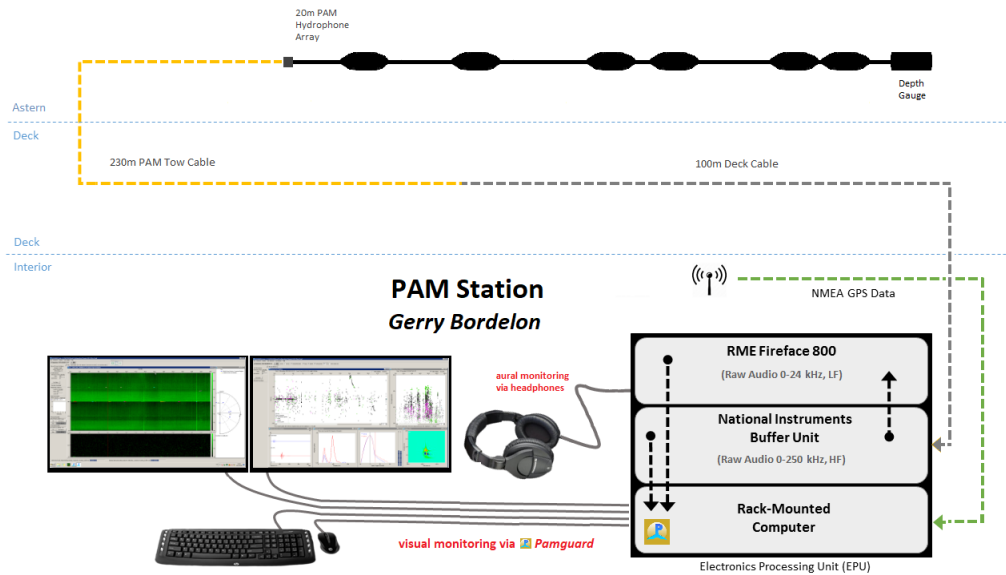


Figure 4: Simplified pathway of data through the PAM system on board the Gerry Bordelon.

The 20-meter linear hydrophone array attachment cable contained six individual hydrophone elements spaced eight meters, two meters and 0.25 meters apart, as well as a depth transducer (Figure 5). The forward hydrophone pair (H1, H2) was used to analyze and record low frequencies (10 – 24,000 Hz); the middle hydrophone pair (H3, H4) was used to analyze and record middle frequencies (200 – 200,000 Hz), and the trailing hydrophone pair (H5, H6) was used to analyze and record high frequency sound (2,000 – 200,000 Hz). The hydrophone array cable was attached to the 230-meter heavy-duty tow cable and manually deployed from the port-side on the back deck. The connector end of the tow cable was attached to the 100-meter deck cable located on sheltered section at the port stern of the vessel. The deck cable was secured with cable ties to hand rails that led it from port to starboard side of the vessel and into the instrument room, where the PAM station was located.

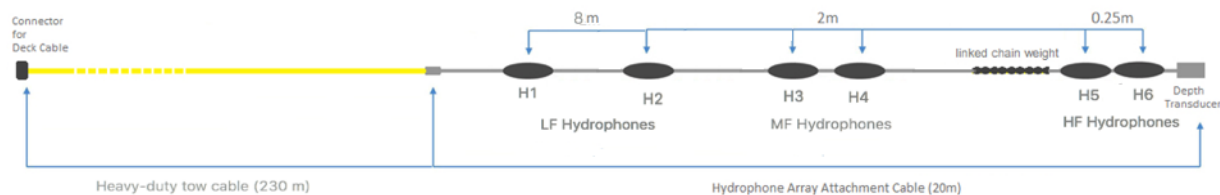


Figure 5: Diagram of hydrophone element separation and location of added weight on 250m hydrophone cable.

The deck cable interfaced between the hydrophone cable installed on the back deck of the vessel and the electronics processing unit (EPU) located in the main survey lab. The rack-mounted EPU was set up with the two pre-installed, wall-mounted monitors, keyboard, mouse and headphones. The EPU contained a buffer unit with Universal Serial Base (USB) output, an RME Fireface 800 ADC unit with firewire output, and a rack-mounted computer. A Global Positioning System (GPS) feed of GNGGA strings was supplied from the ship's navigation system and routed to the computer, reading data every 20 seconds. Data from

the hydrophone cable's depth transducer was routed through the buffer unit to the computer, via USB connection. *Pamguard Beta* versions 1.15.11 and 1.15.13 were the software versions utilized for monitoring during the survey.

Raw feed from hydrophone elements H5 and H6 was digitized in the buffer unit using an analogue-digital National Instruments data acquisition (DAQ) soundcard at a sampling rate of 500 kilohertz. The output was filtered for high frequency (HF) content and visualized using the *Pamguard* software. A sixth order Butterworth high-pass digital pre-filter of 30 kilohertz and a high-pass trigger filter of 40 kilohertz were applied. *Pamguard* used the difference between the time that a signal arrived at each of the two hydrophones to calculate and display the bearing to the source of the signal. A scrolling bearing/time module displayed the filtered data in real time, allowing for the detection and directional mapping of click trains. Additional components of the HF click detector system in *Pamguard* were an amplitude/time display that registered click intensity data in real time, as well as click waveform, click spectrum, and Wigner plot displays, providing the PAM operator immediate review of individual click characteristics in the identification process. One of the two monitors were designated for displaying *Pamguard* HF click detector and sound recorder modules.

Raw feed from the MF and LF hydrophone elements (H1, H2, H3, H4) was routed from the buffer unit to the RME Fireface 800 unit, where it was digitized at a sampling rate of 48 kilohertz. The relatively low frequency (LF) output was further processed within *Pamguard* by applying Engine Noise Fast Fourier Transform (FFT) filters, including click suppression and spectral noise removal filters (e.g. median filter, average subtraction, Gaussian kernel smoothing and thresholding). Filtered LF content was visualized in two spectrograms, one displaying two channel feeds at frequency ranges of three to 24 kilohertz, and another displaying one channel feed at a frequency range of zero to three kilohertz. LF click detector modules allowed for review of individual click characteristics as well as the detection and tracking of click trains.

A map module on the LF system interfaced with GPS data provided by the vessel to display the vessel location and could be used to determine range and bearing estimates based on clicks tracked in the click detector module. *Pamguard* contains a function for calculating the range to vocalizing marine mammals based upon the least squares fit test. This method is most effective with animals that are relatively stationary in comparison to the moving vessel, such as sperm whales. The mathematical function estimates the range to vocalizing marine mammals by calculating the most likely crossing of a series of bearing lines generated from tracked clicks or whistles and plotted on a map display. Additionally, the bearings of detected whistles and moans were calculated using a Time-of-Arrival-Distance (TOAD) method (the signal time delay between the arrival of a signal on each hydrophone is compared), and presented on a radar display, along with amplitude information for the detected signal as a proxy for range.

Additional modules displayed on the LF monitor included an LF sound recorder and clip generator. The clip generator module within *Pamguard* could also be used to generate short sound clips in response to either an automatic detection or the operator manually selecting a portion of the spectrogram display. This module was useful in the event that the whistle-and-moan detector falsely triggered and identified a non-biological sound (i.e. echosounder) or if it missed detecting tonal signatures that the operator determined to be vocalizations.

2.3.2 Hydrophone Deployment

The hydrophone cable was deployed manually from the port stern of the vessel's back deck. Two deck cables, a main and a spare, were installed along the deck running from the port stern to the main survey lab. The hydrophone cable was attached via Chinese finger to the port side rail to assist in keeping the

cable towing to port and away from other towed equipment. The end of the deployed hydrophone cable was approximately 65 meters from the port stern of the vessel.

PAM system specifications can be found in Appendix D, and a more detailed description of the hydrophone deployment method can be found in Appendix E.

3 Survey Operations and Monitoring Effort

3.1 Survey Operations Summary

3.1.1 General Survey Parameters

Operations for the survey began with dockside source calibrations in Norfolk, VA at 11:00 UTC on 26 October 2018. The *Gerry Bordelon* transited from Norfolk, VA, to New Bedford, MA, on 28 October 2018. Acquisition continued according to the survey plan with survey operations briefly suspended when necessary for weather, equipment maintenance, or crew changes, as outlined in Table 2. The survey was completed on 30 January 2019 while the *Gerry Bordelon* was in port.

Table 2: Transits of the *Gerry Bordelon* during Bay State Survey 2018/19

Date Depart	Date Arrive	Description of Transit
28-10-2018	30-10-2018	Transit from Norfolk, VA to New Bedford, MA to begin dockside source calibrations.
01-11-2018	01-11-2018	Transit from New Bedford to conduct sea trials; return for maintenance.
04-11-2018	06-11-2018	Transit from New Bedford to prospect site; return for weather and crew change.
08-11-2018	10-11-2018	Transit from New Bedford to prospect site; return for weather.
11-11-2018	11-11-2018	Transit from New Bedford to prospect; early return to port for ASV issues.
12-11-2018	13-11-2018	Transit from New Bedford to prospect; return to Vineyard Sound for weather.
17-11-2018	20-11-2018	Transit from New Bedford to prospect site; return for crew change.
23-11-2018	24-11-2018	Transit from New Bedford to prospect site; return for weather.
30-11-2018	02-12-2018	Transit from New Bedford to prospect site; return for weather and crew change.
05-12-2018	06-12-2018	Transit from New Bedford to prospect site; return for weather.
09-12-2018	10-12-2018	Transit from New Bedford to prospect site; return for weather.
13-12-2018	14-12-2018	Transit from New Bedford to prospect site; return for weather.
14-12-2018	15-12-2018	Transit from New Bedford to prospect site; return for weather and crew change.
20-12-2018	21-12-2018	Transit from New Bedford to prospect site; return for weather.
26-12-2018	28-12-2018	Transit from New Bedford to prospect site; return for weather and crew change.
02-01-2019	03-01-2019	Transit from New Bedford to prospect site; return for weather.
07-01-2019	08-01-2019	Transit from New Bedford to prospect site; return for weather.
12-01-2019	14-01-2019	Transit from New Bedford to prospect site; return to Kingstown, RI for maintenance and crew change.
19-01-2019	20-01-2019	Transit from Kingstown, RI for source calibrations; return for weather.
21-01-2019	21-01-2019	Transit from Kingstown, RI to New Bedford, MA.
26-01-2019	26-01-2019	Transit from New Bedford to prospect site; return for weather and crew change.

3.1.2 HRG survey equipment operations

The *Gerry Bordelon* was engaged in source operations for a total of 456 hours and 41 minutes during the survey. This total included source operations on a survey line, source operations not on a survey line, and source testing (Table 3).

There were 132 hours and 11 minutes of survey acquisition. There were 314 hours and 07 minutes of source activity while not actively in acquisition; this included 168 hours and 28 minutes when only the high frequency multi-beam source was active, most often associated with transit to and from port and when holding weather patterns. The total duration of HRG source testing throughout the survey program was 10 hours and 23 minutes.

Table 3: Acoustic Source Operations during Bay State Survey

Acoustic Source Operations	Duration HH:MM
Source Tests	10:23
Source Activity on a Survey Line	132:11
Source Activity not on a Survey Line	314:07
Total Time Acoustic Sources Were Active	456:41

None of the survey sources utilized in survey operations were capable of being ramped-up, so the sources were either silent or active and there was no time incurred for ramp-up operations during the survey program.

Of the five total survey sources, two sources operated at frequencies less than 200 kilohertz; this included the sub-bottom profiler (SBP), magnetometer, and the USBL. The SBP and/or USBL were active for a total of 282 hours. Of total source activity the lower frequency (LF) source(s) were active approximately 62% of the time. Figure 6 provides a breakdown of source activity in relation to LF source activity, including the total time that only non-LF sources were active.

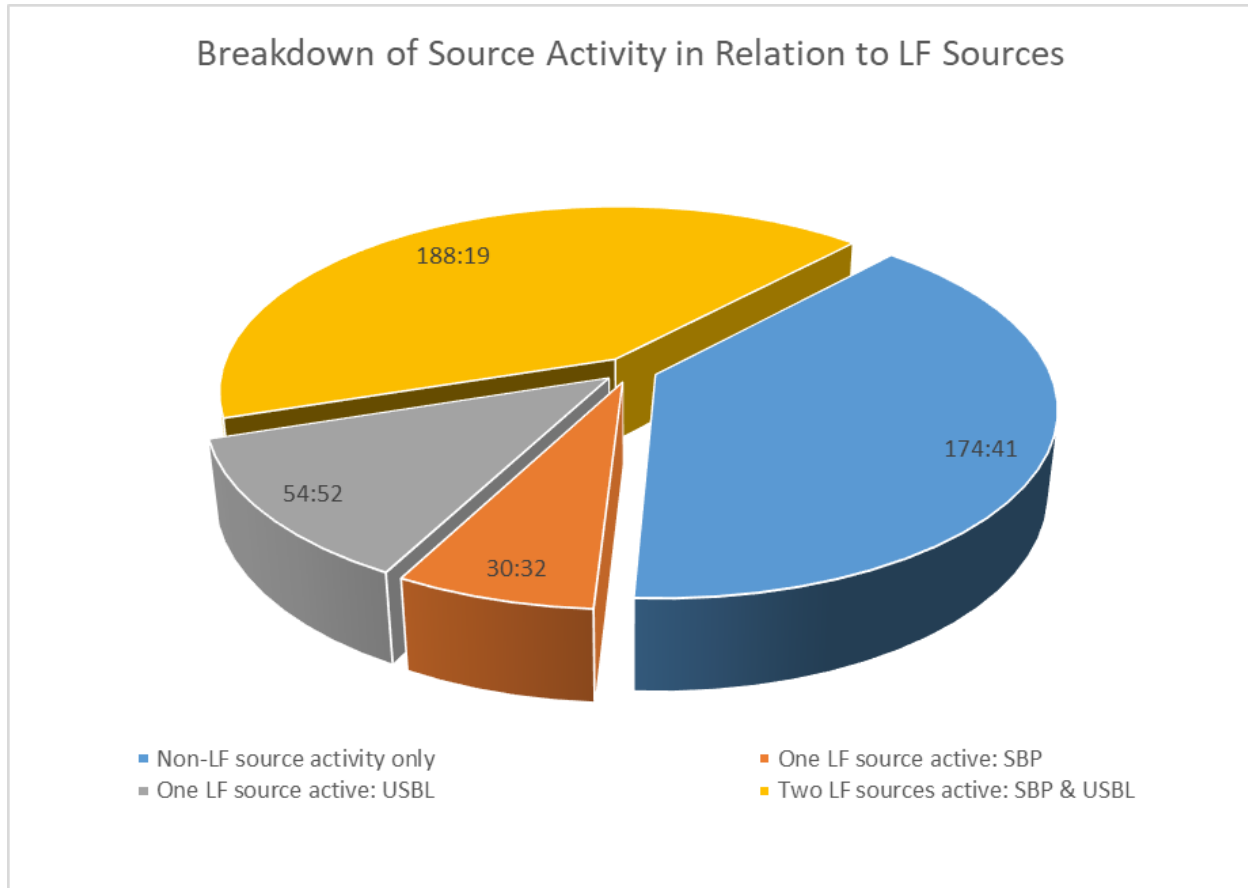


Figure 6: Breakdown of source activity, in relation to the LF source(s), during the survey.

3.2 Visual Monitoring Survey Summary

Visual monitoring during the survey program was conducted day and night by one or two PSOs respectively, starting when the vessel left the dock and terminating upon return to port. Visual observations were suspended only while the vessel was dockside in port. There were 12 occasions when PSO observations were also conducted dockside, in conjunction with source calibrations. When visual monitoring was suspended, low-frequency source operations were also suspended.

The PSOs conducted visual observations for a total of 758 hours and 21 minutes over a period of 51 days. Of this total visual monitoring effort, 370 hours and 09 minutes was accumulated during daylight hours and 388 hours and 12 minutes was undertaken at night using night vision monitoring equipment.

Of the overall total visual monitoring effort, 54% (410 hours and 19 minutes) was undertaken while the acoustic sources were active, and 46% (348 hours and 02 minutes) was undertaken while the acoustic sources were silent. Visual monitoring while the acoustic source was silent was mainly conducted during the transits to and from the survey sites and during equipment deployment, recovery, and maintenance.

Table 4 details visual monitoring with acoustic source operations throughout the survey program.

Table 4: Total Visual Monitoring Effort during the Bay State Survey Program

Visual Monitoring Effort	Duration (hh:mm)	% of Overall Visual Monitoring Effort
Total monitoring while acoustic source active	410:19	54%
Total monitoring while acoustic source silent	348:02	46%
Total monitoring effort	758:21	100%
Total monitoring during daylight	370:09	49%
Total monitoring during reduced visibility	388:12	51%
Total monitoring effort	758:12	100%

3.3 Acoustic Monitoring Summary

Acoustic monitoring during the survey was conducted continuously throughout acoustic source operations and to the maximum extent possible while the acoustic source was silent during all periods of reduced visibility, including night, beginning on 04 November 2018.

Throughout the entire survey program, acoustic monitoring was conducted on 29 days for a total of 190 hours and 46 minutes. Of the overall total acoustic monitoring effort, 68% (129 hours and 02 minutes) was undertaken while the acoustic source was active, and 32% (61 hours and 44 minutes) was undertaken while the acoustic source was silent. Acoustic monitoring while the acoustic source was silent was mainly conducted during the brief periods of time between recovery/deployment of the seismic gear and recovery/deployment of the PAM cable

Table 5 details acoustic monitoring with acoustic source operations throughout the Bay State survey program.

Table 5: Total Acoustic Monitoring Effort during the Bay State Survey Program

Acoustic Monitoring Effort	Duration (hh:mm)	% of Overall Visual Monitoring Effort
Total monitoring while acoustic source active	129:02	68%
Total monitoring while acoustic source silent	61:44	32%
Total acoustic monitoring effort	190:46	100%
Total monitoring occurring with concurrent visual monitoring	190:46	100%
Total monitoring occurring as PAM only	00:00	0%
Total acoustic monitoring effort	190:46	100%

Visual observers and PAM Operators simultaneously monitored the exclusion zone and surrounding areas for 190 hours and 46 minutes during the survey. This is equal to the total time of acoustic monitoring.

3.4 Environmental Conditions

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

Visibility was classified as ‘excellent’ if it extended to five kilometers or greater, ‘moderate’ if it was between two to five kilometers, and ‘poor’ if it was less than two kilometers. Visibility conditions were excellent for 39% of the overall visual monitoring effort, totaling 294 hours and 40 minutes. Visibility conditions were moderate for 4% of the overall visual monitoring effort, totaling 31 hours and 46 minutes. Poor visibility conditions occurred for 57% of the overall visual monitoring effort, totaling 431 hours and 55 minutes. Poor visibility consisted of periods of rain or fog, the brief periods of reduced lighting before sunrise and after sunset, as well as night-vision monitoring (Table 6).

Table 6: Summary of Visibility during Visual Monitoring

Visibility	Duration (hh:mm)	% of Overall Visibility
Excellent (Greater than five kilometers)	294:40	39%
Moderate (two to five kilometers)	31:46	4%
Poor (less than two kilometers)	431:55	57%
Total Visual Monitoring Effort	758:21	100%

*Total hours of poor conditions include night-vision monitoring

The Beaufort sea state recorded during visual monitoring ranged from level one to level six over the course of the survey program. A total of 587 hours (77%) of visual observations were undertaken in conditions where the Beaufort state was level three or less, which were considered good conditions for the detection of protected species. Beaufort sea states of four to six were recorded for a total of 171 hours and 21 minutes, comprising 23% of all visual monitoring observations (Table 7).

Table 7: Summary of Beaufort sea state during Visual Monitoring

Beaufort Sea State	Duration (hh:mm)	% of Overall Visibility
B1	38:18	5%
B2	236:06	31%
B3	312:36	41%
B1 through B3	587:00	77%
B4	124:55	17%
B5	29:26	4%
B6	17:00	2%
B4 through B6	171:21	23%

Swell heights during visual observations were generally low, with swells of less than two meters recorded for 674 hours and 20 minutes, 89% of the total visual effort during the survey program. Swells between two and four meters were recorded for 84 hours and 01 minutes, 11% of the total visual effort. Swells did not exceed four meters during the survey (Table 8).

Table 8: Summary of Swell Height during Visual Monitoring

Beaufort Sea State	Duration (hh:mm)	% of Overall Visibility
Less than 2 meters	674:20	89%
2 to 4 meters	84:01	11%

4 Protected Species Detection Results

There were 76 detection events of marine mammals during this survey and no detections of sea turtles. Detections consisted of two species of whales (humpback and minke whales), one species of dolphin (common dolphins) and one species of pinnipeds (harbor seal) that were identified (Table 9, Figure 7). There were also detections of whales, dolphins and pinnipeds not identifiable at the species level.

Table 9: Number of detection records collected for each protected species during the survey program.

Species	Total Number of Detection Records	Total Number of Visually Detected Animals Recorded
Whales		
Humpback whale	2	3
Minke whale	1	1
Unidentifiable whale	2	2
Dolphins		
Common dolphin	60	478
Unidentifiable dolphin	9	10
Pinnipeds		
Harbor seal	1	1
Unidentifiable seal	1	1

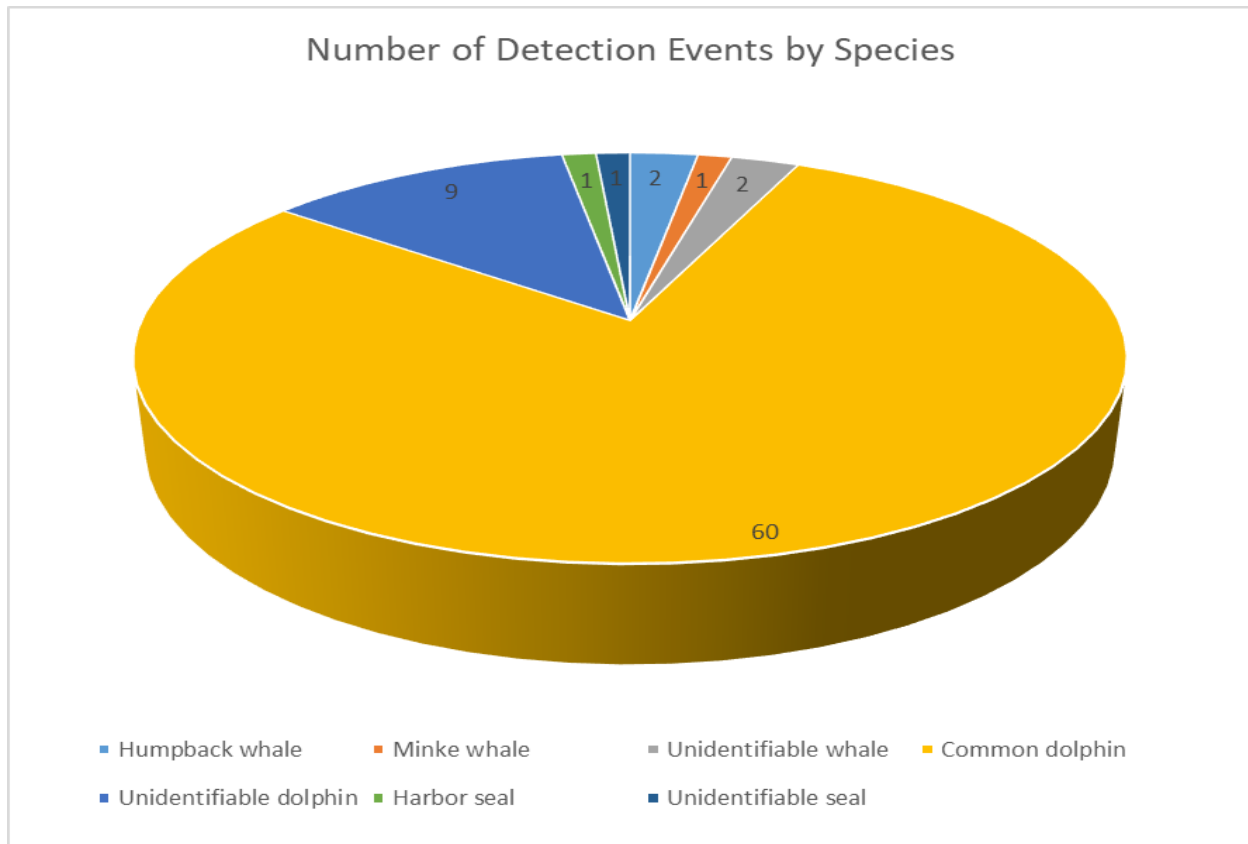


Figure 7: Number of detection events by species group during the survey program

Of the total marine mammal detections, 56 detections were first made while the survey LF sound source (SPB and/or USBL) was active and 20 detections were first made while the LF sound source was inactive. At closest approach, common dolphin species averaged 79 meters to active LF source and 20 meters to inactive LF source, whale species averaged 825 meters from active LF source and 2210 meters to inactive LF source, and pinniped species averaged 90 meters to inactive LF source (Table 10).

Table 10: Average Closest Approach of Protected Species to the Acoustic LF Source During Survey

Species Detected	Active LF Source		Inactive LF Source	
	Number of detections	Average closest approach to source (meters)	Number of detections	Average closest approach to source (meters)
Humpback whale	1	1500	1	4000
Minke whale	1	150	0	
Unidentifiable whale	0		2	420
All Whale Species	2	825	3	2210
Common dolphin	45	79	15	20
Unidentifiable dolphin	9*	1800**	0	
All Dolphin Species	64	939	15	20
Harbor seal	0		1	120
Unidentifiable seal	0		1	60
All Pinniped Species	0	N/A	2	90

*Eight of the unidentified dolphin detections were solely acoustic detections; distance was not determined to marine mammals that were only acoustically detected.

** Distance shown is for the one visual detection of unidentified dolphins

A summary table of each detection event is provided in Appendix F and Appendix G. Photographs taken during detection events are included in Appendix H. Screenshots taken during acoustic detection events are included in Appendix I.

4.1 Marine Mammal Detection Summary

A total of 76 marine mammal detection events were recorded during the survey. Detections were made both visually by PSOs and acoustically by PAM Operators, with visual detections occurring more frequently than any other method: 44 visual only detections, 9 acoustic only detections and 23 detections that were made both visually and acoustically (Figure 8). Of the 44 detections that were made visually only, 11 occurred at night while there was also acoustic monitoring ongoing.

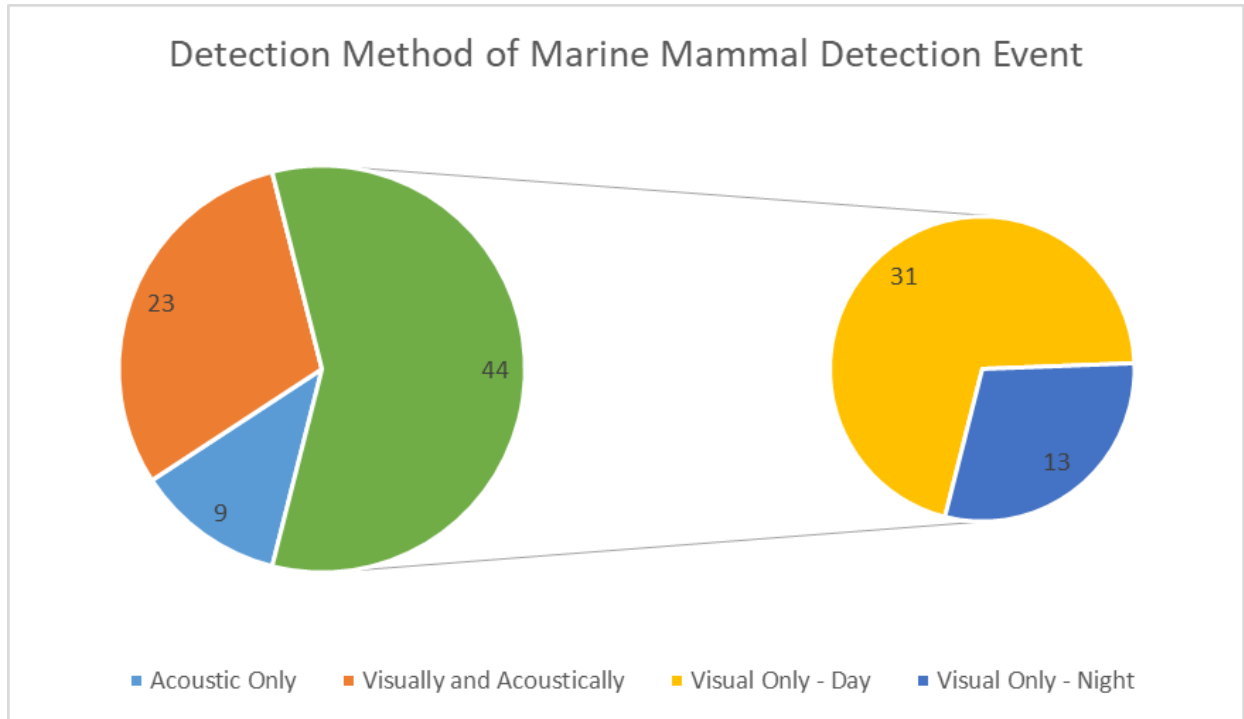


Figure 8: Detection Method of Marine Mammal Detection Events during Survey

When factoring in visual and acoustic monitoring effort to calculate the marine mammal detection rate during the survey, the overall acoustic detection rate is significantly higher than the visual detection rate (Table 11).

Table 11: Detection Rate of Marine Mammals per Unit Effort

Monitoring method	Number of detections made	Monitoring Effort (HH:MM)	Monitoring Effort (Decimal)	Detection rate (Dets/hour effort)
Visual monitoring	67	758:21	758.35	0.088
Acoustic monitoring	31	190:46	190.77	0.162

Four different marine mammal species, including two whale species, one delphinid species and one pinniped species were identified during the survey. Common dolphins were sighted far more often than any other species, with a total of 60 common dolphin detections. Unidentified delphinids were detected on nine occasions. Two sightings were made of humpback whales, one sighting of a minke whale, and two sightings of whales that were not identified at the species level. One harbor seal and one unidentifiable seal were also sighted. Detections of marine mammals that were not identified at the species level were due either to the brevity of the sighting event, the visual conditions at time of detection or the distance of the sighted mammals from the vessel. More detail is provided for detection events by species in Sections 4.1.1 through 4.1.7. The location of each marine mammal detection event is shown in Figure 9.

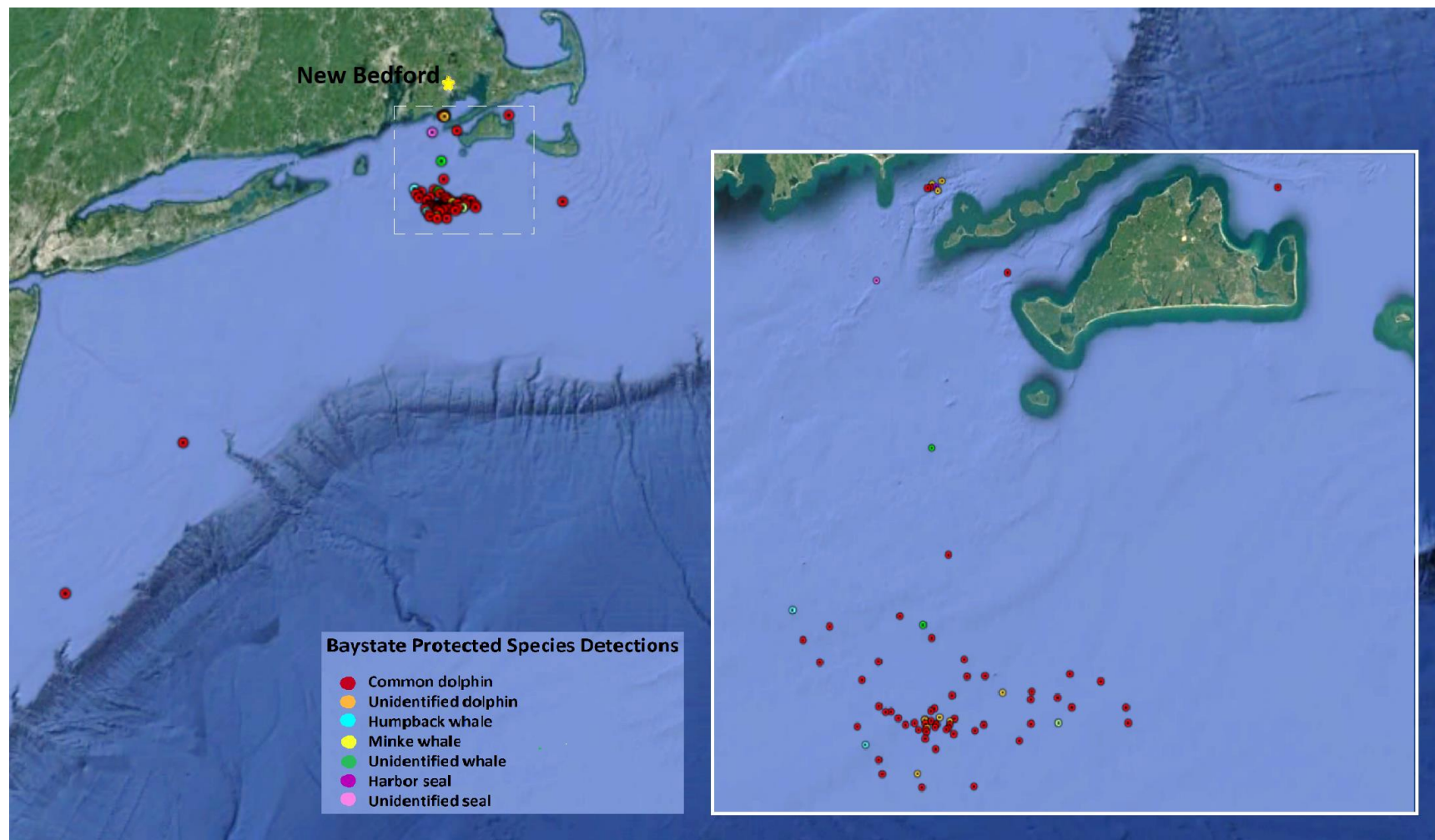


Figure 9: Location of marine mammal detection events with inset focusing in on detection locations in main survey area.

4.1.1 Humpback whale

There were two sightings of humpback whales during the survey. One detection occurred while the LF sources were active, with a closest point of approach of 1500 meters. The other detection occurred while the LF sources were not deployed, with a closest point of approach of 4000 meters. No mitigation actions resulted from the sightings. The groups consisted of one and two individuals; dorsal fins were visible in both sightings, with blowing and diving behaviors noted.

4.1.2 Minke whale

There was one sighting of a minke whale during the survey. The detection occurred while the LF sources were active, with a closest point of approach of 150 meters. A shutdown of the active sources resulted from this sighting. No strike avoidance measures were required. The group consisted of one individual; its dorsal fin was visible, and it was observed briefly surfacing then diving.

4.1.3 Unidentified whale

There were two sightings of whales that were not identifiable at the species level. Both detections occurred while the vessel was in transit during inclement weather and the LF sources were not deployed. Closest points of approach were 100 and 740 meters. No mitigation actions, nor strike avoidance measures, were required for the sightings. Each detection consisted of one individual and blowing behaviors were observed.

4.1.4 Common dolphin

Common dolphins were sighted more frequently than any other marine mammal species, with 60 common dolphin detections during the survey. Fifteen detections initiated while the LF sources were silent and 45 while the sources were active. Closest point of approach to the active sources ranged from 10 to 1510 meters, with 70 percent of detections at a distance of less than 30 meters. Closest point of approach during source silence ranged from 1 to 200 meters, with all but one detection at a distance of less than 25 meters. Pods ranged in size from a single animal to approximately 70 individuals, with 80 percent of detections containing groups of 3 to 10 individuals. In general, common dolphins were observed exhibiting porpoising behaviors, brief interludes of bow-riding as well as swimming below the surface, feeding, fast travel and diving, as well as brief interludes of bow-riding.

4.1.5 Unidentifiable dolphin

There were nine detections of dolphins that were not identifiable at the species level; all detections occurred while the LF source was active. One of the detections was a sighting of a pod of 10 unidentifiable dolphins, with a closest observed approach of 1800 meters to the active LF source. The remaining eight unidentifiable dolphin detections were solely acoustic and consisted of aurally and visually detected tonal vocalizations; distances and pod size for these acoustic detections were not determined.

4.1.6 Harbor seal

There was one sighting of a harbor seal during the survey. The detection occurred while the vessel was in transit and the LF sources were not deployed. Closest point of observed approach was 120 meters. No mitigation actions resulted from this sighting. The group consisted of one individual, which was observed swimming and diving.

4.1.7 Unidentified seal

There was one sighting of a seal that was not identified at the species level. The detection occurred while the vessel was in transit and the LF sources were not deployed. Closest point of observed approach was 60 meters. No mitigation actions resulted from this sighting. The group consisted of one individual, which was observed swimming and diving.

4.2 Acoustic Detections

There were 31 acoustic detections made during the survey program, all delphinid. Identification of the delphinid species was made on 23 occasions, all common dolphins; a majority of these were connected with concurrent visual sighting, where the PSOs were able to identify the dolphins to the species level. There was also one solely acoustic detection where the PAM operator identified the dolphins as common dolphins. The remaining eight acoustic detection events were identified to the level of 'unidentified delphinid'. Most acoustic detections consisted of aurally and visually detected tonal vocalizations on the Panguard Spectrogram, often activating the Whistle Moan Detector (Table 12). In addition to tonal vocalizations, some acoustic detections included high-frequency click trains on the Panguard Click Detector

Table 12: Summary of Acoustic Detections occurring during the Bay State Survey Program

Acoustic Detection Number	Concurrent visual detection	Detection first made	Detection properties:		
			HF Click Detection	Visually observed tonal vocalizations	Aurally detected tonal vocalizations
1	No	Acoustically	No	Yes, 5 – 16kHz	No
2	No	Acoustically	No	Yes	Yes
3	No	Acoustically	No	Yes, 5 – 16kHz	Yes
4	Yes (VD#4)	Simultaneously	No	Yes	Yes
5	Yes (VD#10)	Simultaneously	No	Yes, 6 – 15kHz	Yes
6	Yes (VD#11)	Simultaneously	No	Yes, 5 – 13kHz	Yes
7	Yes (VD#12)	Simultaneously	No	Yes, 6 – 14kHz	Yes
8	Yes (VD#13)	Simultaneously	No	Yes, 5 – 15kHz	No
9	Yes (VD#14)	Simultaneously	No	Yes, 5 – 15kHz	Yes
10	Yes (VD#15)	Simultaneously	No	Yes, 8 – 16kHz	Yes
11	Yes (VD#16)	Simultaneously	No	Yes, up to 19kHz	No
12	Yes (VD#19)	Simultaneously	No	Yes, 6-22kHz	No
13	Yes (VD#20)	Acoustically	No	Yes, 6-18kHz	No
14	Yes (VD#21)	Acoustically	No	Yes, 6-24kHz	Yes
15	Yes (VD#23 & VD#24)	Visually	No	Yes, 6-15kHz, burst pulse	No
16	Yes (VD#26)	Visually	No	Yes, 5-20kHz	Yes
17	Yes (VD#27)	Visually	No	Yes, 6-25kHz	Yes
18	Yes (VD#29)	Visually	No	Yes, 12-22kHz	Yes
19	Yes (VD#30)	Acoustically	No	Yes, 3-22kHz	Yes
20	Yes (VD#32)	Simultaneously	No	Yes, 6-22kHz	Yes
21	Yes (VD#33)	Simultaneously	Yes, bearing range 20-80°	Yes, 6-14kHz	Yes
22	No	Acoustically	No	Yes, 8-14kHz	Yes
23	No	Acoustically	No	Yes, 5-25kHz	Yes

24	No	Acoustically	No	Yes, 7-10kHz	Yes
25	Yes (VD#46)	Visually	No	Yes, 7-12kHz	Yes
26	Yes (VD#47)	Visually	Yes, bearing 70°	Yes, 4-24kHz	Yes
27	No	Acoustically	No	Yes, 6-20kHz	Yes
28	Yes (VD#50)	Visually	No	Yes, 5-20kHz	Yes
29	Yes (VD#53)	Visually	Yes, bearing range 47 to 120°	Yes, 7-17kHz	Yes
30	No	Acoustically	No	Yes, 10-12kHz	Yes
31	No	Acoustically	No	Yes, 6-15kHz	Yes

5 Mitigation Actions Summary

There were 27 mitigation actions implemented during this survey (Table 13). Mitigation actions consisted of 24 shut-downs of an active LF source and three delays to the initiation of the source(s). The total duration of mitigation downtime accumulated by the implementation of the 27 mitigation actions totaled 25 hours and 29 minutes. Mitigation downtime was calculated using the total duration that the animal(s) was observed inside its respective exclusion zone plus the additional search period time required following its detection before the vessel was permitted to resume source operations.

In specific instances mitigation downtime did not represent the total lost operational time that resulted from mitigation action. For 15 of the total 27 mitigation, additional time was required in order for the vessel to circle in order to approach the survey line again or to fill holes on a survey line left by a shut-down or delay. The production loss accumulated by implementation of mitigation action was calculated to be 21 hours and 54 minutes.

Table 13: Number and Duration of Mitigation Actions Implemented during the Survey Program

Mitigation Action	Dolphins			Whales		
	Number	Mitigation Downtime	Production Loss	Number	Mitigation Downtime	Production Loss
Delay of Source Initiation	3	2:47	1:47	0	0:00	00:00
Shutdown of Active Source	23	22:12	20:07	1	00:30	00:00
Total Mitigation	26	24:59	21:54	1	00:30	00:00

Mitigation actions were implemented for 25 common dolphin species detections, accounting for 95 percent of mitigation downtime and 100 percent of production loss time. There was one mitigation action for a minke whale species detection, accounting for two percent of total mitigation downtime, and one mitigation action for an unidentifiable dolphin species detection, accounting for three percent of total mitigation downtime (Table 14).

Table 14: Mitigation Actions and Downtime Duration by Species during the Survey Program

Species	Number of Delays	Number of Shut-downs	Duration of Mitigation Downtime	Percentage of Mitigation Downtime	Duration of Production Loss	Percentage of Production Loss
Minke whale	0	1	00:30	2	0:00	0
Common dolphin	3	22	24:23	95	21:54	100
Unidentified dolphin	0	1	00:36	3	0:00	0

The three delays to operations were attributed to detections of common dolphins. The shut-downs of the active source were attributed to detections of common dolphins and one minke whale, as well one detection of unidentifiable dolphins. A summary of each mitigation action can be found in Appendix J.

5.1 Marine Mammals Known to have been Exposed to 160dB or Greater of Received Sound Levels

NMFS granted an IHA for the survey allowing for Level B harassment takes (exposure to sound pressure levels equal to or greater than 160 dB re: 1 μ Pa (rms) where there is a potential for behavioural changes) for 13 marine mammal species during the Bay State survey. For sea turtles, behavioural harassment (Level B) was expected to occur in the 175 dB zone, and PTS (Level A) was expected to occur in the 195 dB zone.

A total of 8,534 individual marine mammals from 13 species were authorized for Level B exposures in the IHA. No Level A exposures were authorized. During the survey, 182 protected species individuals, all common dolphins, were observed within the Level B harassment zone (Table 15). No protected species were observed within the Level A harassment zone while the acoustic sources were active.

Table 15: Number of Authorized and Potential Level A and B Exposures during the Massachusetts Bay State survey program

Species	IHA Authorized Level A Exposures	Potential Level A Exposures / PTS During the Program	IHA Authorized Level B Exposures	Potential Level B Exposures / PTS During the Program
Humpback whale	0	0	17	0
Fin whale	0	0	31	0
Sperm whale	0	0	5	0
Minke whale	0	0	20	0
Bottlenose dolphin	0	0	1000	0
Risso's dolphin	0	0	30	0
Atlantic spotted dolphin	0	0	50	0
Long-finned pilot whale	0	0	3	0
Common dolphin	0	0	2000	182
Atlantic white-sided dolphin	0	0	500	0
Harbor porpoise	0	0	871	0
Harbor seal	0	0	1636	0
Gray seal	0	0	2371	0

The number of potential exposures may be an underestimation and, therefore, may be a minimum estimate of the actual number of protected species potentially exposed to received sound levels within the predicted Level A and Level B harassment zones. It is possible that the estimated numbers of animals recorded were underestimates due to some animals not being seen or having moved away before they were observed. This is most likely to have occurred with large pods of dolphins where exact number of individuals is difficult to determine.

The Beaufort sea state has a large impact on the ability to visibly detect many smaller or unobtrusive marine species such as beaked whales and sea turtles. During the survey, there were several days (23% of the duration of all visual monitoring) where Beaufort sea states (equal to or greater than level four) may

have resulted in some missed protected species detections. However, most of all visual monitoring observations throughout the survey program (77%) were conducted during Beaufort sea states of level three or less, in conditions that are considered favourable for marine mammal detections.

Table 16 describes the behavior of all animals which were visually observed within the predicted Level B harassment zones during the survey program. No highly distinctive behavioral reactions observed in relation to the vessel or acoustic source during the survey, although several of the protected species detected were last observed moving away from the vessel.

Table 16: Behavior of Species Visually Observed inside the Predicted Areas of Sound Pressure Levels of 160 dB or Greater

Species	Detection No.	No. of Animals	Highest Observed Sound Pressure Level (dB)	Initial behavior	Initial direction in relation to vessel	Subsequent and Final behavior	Subsequent and Final direction in relation to vessel
Common Dolphin	3	3	160	Breaching/ Acrobatic behavior	Parallel to vessel	Swimming below surface	Parallel to vessel
Common Dolphin	4	6	160	Swimming below surface	Parallel to vessel	Diving	Crossing ahead of vessel
Common Dolphin	6	5	160	Porpoising	Towards vessel	Breaching/ Acrobatic behavior	Parallel in opposite direction as vessel
Common Dolphin	8	10	160	Bow-riding	Towards Vessel	Fast travel	Parallel to vessel
Common Dolphin	9	4	160	Bow-riding	Towards Vessel	Fast travel	Parallel to vessel
Common Dolphin	10	4	160	Fast travel	Parallel in opposite direction as vessel	Surfacing	Parallel in opposite direction as vessel
Common Dolphin	11	4	160	Surfacing	Parallel in opposite direction as vessel	Bow-riding	Away from vessel
Common Dolphin	12	6	160	Fast travel	Towards vessel	Breaching/ Acrobatic behavior	Parallel in opposite direction as vessel
Common Dolphin	13	3	160	Swimming below surface	Parallel to vessel	Surfacing	Parallel to vessel
Common Dolphin	14	6	160	Breaching/ Acrobatic behavior	Towards vessel	Diving	Parallel to vessel
Common Dolphin	15	3	160	Breaching/ Acrobatic behavior	Parallel to vessel	Diving	Away from vessel

Species	Detection No.	No. of Animals	Highest Observed Sound Pressure Level (dB)	Initial behavior	Initial direction in relation to vessel	Subsequent and Final behavior	Subsequent and Final direction in relation to vessel
Common Dolphin	16	2	160	Porpoising	Towards vessel	Swimming	Parallel to vessel
Common Dolphin	17	3	160	Swimming below surface	Parallel to vessel	Porpoising	Parallel to vessel
Common Dolphin	19	3	160	Breaching/ Acrobatic behaviour	Parallel to vessel	Milling	Away from vessel
Common Dolphin	20	3	160	Fast travel	Parallel to vessel	Porpoising	Away from vessel
Common Dolphin	21	1	160	Fast travel	Parallel to vessel	Porpoising	Parallel to vessel
Common Dolphin	23	5	160	Breaching/ Acrobatic behaviour	Towards vessel	Swimming below surface	Away from vessel
Common Dolphin	24	4	160	Surfacing	Parallel to vessel	Porpoising	Away from vessel
Common Dolphin	25	3	160	Porpoising	Parallel to vessel	Fast travel	Parallel to vessel
Common Dolphin	26	5	160	Fast travel	Parallel to vessel	Surfacing	Parallel to vessel
Common Dolphin	31	5	160	Swimming below surface	Parallel to vessel	Bow-riding	Away from vessel
Common Dolphin	32	4	160	Breaching/ Acrobatic behavior	Parallel to vessel	Bow-riding	Away from vessel
Common Dolphin	33	7	160	Breaching/ Acrobatic behavior	Towards vessel	Milling	Away from vessel
Common Dolphin	34	3	160	Fast travel	Parallel to vessel	Fast travel	Parallel to vessel
Common Dolphin	35	3	160	Fast travel	Towards vessel	Swimming below surface	Crossing ahead
Common Dolphin	40	3	160	Swimming below surface	Parallel in opposite direction as vessel	Swimming below surface	Parallel in opposite direction as vessel
Common Dolphin	42	10	160	Swimming	Crossing ahead of vessel	Surfacing	Away from vessel
Common Dolphin	43	6	160	Swimming	Towards vessel	Surfacing	Milling

Species	Detection No.	No. of Animals	Highest Observed Sound Pressure Level (dB)	Initial behavior	Initial direction in relation to vessel	Subsequent and Final behavior	Subsequent and Final direction in relation to vessel
Common Dolphin	45	8	160	Bow-riding	Towards vessel	Diving	Parallel to vessel
Common Dolphin	46	3	160	Swimming below surface	Towards vessel	Swimming below surface	Away from vessel
Common Dolphin	47	4	160	Feeding	Crossing ahead of vessel	Porpoising	Away from vessel
Common Dolphin	50	4	160	Porpoising	Towards vessel	Bow-riding	Parallel to vessel
Common Dolphin	51	3	160	Porpoising	Parallel to vessel	Porpoising	Away from vessel
Common Dolphin	52	8	160	Feeding	Parallel to vessel	Swimming	Away from vessel
Common Dolphin	53	5	160	Feeding	Parallel to vessel	Milling	Away from vessel
Common Dolphin	55	7	160	Breaching/ Acrobatic behavior	Towards vessel	Swimming below surface	Parallel to vessel
Common Dolphin	57	7	160	Breaching/ Acrobatic behavior	Towards vessel	Fast travel	Away from vessel
Common Dolphin	61	5	160	Breaching/ Acrobatic behavior	Towards vessel	Swimming below surface	Parallel to vessel
Common Dolphin	64	3	160	Breaching/ Acrobatic behavior	Towards vessel	Porpoising	Away from vessel
Common Dolphin	66	1	160	Fast travel	Towards vessel	Diving	Crossing ahead of vessel

5.2 Implementation and Effectiveness of Mitigation Protocols

To minimize the potential impacts to marine mammals and sea turtles during the Survey, PSOs were prepared to implement mitigation measures whenever protected species were detected approaching, entering, or within the exclusion zones designated in the OCS-A 0500 lease and IHA.

Mitigation measures in the IHA and OCS-A 0500 lease required:

- Establishment of Exclusion Zones around energy sources with operating frequencies below 200 kHz
 - 500-meter exclusion zone (EZ) for North Atlantic right whales.

- 135-meter EZ for all marine mammal species with no Level B potential exposure allowances in the project IHA.
 - 100-meter EZ was implemented for Endangered Species Act (ESA) listed animals.
 - 75-meter EZ was used for harbor porpoise.
 - 50-meter EZ was implemented for sea turtles.
 - 5-meter EZ was used for all other marine mammal species with Level B potential exposure allowances in the project IHA.
- Search periods of 60 minutes conducted visually (daytime) or visually and acoustically (all periods of reduced visibility, including night) prior to the initiation of the sound sources from silence
 - Delays to the initiation of the sound sources if marine mammals or sea turtles were detected inside their respective exclusion zones during the search period prior to the initiation of the source
 - Shut-down of the active source upon detection of marine mammals or sea turtles inside their respective exclusion zones while a sound source with an operating frequency below 200 kHz was active and a subsequent search period of the exclusion zones
 - Once the sound source had been shut down for a protected species detection, operations would not resume until a specific time had passed following the last detection of the animal(s) or once the animal had exited the EZ: 15 minutes for small delphinoid cetaceans and pinnipeds, 30 minutes for non-delphinoid cetaceans, 30 minutes for North Atlantic right whales, and 60 minutes for sea turtles.

Throughout the survey, there were 27 mitigation actions implemented for protected species, including 24 shut-downs of the active source and three delays to the initiation of the source.

Shut-downs of the active sources were implemented proactively and successfully such that sources were silenced before marine mammals or sea turtles were observed inside the predicted Level A exposure zones. No marine mammals or sea turtles were observed inside the predicted Level A exposure zones during this survey.

If an injured or dead protected species was discovered during the survey, and the lead visual observer determined that the cause of death was unknown or unrelated to the activities of the vessel, the incident was to be immediately reported. If a dead protected species was observed, where the death was determined to be unrelated to the survey activities or where the Lead PSO deemed the death to be old, the carcass would be reported to the NMFS Stranding hotline, to NMFS and to BOEM within 24 hours. There were no such observations made during the survey.

Passive acoustic monitoring was conducted throughout the survey during hours of reduced visibility, with most of the acoustic monitoring undertaken while the source was active. High levels of background noise on the hydrophone cable were experienced when the vessel traveled at higher speeds (greater than six knots), which made it impractical to conduct monitoring for baseline acoustic data collection while the vessel was in transit to and from the survey site.

A total of 8,534 individual marine mammals from 13 species (including four whale species, six delphinid species, two seal species, and the harbor porpoise) were authorized for potential sound exposures in the IHA. All 13 species were authorized for potential Level B exposures, with no authorizations for potential Level A exposures. No authorizations were specified in regards to potential sound exposure numbers for

species of sea turtles. During the survey 182 individual protected species were observed within the predicted Level B exposure zone. This total represents 2% of the authorized Level B exposures. No protected species was observed within the predicted Level A exposure zone. The species composition of this total, in relation to the total allowed potential exposures, is shown in Table 15.

PSOs likely did not detect all animals present. However, it is highly unlikely that the actual number of animals present during survey operations reached anywhere near the fully authorized levels for all species. The combination of conservative predicted mitigation zones, combined with conservative take estimation by NMFS (*i.e.*, the precautionary approach), appears for most species to have resulted in an overestimation of take and of overall impact on marine species from the activity.

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

APPENDICES

APPENDIX A:

Incidental Harassment Authorization

APPENDIX B:

Reticle Binocular Calibration Table

Table B- 1: Reticule Binocular Calibration Table

Week #	Date	Observer Name	Ret. Binoc. Estimated distance (m)	True Distance from Radar (m)	Sea State (Beaufort)	Wind Force (knots)	Swell (m)
1	10/26/2018	Eren Penfield-Espinosa	2200	2410	1	5	<2
2	11/6/2018	Mercedes Serrano	300	350	2	7	<2
3	11/17/2018	Eren Penfield-Espinosa	1200	1480	3	13	<2
4	11/23/2018	Yesenia Balderas	2800	2590	2	10	<2
5	12/2/2018	Laura Bluth	2000	1850	3	15	<2
6	12/9/2018	Yesenia Balderas	2000	1960	2	6	<2
7	12/13/2018	Laura Bluth	500	560	3	14	<2
8	12/20/2018	Yesenia Balderas	1000	1110	2	6	<2
9	12/27/2018	Laura Bluth	1200	1110	3	10	<2
10	1/2/2019	Brad Shead	700	780	2	7	<2
11	1/7/2019	Laura Bluth	200	220	4	17	<2
12	1/19/2019	Jeri Butcher	2000	1850	2	8	<2
13	1/26/2019	Eren Penfield-Espinosa	200	220	3	14	<2
14	1/28/2019	Jeri Butcher	1000	930	3	15	<2

APPENDIX C:

Night Monitoring Equipment Specifications

APPENDIX D:

Passive Acoustic Monitoring System Specifications

APPENDIX E:

PAM Hydrophone Deployment

Survey Deployment

A 250 meter conventionally towed hydrophone cable, with a six-hydrophone element array set at the last 20 meters of the cable, and a 100-meter deck cable have been supplied for the survey. The hydrophone cable and the connected 100 meter deck cable are both spooled onto wooden reels secured at the port stern, with the deck cable leading to the data processing unit (DPU) located in the instrument room (Figure E- 1).



Figure E- 1: PAM monitoring station in the survey room

The complete towed portion of the hydrophone cable is guided from the secured wooden cable reel on the port stern and coiled around a bollard (Figure E- 2 and Figure E- 3). The hydrophone cable is connected to a port stern tow point by Chinese finger, which was attached to the cable at the tow point to prevent excessive strain on the cable or snapping. Pre-measured distances were marked on the hydrophone tow cable at 10-meter increments to assist with accurate deployment in relation to the source locations off the port side of the vessel should a change to hydrophone deployment distances become necessary.

During deployment, the hydrophone cable is slowly fed out manually from the port stern by two PAM operators. One operator slowly uncoils the hydrophone cable from the bollard while feeding it to the other who ensures proper deployment off the stern.



Figure E- 2: Deck and tow cable reels secured on the port stern of the vessel



Figure E- 3: Tow cable and hydrophone attachment stored on the bollard

When the tow cable is fully deployed from the *Gerry Bordelon*, the hydrophones are approximately 65 meters from the stern of the vessel, towing at a depth of three to six meters depending on sea current and vessel speed. The hydrophone tow cable is attached to the deck cable with the ITT 19 pin connector. Two foam floats were attached to the hydrophone cable two meters apart and at one meter from the first hydrophone to achieve optimal depth of the towed hydrophone array (Figure E- 4). They were secured with cable-ties and waterproof tape on both ends and the middle.



Figure E- 4: Floating tubes attached and secured to the hydrophone cable

APPENDIX F:

Summary of Visual Detections of Protected Species during the Survey

Table F- 1: Summary of Visual Detections of Protected Species during the Survey

Date	Visual Det. No.	Time at first visual sighting	Time at last visual sighting	Detection Cue	Water depth (m)	GIS Latitude	GIS Longitude	Common name	Certainty of Id	Total No. of animals	Initial Behavior	Subsequent behaviors	Range of animals to vessel at first detection	Range of animals to source at first detection	Animal(s) Pace at Initial Detection	Direction of travel at Initial Detection	Range of animals to vessel at last detection	Range of animals to source at last detection	Animal(s) Pace at Final Detection	Direction of travel at Final Detection	Source activity at initial detection	Source activity at final detection	Source mitigation action required
2018-10-29	1	05:37	06:40	Splash	15	38.75873	-073.54676	Common Dolphin	Probable	6	Tail or Pectoral Slapping	Bow riding/ Fast Travel/ Diving	10	35	Vigorous	Parallel in Same Direction as Vessel	50	60	Vigorous	Parallel in Same Direction as Vessel	Source not deployed	Source not deployed	None
2018-10-29	2	13:49	13:50	Dorsal Fin	28	39.60343	-072.76500	Common Dolphin	Definite	70	Surfacing	Fast Travel/ Diving	40	65	Vigorous	Crossing Ahead of Vessel	30	55	Vigorous	Away From Vessel	Source not deployed	Source not deployed	None
2018-11-12	3	07:09	07:14	Splash	24	41.47089	-070.47089	Common Dolphin	Probable	3	Breaching/ Jumping/ Acrobatic Behaviour	Surfacing/ Swimming Below Surface	50	50	Vigorous	Parallel in Same Direction as Vessel	30	30	Vigorous	Parallel in Same Direction as Vessel	Full Volume While Not On Survey Line	Full Volume While Not On Survey Line	None
2018-11-12	4	10:04	10:33	Body	23	41.46208	-070.96860	Common Dolphin	Probable	6	Swimming Below Surface	Swimming/ Breaching /Jumping/ Acrobatic Behaviour/ Diving	3	15	Moderate	Parallel in Same Direction as Vessel	50	70	Moderate	Crossing Ahead of Vessel	Full Volume While Not On Survey Line	Source deployed but silent	Shutdown of Active Source
2018-11-12	5	17:31	17:45	Splash	21	41.47105	-070.97317	Common Dolphin	Definite	30	Milling	Breaching/J umping/Acr obatic Behaviour	300	325	Vigorous	Crossing Ahead of Vessel	550	575	Moderate	Away From Vessel	Full Volume While Not On Survey Line	Full Volume While On Survey Line	None
2018-11-13	6	00:50	00:59	Body	31	41.38393	-070.85898	Common Dolphin	Definite	5	Swimming	Porpoising/ Surfacing/ Swimming Below Surface/ Breaching/ Jumping/ Acrobatic Behaviour	20	50	Moderate	Towards Vessel	20	15	Moderate	Parallel in Opposite Direction as Vessel	Full Volume While Not On Survey Line	Source deployed but silent	Shutdown of Active Source
2018-11-18	7	06:14	06:39	Body	53	40.98081	-070.89237	Common Dolphin	Definite	4	Blowing	Surfacing/ Swimming Below Surface	20	10	Moderate	Parallel in Same Direction as Vessel	15	20	Moderate	Parallel in Same Direction as Vessel	Source deployed but silent	Source deployed but silent	Delay to Initiation of Source
2018-11-18	8	15:48	16:03	Dorsal Fin	54	40.99483	-071.03967	Common Dolphin	Definite	25	Bow riding	Surfacing/ Swimming Below Surface/ Fast Travel/ Swimming	60	60	Moderate	Towards Vessel	15	15	Moderate	Parallel in Same Direction as Vessel	Full Volume While On Survey Line	Source deployed but silent	Shutdown of Active Source

Date	Visual Det. No.	Time at first visual sighting	Time at last visual sighting	Detection Cue	Water depth (m)	GIS Latitude	GIS Longitude	Common name	Certainty of Id	Total No. of animals	Initial Behavior	Subsequent behaviors	Range of animals to vessel at first detection	Range of animals to source at first detection	Animal(s) Pace at Initial Detection	Direction of travel at Initial Detection	Range of animals to vessel at last detection	Range of animals to source at last detection	Animal(s) Pace at Final Detection	Direction of travel at Final Detection	Source activity at initial detection	Source activity at final detection	Source mitigation action required
2018-11-18	9	17:39	18:07	Dorsal Fin	53	40.99696	-070.92106	Common Dolphin	Definite	4	Bow riding	Surfacing/ Swimming Below Surface/ Fast Travel	40	65	Moderate	Towards Vessel	10	25	Moderate	Parallel in Same Direction as Vessel	Full Volume While On Survey Line	Source deployed but silent	Shutdown of Active Source
2018-11-18	10	21:40	21:53	Body	56	40.97713	-071.06232	Common Dolphin	Definite	30	Fast Travel	Swimming/ Surfacing	800	800	Vigorous	Parallel in Opposite Direction as Vessel	2	3	Moderate	Parallel in Opposite Direction as Vessel	Full Volume While On Survey Line	Source deployed but silent	Shutdown of Active Source
2018-11-18	11	23:07	23:12	Body	55	40.98038	-070.91730	Common Dolphin	Definite	4	Diving	Surfacing/ Swimming Below Surface/ Bow Riding	15	40	Moderate	Parallel in Opposite Direction as Vessel	50	55	Moderate	Away From Vessel	Full Volume While On Survey Line	Source deployed but silent	Shutdown of Active Source
2018-11-19	12	04:13	04:16	Body	58	40.95010	-070.77300	Common Dolphin	Definite	6	Fast Travel	Bow riding/ Breaching/ Jumping/ Acrobatic Behaviour	30	40	Vigorous	Towards Vessel	200	200	Vigorous	Parallel in Opposite Direction as Vessel	Full Volume While On Survey Line	Full Volume While On Survey Line	None
2018-11-19	13	08:14	10:23	Body	55	40.91777	-070.84565	Common Dolphin	Definite	20	Swimming Below Surface	Breaching/ Jumping/ Acrobatic Behaviour/ Diving/ Feeding/ Milling/ Surfacing	5	10	Moderate	Parallel in Same Direction as Vessel	10	55	Vigorous	Parallel in Same Direction as Vessel	Full Volume While On Survey Line	Source deployed but silent	Shutdown of Active Source
2018-11-20	14	04:36	04:58	Body	56	40.94590	-071.02983	Common dolphin	Definite	6	Swimming Below Surface	Breaching/ Jumping/ Acrobatic Behaviour/ Diving	20	35	Moderate	Towards Vessel	15	15	Moderate	Parallel in Same Direction as Vessel	Full Volume While On Survey Line	Source deployed but silent	Shutdown of Active Source
2018-11-20	15	05:30	05:48	Splash	57	40.96167	-070.04978	Common dolphin	Definite	3	Breaching/ Jumping/ Acrobatic Behaviour	Swimming Below Surface/ Fast Travel/ Bow Riding/ Diving/ Feeding	100	130	Vigorous	Parallel in Same Direction as Vessel	200	230	Vigorous	Away From Vessel	Full Volume While On Survey Line	Source deployed but silent	Shutdown of Active Source
2018-11-20	16	06:42	09:05	Splash	60	40.96185	-070.93793	Common dolphin	Definite	7	Swimming Below Surface	Feeding/ Porpoising/ Swimming	20	25	Moderate	Towards Vessel	10	30	Moderate	Parallel in Same Direction as Vessel	Full Volume While On Survey Line	Source deployed but silent	Shutdown of Active Source

Date	Visual Det. No.	Time at first visual sighting	Time at last visual sighting	Detection Cue	Water depth (m)	GIS Latitude	GIS Longitude	Common name	Certainty of Id	Total No. of animals	Initial Behavior	Subsequent behaviors	Range of animals to vessel at first detection	Range of animals to source at first detection	Animal(s) Pace at Initial Detection	Direction of travel at Initial Detection	Range of animals to vessel at last detection	Range of animals to source at last detection	Animal(s) Pace at Final Detection	Direction of travel at Final Detection	Source activity at initial detection	Source activity at final detection	Source mitigation action required
2018-11-20	17	09:51	10:11	Body	60	40.94933	-070.96208	Common dolphin	Definite	3	Swimming Below Surface	Feeding/ Porpoising	10	20	Moderate	Parallel in Same Direction as Vessel	10	15	Moderate	Parallel in Same Direction as Vessel	Full Volume While On Survey Line	Source deployed but silent	Shutdown of Active Source
2018-11-20	18	18:32	18:37	Blow	35	41.20650	-070.96667	Unidentifiable Whale	Definite	1	Surfacing	Blowing/ Swimming	100	100	Sedate	Parallel in Opposite Direction as Vessel	3000	3000	Moderate	Parallel in Opposite Direction as Vessel	Source not deployed	Source not deployed	None
2018-12-01	19	05:48	07:22	Splash	57	40.94628	-071.02202	Common dolphin	Definite	3	Breaching/ Jumping/ Acrobatic Behaviour	Fast Travel/ Swimming Below Surface/ Milling	10	30	Moderate	Parallel in Same Direction as Vessel	15	20	Vigorous	Away From Vessel	Full Volume While On Survey Line	Source deployed but silent	Shutdown of Active Source
2018-12-01	20	08:15	08:16	Body	57	40.93333	-071.00205	Common dolphin	Definite	3	Fast Travel	Porpoising/ Feeling	80	110	Moderate	Parallel in Same Direction as Vessel	100	130	Moderate	Away From Vessel	Full Volume While Not On Survey Line	Full Volume While Not On Survey Line	None
2018-12-01	21	10:07	10:08	Body	56	40.93163	-071.06862	Common dolphin	Definite	1	Fast Travel	Porpoising	10	55	Vigorous	Parallel in Same Direction as Vessel	15	60	Vigorous	Parallel in Same Direction as Vessel	Full Volume While Not On Survey Line	Full Volume While Not On Survey Line	None
2018-12-01	22	13:10	13:11	Blow	56	40.91386	-071.05713	Humpback whale	Definite	1	Blowing	Diving with Flukes/ Fluking	1500	1500	Sedate	Away From Vessel	1500	1500	Sedate	Away From Vessel	Full Volume While Not On Survey Line	Full Volume While Not On Survey Line	None
2018-12-01	23	21:37	21:53	Breach	56	40.89926	-071.03872	Common dolphin	Definite	9	Breaching/ Jumping/ Acrobatic Behaviour	Bow riding/ Swimming Below Surface	30	55	Vigorous	Towards Vessel	15	15	Moderate	Away From Vessel	Full Volume While On Survey Line	Source deployed but silent	Shutdown of Active Source
2018-12-01	24	22:33	22:52	Splash	64	40.88548	-071.03373	Common dolphin	Definite	4	Surfacing	Swimming/ Porpoising	20	50	Vigorous	Parallel in Same Direction as Vessel	15	20	Vigorous	Away From Vessel	Full Volume While On Survey Line	Full Volume While On Survey Line	None
2018-12-02	25	01:10	01:11	Body	60	40.87355	-070.90817	Common dolphin	Definite	3	Porpoising	Fast Travel	15	25	Vigorous	Parallel in Same Direction as Vessel	30	45	Vigorous	Parallel in Same Direction as Vessel	Full Volume While On Survey Line	Full Volume While On Survey Line	None

Date	Visual Det. No.	Time at first visual sighting	Time at last visual sighting	Detection Cue	Water depth (m)	GIS Latitude	GIS Longitude	Common name	Certainty of Id	Total No. of animals	Initial Behavior	Subsequent behaviors	Range of animals to vessel at first detection	Range of animals to source at first detection	Animal(s) Pace at Initial Detection	Direction of travel at Initial Detection	Range of animals to vessel at last detection	Range of animals to source at last detection	Animal(s) Pace at Final Detection	Direction of travel at Final Detection	Source activity at initial detection	Source activity at final detection	Source mitigation action required
2018-12-02	26	01:49	07:39	Body	61	40.87265	-070.97938	Common dolphin	Definite	8	Fast Travel	Porpoising/ Feeding/ Milling/ Swimming Below Surface/ Surfacing	20	65	Vigorous	Parallel in Same Direction as Vessel	35	40	Vigorous	Parallel in Same Direction as Vessel	Full Volume While On Survey Line	Source deployed but silent	Shutdown of Active Source
2018-12-05	27	07:34	10:35	Splash	46	41.02931	-071.10788	Common dolphin	Definite	7	Fast Travel	Porpoising/ Feeding/ Milling	30	55	Vigorous	Towards Vessel	20	20	Moderate	Away From Vessel	Source deployed but silent	Source deployed but silent	Delayed Ramp-up from silence
2018-12-05	28	20:41	20:44	Blow	36	41.04537	-071.15947	Humpback whale	Definite	2	Blowing	Diving/ Diving with Flukes/Fluking	4000	4025	Sedate	Crossing Ahead of Vessel	4000	4025	Sedate	Crossing Ahead of Vessel	Source not deployed	Source not deployed	None
2018-12-05	29	21:21	21:22	Body	43	41.01595	-071.14438	Common dolphin	Definite	15	Breaching/ Jumping/A crobatic Behaviour	Fast Travel	20	30	Vigorous	Crossing Ahead of Vessel	10	35	Moderate	Crossing Ahead of Vessel	Source not deployed	Source not deployed	None
2018-12-05	30	23:09	23:40	Body	55	40.93977	-071.01223	Common dolphin	Definite	7	Breaching/ Jumping/A crobatic Behaviour	Feeding/ Milling	10	6	Vigorous	Parallel in Same Direction as Vessel	20	45	Sedate	Parallel in Same Direction as Vessel	Source deployed but silent	Source deployed but silent	None
2018-12-06	31	03:32	03:36	Body	56	40.99409	-071.12083	Common dolphin	Definite	5	Swimming Below Surface	Feeding/ Milling/ Bow riding	30	65	Moderate	Parallel in Same Direction as Vessel	20	55	Moderate	Away From Vessel	Full Volume While Not On Survey Line	Full Volume While Not On Survey Line	None
2018-12-06	32	04:25	05:41	Splash	54	40.95137	-071.03890	Common dolphin	Definite	4	Breaching/ Jumping/A crobatic Behaviour	Feeding/ Milling/ Bow riding	30	30	Vigorous	Parallel in Same Direction as Vessel	20	35	Moderate	Away From Vessel	Full Volume While Not On Survey Line	Source deployed but silent	Shutdown of Active Source
2018-12-06	33	06:22	06:45	Splash	57	40.94685	-070.96735	Common dolphin	Definite	7	Breaching/ Jumping/A crobatic Behaviour	Feeding/ Milling	15	15	Vigorous	Towards Vessel	30	45	Moderate	Away From Vessel	Full Volume While Not On Survey Line	Source deployed but silent	Shutdown of Active Source
2018-12-06	34	09:27	09:27	body	62	40.90975	-070.96052	Common dolphin	Definite	3	Fast Travel		10	30	Vigorous	Parallel in Same Direction as Vessel	30	50	Vigorous	Parallel in Same Direction as Vessel	Full Volume While Not On Survey Line	Full Volume While Not On Survey Line	None

Date	Visual Det. No.	Time at first visual sighting	Time at last visual sighting	Detection Cue	Water depth (m)	GIS Latitude	GIS Longitude	Common name	Certainty of Id	Total No. of animals	Initial Behavior	Subsequent behaviors	Range of animals to vessel at first detection	Range of animals to source at first detection	Animal(s) Pace at Initial Detection	Direction of travel at Initial Detection	Range of animals to vessel at last detection	Range of animals to source at last detection	Animal(s) Pace at Final Detection	Direction of travel at Final Detection	Source activity at initial detection	Source activity at final detection	Source mitigation action required
2018-12-06	35	10:30	10:43	Body	60	40.93100	-070.96143	Common dolphin	Definite	3	Fast Travel	Porpoising/ Swimming Below Surface	15	40	Vigorous	Towards Vessel	5	30	Vigorous	Crossing Ahead of Vessel	Full Volume While On Survey Line	Full Volume While On Survey Line	None
2018-12-06	36	15:31	15:32	Body	25	41.37605	-071.04533	Harbor Seal	Definite	1	Swimming	Diving	100	150	Vigorous	Away From Vessel	70	120	Vigorous	Away From Vessel	Source not deployed	Source not deployed	None
2018-12-09	37	10:23	10:50	Splash	45	41.03958	-071.01048	Common dolphin	Definite	4	Fast Travel	Swimming/ Feeding/ Swimming Below Surface	20	25	Vigorous	Parallel in Same Direction as Vessel	10	40	Vigorous	Parallel in Same Direction as Vessel	Source not deployed	Source not deployed	None
2018-12-09	38	12:42	12:43	Body	59	40.93828	-070.97527	Common dolphin	Definite	1	Swimming Below Surface		5	30	Vigorous	Parallel in Opposite Direction as Vessel	5	10	Vigorous	Parallel in Opposite Direction as Vessel	Source not deployed	Source not deployed	None
2018-12-09	39	13:37	13:39	Breach	60	40.91989	-070.97506	Common dolphin	Definite	4	Breaching/ Jumping/ Acrobatic Behaviour	Swimming/ Fast Travel	100	120	Vigorous	Crossing Ahead of Vessel	50	45	Vigorous	Away From Vessel	Source not deployed	Source not deployed	None
2018-12-09	40	14:15	14:17	Body	65	40.93703	-070.96703	Common dolphin	Definite	3	Swimming Below Surface		15	25	Moderate	Parallel in Opposite Direction as Vessel	1	15	Moderate	Parallel in Opposite Direction as Vessel	Full Volume While Not On Survey Line	Source deployed but silent	Shutdown of Active Source
2018-12-09	41	15:51	15:52	Breach	62	40.92878	-070.94617	Common dolphin	Definite	3	Breaching/ Jumping/ Acrobatic Behaviour	Fast Travel	300	310	Moderate	Parallel in Opposite Direction as Vessel	280	280	Moderate	Parallel in Opposite Direction as Vessel	Full Volume While On Survey Line	Full Volume While On Survey Line	None
2018-12-09	42	16:25	16:31	Dorsal Fin	59	40.92838	-070.98418	Common dolphin	Definite	10	Swimming	Diving/ Surfacing/ Swimming	100	140	Moderate	Crossing Ahead of Vessel	10	45	Moderate	Away From Vessel	Full Volume While Not On Survey Line	Full Volume While Not On Survey Line	None
2018-12-09	43	18:11	18:34	Splash	59	40.93915	-070.93462	Common dolphin	Definite	14	Swimming	Diving/ Surfacing/ Breaching/ Jumping/ Acrobatic Behaviour/ Milling/ Swimming	50	90	Moderate	Towards Vessel	400	410	Sedate	Milling	Full Volume While Not On Survey Line	Source deployed but silent	Shutdown of Active Source

Date	Visual Det. No.	Time at first visual sighting	Time at last visual sighting	Detection Cue	Water depth (m)	GIS Latitude	GIS Longitude	Common name	Certainty of Id	Total No. of animals	Initial Behavior	Subsequent behaviors	Range of animals to vessel at first detection	Range of animals to source at first detection	Animal(s) Pace at Initial Detection	Direction of travel at Initial Detection	Range of animals to vessel at last detection	Range of animals to source at last detection	Animal(s) Pace at Final Detection	Direction of travel at Final Detection	Source activity at initial detection	Source activity at final detection	Source mitigation action required
2018-12-09	44	18:54	18:57	Dorsal Fin	59	40.93367	-070.95967	Common dolphin	Definite	15	Fast Travel		1500	1510	Moderate	Parallel in Opposite Direction as Vessel	1800	1800	Moderate	Parallel in Opposite Direction as Vessel	Full Volume While Not On Survey Line	Full Volume While On Survey Line	None
2018-12-09	45	18:59	19:04	Splash	56	40.93373	-070.95972	Common dolphin	Definite	8	Swimming	Bow Riding/ Swimming Below Surface/ Diving	50	90	Moderate	Towards Vessel	1	40	Sedate	Parallel in Same Direction as Vessel	Full Volume While Not On Survey Line	Full Volume While Not On Survey Line	None
2018-12-09	46	23:15	00:06	Body	59	40.93348	-070.94115	Common dolphin	Definite	3	Swimming Below Surface		5	40	Sedate	Towards Vessel	30	30	Sedate	Away From Vessel	Full Volume While On Survey Line	Source deployed but silent	Shutdown of Active Source
2018-12-10	47	02:00	07:12	Body	60	40.93502	-070.98990	Common Dolphin	Definite	8	Feeding	Milling/ Swimming Below Surface/ Porpoising	15	43	Moderate	Crossing Ahead of Vessel	40	45	Vigorous	Away From Vessel	Full Volume While Not On Survey Line	Source deployed but silent	Shutdown of Active Source
2018-12-10	48	12:05	12:06	Blow	51	41.01800	-070.96631	Unidentifiable Whale	Definite	1	Blowing		800	840	Moderate	Away From Vessel	700	740	Moderate	Away From Vessel	Source not deployed	Source not deployed	None
2018-12-14	49	19:46	19:49	Dorsal Fin	44	41.03088	-070.97825	Common Dolphin	Definite	8	Fast Travel	Porpoising/ Bow riding/ Divind/ Fast Travel	100	140	Moderate	Crossing Ahead of Vessel	50	60	Moderate	Crossing Astern of Vessel	Source not deployed	Source not deployed	None
2018-12-14	50	22:21	23:48	Dorsal Fin	59	40.93022	-070.94295	Common Dolphin	Definite	6	Swimming Below Surface	Feeding/ Porpoising/ Swimming/ Bow riding	30	50	Moderate	Towards Vessel	50	55	Moderate	Parallel in Same Direction as Vessel	Full Volume While On Survey Line	Source deployed but silent	Shutdown of Active Source
2018-12-15	51	01:27	01:30	Body	58	40.92647	-070.97340	Common Dolphin	Definite	3	Swimming Below Surface	Porpoising	10	20	Moderate	Parallel in Same Direction as Vessel	100	100	Moderate	Away From Vessel	Full Volume While Not On Survey Line	Full Volume While On Survey Line	None
2018-12-15	52	03:37	06:06	Body	58	40.92437	-070.93575	Common Dolphin	Definite	8	Swimming Below Surface	Feeding/ Swimming	15	25	Moderate	Parallel in Same Direction as Vessel	45	30	Moderate	Away From Vessel	Full Volume While Not On Survey Line	Full Volume While On Survey Line	Shutdown of Active Source

Date	Visual Det. No.	Time at first visual sighting	Time at last visual sighting	Detection Cue	Water depth (m)	GIS Latitude	GIS Longitude	Common name	Certainty of Id	Total No. of animals	Initial Behavior	Subsequent behaviors	Range of animals to vessel at first detection	Range of animals to source at first detection	Animal(s) Pace at Initial Detection	Direction of travel at Initial Detection	Range of animals to vessel at last detection	Range of animals to source at last detection	Animal(s) Pace at Final Detection	Direction of travel at Final Detection	Source activity at initial detection	Source activity at final detection	Source mitigation action required
2018-12-15	53	07:32	09:26	Body	59	40.92867	-070.97442	Common Dolphin	Definite	5	Swimming Below Surface	Feedin/ Milling	40	30	Moderate	Parallel in Same Direction as Vessel	20	35	Moderate	Away From Vessel	Full Volume While Not On Survey Line	Full Volume While On Survey Line	none
2018-12-15	54	15:48	15:54	Body	59	40.93648	-070.94084	Unidentifiable Dolphin	Definite	10	Fast Travel		1800	1800	Vigorous	Parallel in Opposite Direction as Vessel	1800	1800	Vigorous	Parallel in Opposite Direction as Vessel	Full Volume While Not On Survey Line	Full Volume While On Survey Line	none
2018-12-20	55	14:04	14:08	Breach	61	40.92743	-070.90660	Common dolphin	Definite	7	Breaching/ Jumping/ Acrobatic Behaviour	Fast Travel/ Bow riding/ Swimming Below Surface	250	260	Vigorous	Towards Vessel	5	20	Moderate	Parallel in Same Direction as Vessel	Full Volume While Not On Survey Line	Full Volume While Not On Survey Line	None
2018-12-20	56	22:10	22:34	Dorsal Fin	58	40.93462	-070.69555	Common dolphin	Definite	2	Swimming Below Surface	Porpoising	5	10	moderate	Parallel in Same Direction as Vessel	5	15	Sedate	Parallel in Same Direction as Vessel	Source not deployed	Source not deployed	None
2018-12-26	57	14:34	15:17	Breach	59	40.93324	-070.89445	Common dolphin	Definite	7	Breaching/ Jumping/ Acrobatic Behaviour	Fast Travel/ Bow riding/ Swimming Below Surface/mm Breaching/ Jumping/ Acrobatic Behaviour	300	330	Vigorous	Towards Vessel	200	210	Moderate	Away From Vessel	Full Volume While Not On Survey Line	Full Volume While Not On Survey Line	None
2018-12-26	58	15:10	15:10	Dorsal Fin	58	40.93422	-070.82947	Common Minke Whale	Definite	1	Surfacing	Diving	150	150	Moderate	Parallel in Opposite Direction as Vessel	150	150	Moderate	Parallel in Opposite Direction as Vessel	Full Volume While Not On Survey Line	Full Volume While Not On Survey Line	Shutdown of Active Source
2018-12-26	59	15:28	15:45	Breach	58	40.93492	-070.79165	Common dolphin	Definite	9	Breaching/ Jumping/ Acrobatic Behaviour	Bow riding/ Swimming Below Surface/ Fast Trael	100	120	Moderate	Towards Vessel	100	110	Vigorous	Away From Vessel	Source deployed but silent	Source deployed but silent	Delay to Initiation of Source
2018-12-26	60	17:36	17:38	Breach	54	40.95782	-070.82955	Common dolphin	Definite	7	Breaching/ Jumping/ Acrobatic Behaviour	Fast Travel	300	320	Moderate	Crossing Ahead of Vessel	200	220	Moderate	Away From Vessel	Full Volume While Not On Survey Line	Full Volume While Not On Survey Line	None
2018-12-26	61	17:51	18:11	Breach	55	40.95950	-070.79250	Common Dolphin	Definite	5	Breaching/ Jumping/ Acrobatic Behaviour	Bow riding/ Swimming Below Surface	100	120	Moderate	Towards Vessel	10	25	Moderate	Parallel in Same Direction as Vessel	Full Volume While Not On Survey Line	Source deployed but silent	None

Date	Visual Det. No.	Time at first visual sighting	Time at last visual sighting	Detection Cue	Water depth (m)	GIS Latitude	GIS Longitude	Common name	Certainty of Id	Total No. of animals	Initial Behavior	Subsequent behaviors	Range of animals to vessel at first detection	Range of animals to source at first detection	Animal(s) Pace at Initial Detection	Direction of travel at Initial Detection	Range of animals to vessel at last detection	Range of animals to source at last detection	Animal(s) Pace at Final Detection	Direction of travel at Final Detection	Source activity at initial detection	Source activity at final detection	Source mitigation action required
2018-12-27	62	14:18	14:29	Breach	56	40.94973	-070.69823	Common dolphin	Definite	4	Breaching/Jumping/Acrobatic Behaviour	Fast Travel/Bow riding/Swimming Below Surface	200	215	Moderate	Towards Vessel	250	245	Moderate	Away From Vessel	Source deployed but silent	Source deployed but silent	None
2018-12-27	63	14:48	15:04	Breach	56	40.97523	-070.73258	Common dolphin	Definite	8	Breaching/Jumping/Acrobatic Behaviour	Bow riding/ Porpoising/ Swimming Below Surface	150	140	Moderate	Towards Vessel	50	65	Vigorous	Away From Vessel	Source deployed but silent	Source deployed but silent	None
2018-12-27	64	21:11	21:20	Body	56	40.96550	-070.82833	Common Dolphin	Definite	3	Breaching/Jumping/Acrobatic Behaviour	Bow riding/ Porpoising/ Swimming Below Surface	75	110	Moderate	Towards Vessel	25	40	Moderate	Away From Vessel	Full Volume While On Survey Line	Full Volume While On Survey Line	None
2019-01-03	65	13:11	13:21	Splash	38	41.10001	-070.94307	Common Dolphin	Definite	5	Fast Travel	Porpoising/ Bow riding/ Swimming Below Surface	200	225	Moderate	Towards Vessel	50	60	Sedate	Away From Vessel	Source deployed but silent	Source deployed but silent	none
2019-01-08	66	02:56	02:56	Body	46	40.98253	-070.77519	Common dolphin	Definite	1	Fast Travel	Swimming Below Surface/ Diving	10	35	Vigorous	Towards Vessel	1	20	Vigorous	Crossing Ahead of Vessel	Full Volume While Not On Survey Line	Full Volume While Not On Survey Line	None
2019-01-26	67	17:04	17:05	Body	25	41.46733	-070.97233	Unidentifiable Seal	Definite	1	Surfacing	Swimming	60	60	Sedate	Parallel in Opposite Direction as Vessel	60	60	Sedate	Parallel in Opposite Direction as Vessel	Source not deployed	Source deployed but silent	None

APPENDIX G:

Summary of Acoustic Detections of Protected Species during the Survey

Table G- 1: Summary of Acoustic Detections during the Survey

Record No.	Date	Time (UTC)	Species	Vessel Position	Source Activity Initial Detection (<200kHz)	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
1	11-12-2018	07:18	Unidentified dolphin	41.47523°N 070.96655°W	USBL	Tonal sounds on spectrogram	100m/ USBL	None	
2	11-12-2018	08:25	Unidentified dolphin	41.47842°N 070.95263°W	USBL	Tonal sounds on spectrogram	50m/ USBL	None	
3	11-12-2018	09:07	Unidentified dolphin	41.46840°N 070.95822°W	USBL	Tonal sounds on spectrogram	100m/ USBL	Shut-down	
4	11-12-2018	10:04	Common dolphin	41.46208°N 070.96860°W	USBL	Tonal sounds on spectrogram	10m/ USBL	Shut-down	Correlated with VD#4.
5	11-18-2018	21:40	Common dolphin	40.97713°N 071.06232°W	SBP	Tonal sounds on spectrogram	15m/ SBP	Shut-down	Correlated with VD#10
6	11-18-2018	23:07	Common dolphin	40.98038°N 070.91730°W	SBP	Tonal sounds on spectrogram	15m/ SBP	Shut-down	Correlated with VD#11
7	11-19-2018	04:13	Common dolphin	40.95010°N 070.77300°W	SBP USBL	Tonal sounds on spectrogram	40m/ SBP, USBL	None	Correlated with VD#12

8	11-19-2018	08:14	Common dolphin	40.91777°N 070.84565°W	SBP USBL	Tonal sounds on spectrogram	10m/ SBP, USBL	Shut-down	Correlated with VD#13
9	11-20-2018	04:35	Common dolphin	40.94590°N 071.02983°W	SBP USBL	Tonal sounds on spectrogram	20m/ SBP, USBL	Shut-down	Correlated with VD#14
10	11-20-2018	05:32	Common dolphin	40.96167°N 070.04978°W	SBP USBL	Tonal sounds on spectrogram	10m/ SBP, USBL	Shut-down	Correlated with VD#15
11	11-20-2018	07:40	Common dolphin	40.96185°N 070.93793°W	SBP USBL	Tonal sounds on spectrogram	27m/ SBP, USBL	Shut-down	Correlated with VD#16. Production loss combined with VD#17
12	12-01-2018	05:49	Common dolphin	40.94628°N 071.02202°W	SBP USBL	Tonal sounds on spectrogram	10m/ SBP, USBL	Shut-down	Correlated with VD#19
13	12-01-2018	08:01	Common dolphin	40.93333°N 071.00205°W	SBP USBL	Tonal sounds on spectrogram	110m/ SBP, USBL	None	Correlated with VD#20
14	12-01-2018	10:02	Common dolphin	40.93163°N 071.06862°W	SBP USBL	Tonal sounds on spectrogram	55m/ SBP, USBL	None	Correlated with VD#21
15	12-01-2018	21:38	Common dolphin	40.89926°N 071.03872°W	SBP USBL	Tonal sounds on spectrogram	8m/ SBP, USBL	Shut-down	Correlated with VD#23 and VD#24
16	12-02-2018	02:51	Common dolphin	40.87265°N 070.97938°W	SBP USBL	Tonal sounds on spectrogram	30m/ SBP, USBL	Shut-down	Correlated with VD#26

17	12-05-2018	08:55	Common dolphin	41.02931°N 071.10788°W	None	Tonal sounds on spectrogram	1m/ None	Delay	Correlated with VD#27
18	12-05-2018	21:29	Common dolphin	41.01595°N 071.14438°W	None	Tonal sounds on spectrogram	25m/ None	None	Correlated with VD#29
19	12-05-2018	22:54	Common dolphin	40.93977°N 071.01223°W	None	Tonal sounds on spectrogram	6m/ None	None	Correlated with VD#30
20	12-06-2018	04:21	Common dolphin	40.95137°N 071.03890°W	SBP USBL	Tonal sounds on spectrogram	20m/ SBP, USBL	Shutdown	Correlated with VD#32
21	12-06-2018	06:20	Common dolphin	40.94685°N 070.96735°W	SBP USBL	Tonal sounds on spectrogram	10m/ SBP, USBL	Shutdown	Correlated with VD#33
22	12-06-2018	08:45	Unidentified dolphin	40.94043°N 070.95527°W	SBP USBL	Tonal sounds on spectrogram	Unknown/ SBP, USBL	None	
23	12-06-2018	10:24	Unidentified dolphin	40.93082°N 070.97253°W	SBP USBL	Tonal sounds on spectrogram	Unknown/ SBP, USBL	None	
24	12-09-2018	22:01	Unidentified dolphin	40.93800°N 070.97577°W	SBP USBL	Tonal sounds on spectrogram	Unknown/ SBP, USBL	None	
25	12-09-2018	23:25	Common dolphin	40.93348°N 070.94115° W	SBP USBL	Tonal sounds on spectrogram	10m/ SBP, USBL	Shut-down	Correlated with VD#46.

26	2018-12-10	6:21	Common dolphin	40.93502°N 070.98990°W	None	Tonal sounds and clicks on spectrogram / HF clicks on automated click detector	Unknown/ None	None	Correlated detection with Visual Detection#47; the acoustic detection occurred after the source had been shut down for the visual detection.
27	2018-12-10	8:16	Common dolphin	40.93425°N 070.97472°W	SBP USBL	Tonal sounds on spectrogram	Unknown/ None	None	
28	2018-12-14	23:55	Common dolphin	40.93022°N 070.94295°W	SBP USBL	Tonal sounds on spectrogram	15m/ SBP, USBL	Shut-down	Correlated with VD#50
29	2018-12-15	8:07	Common dolphin	40.92867°N 070.97442°W	SBP USBL	Tonal sounds and clicks on spectrogram / HF clicks on automated click detector	20m/ SBP, USBL	None	Correlated with VD#53
30	2019-01-03	1:30	Unidentified dolphin	40.96452°N 070.86843°W	SBP USBL	Tonal signatures on spectrogram	Unknown/ SBP, USBL	None	
31	2019-01-13	6:05	Unidentified dolphin	40.88582°N 070.98570°W	SBP USBL	Tonal signatures on spectrogram	Unknown/ SBP, USBL	None	

APPENDIX H:
**Photographs of Identified Protected
Species Visually Detected during the
Survey**



Figure H- 1: Visual Detection #9– Common dolphins, 18 Nov 2018



Figure H- 2: Visual Detection #12– Common dolphin, 19 Nov 2018



Figure H- 3: Visual Detection #15– Common dolphins, 20 Nov 2018

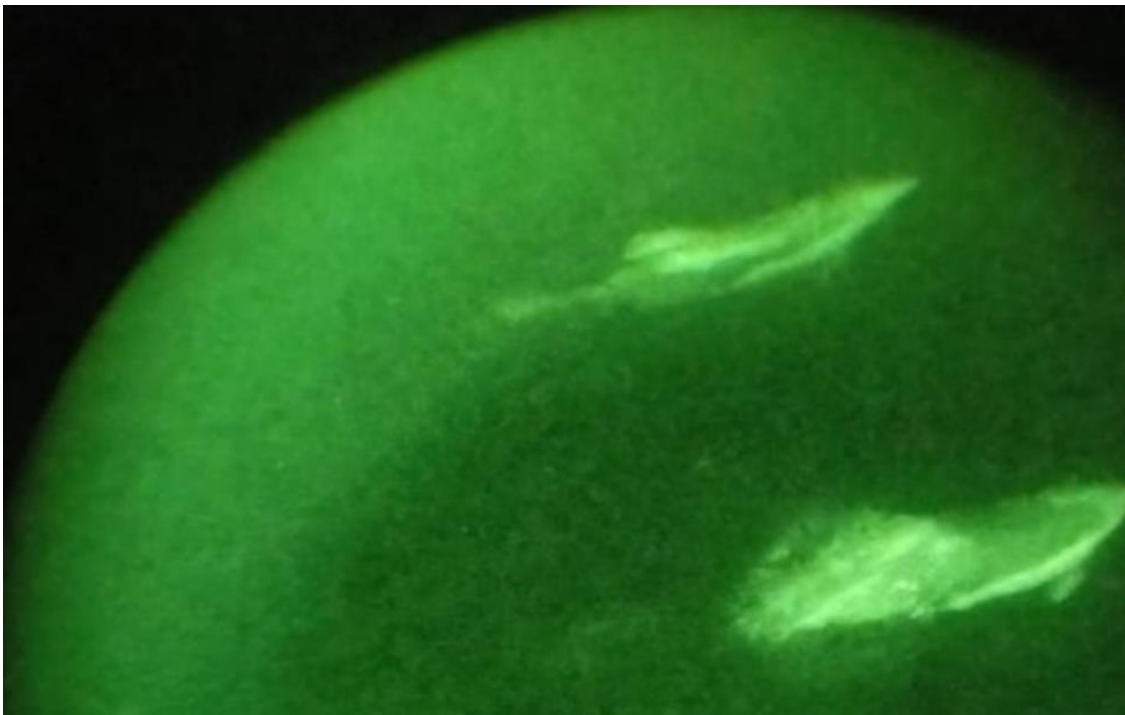


Figure H- 4: Visual Detection #24– Common dolphins, 01 Dec 2018



Figure H- 5: Visual Detection #28– Humpback whale, 05 Dec 2018



Figure H- 6: Visual Detection #33– Common dolphins, 06 Dec 2018



Figure H- 7: Visual Detection #42– Common dolphins, 09 Dec 2018



Figure H- 8: Visual Detection #45– Common dolphins, 09 Dec 2018



Figure H- 9: Visual Detection #49– Common dolphins, 14 Dec 2018



Figure H- 10: Visual Detection #65– Common dolphins, 03 Jan 2018

APPENDIX I:
**Screenshots Taken during Acoustic
Detections of Protected Species during
Survey**

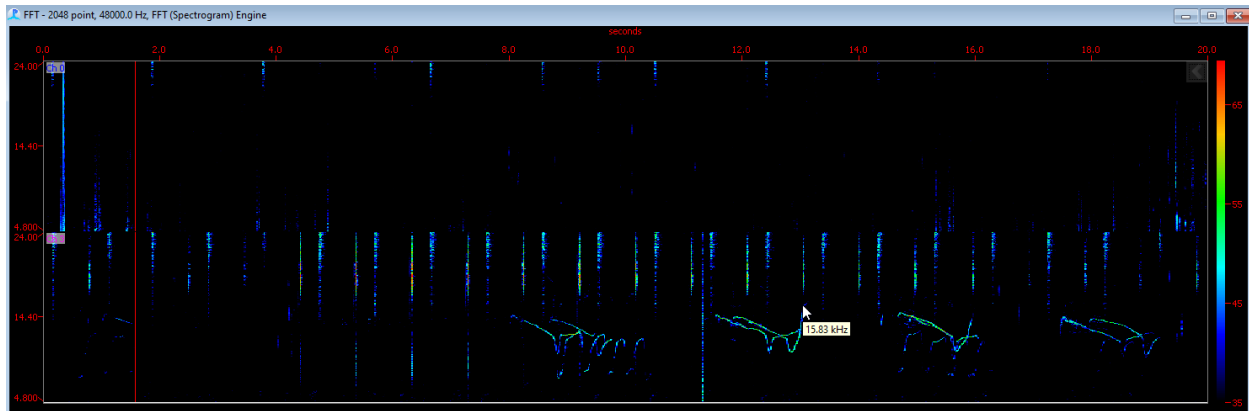


Figure I- 1: Acoustic Detection #1 - Unidentified delphinid tonal vocalizations visualized in Pamguard Spectrogram

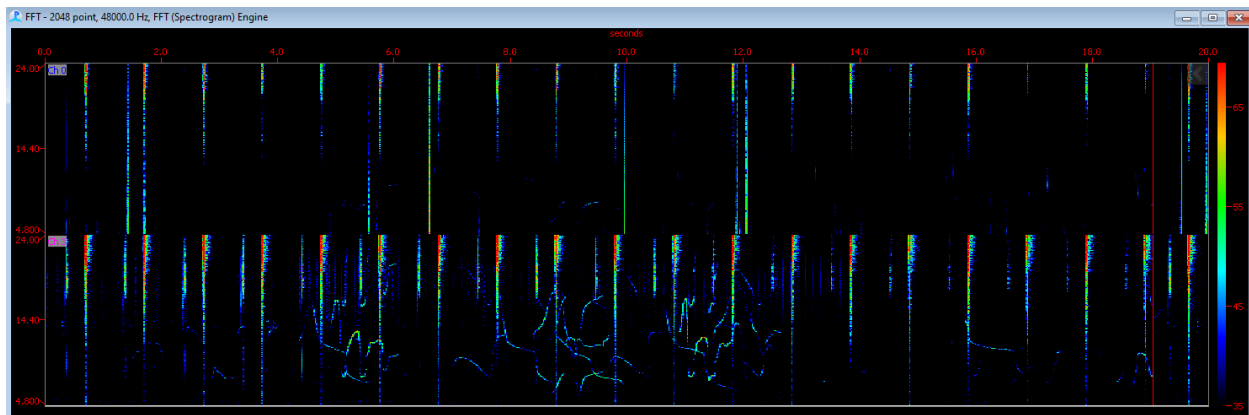


Figure I- 2: Acoustic Detection #4 – Common dolphin delphinid tonal vocalizations visualized in Pamguard Spectrogram

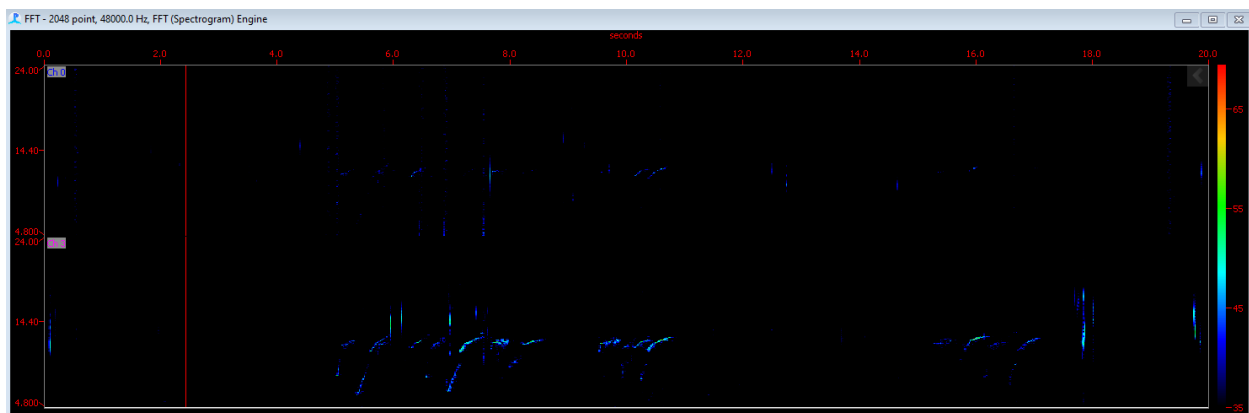


Figure I- 3: Acoustic Detection #6 - Common dolphin delphinid tonal vocalizations visualized in Pamguard Spectrogram

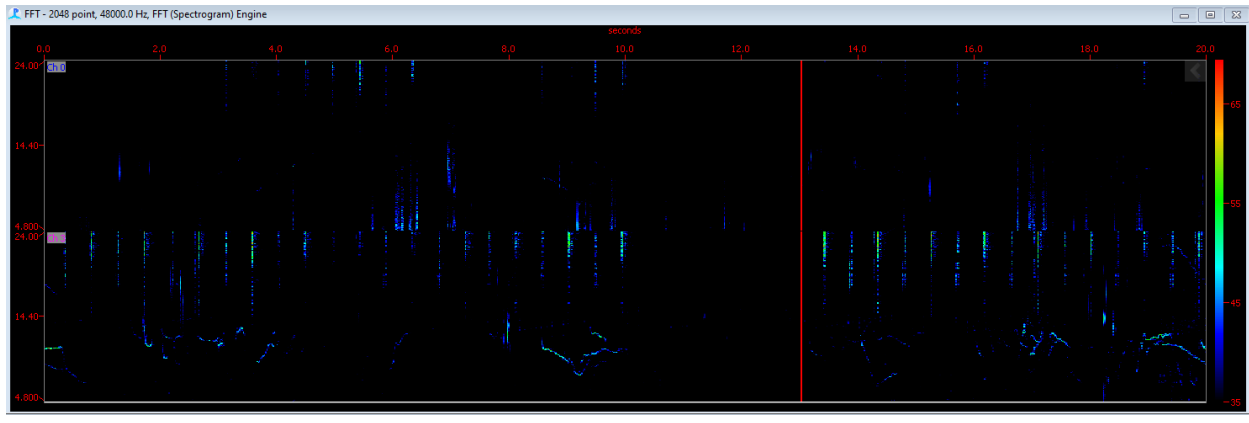


Figure I- 4: Acoustic Detection #7 - Common dolphin delphinid tonal vocalizations visualized in Pamguard Spectrogram

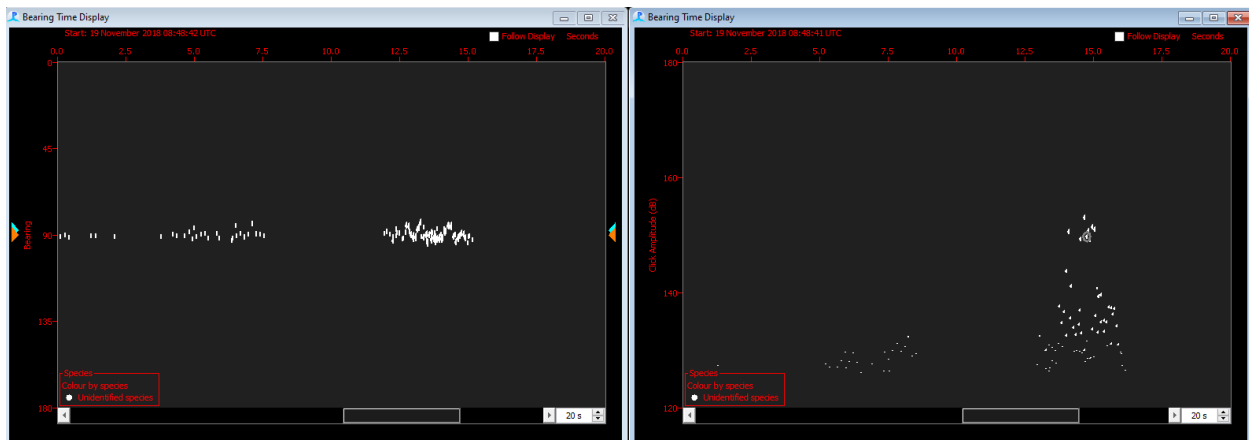


Figure I- 5: Acoustic Detection #8 - Common dolphin delphinid high frequency click trains visualized in Pamguard HF Click Detector

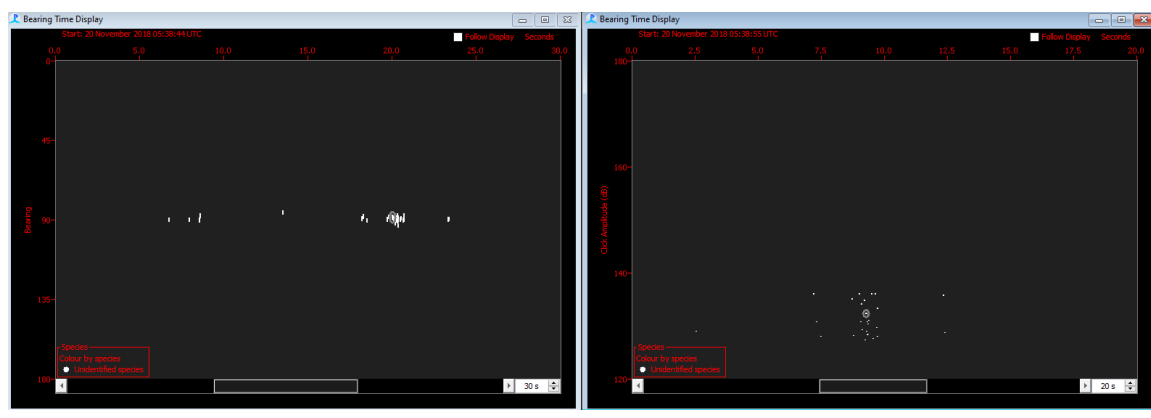


Figure I- 6: Acoustic Detection #10 - Common dolphin delphinid high frequency click trains visualized in Pamguard HF Click Detector

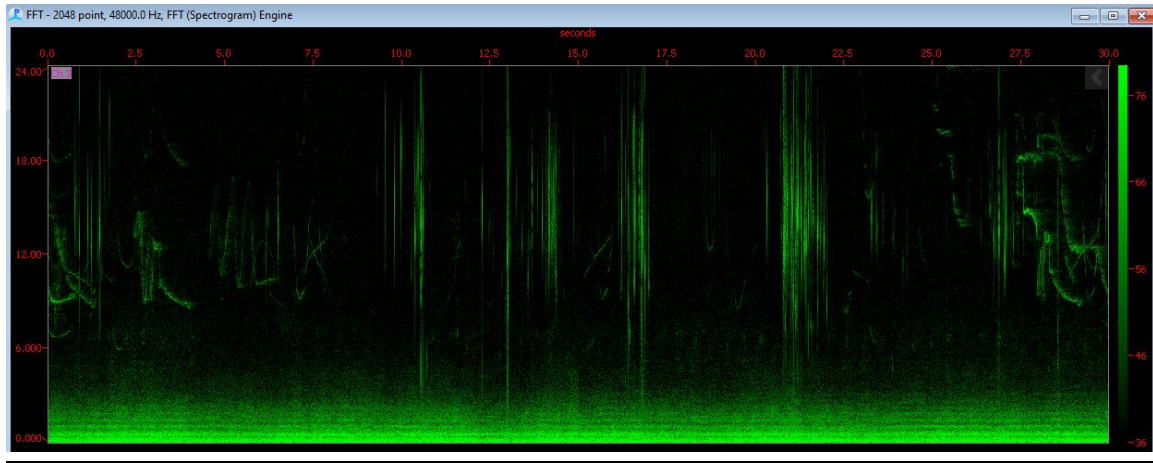


Figure I- 7: Acoustic Detection #12 - Common dolphin delphinid tonal vocalizations visualized in Pamguard Spectrogram

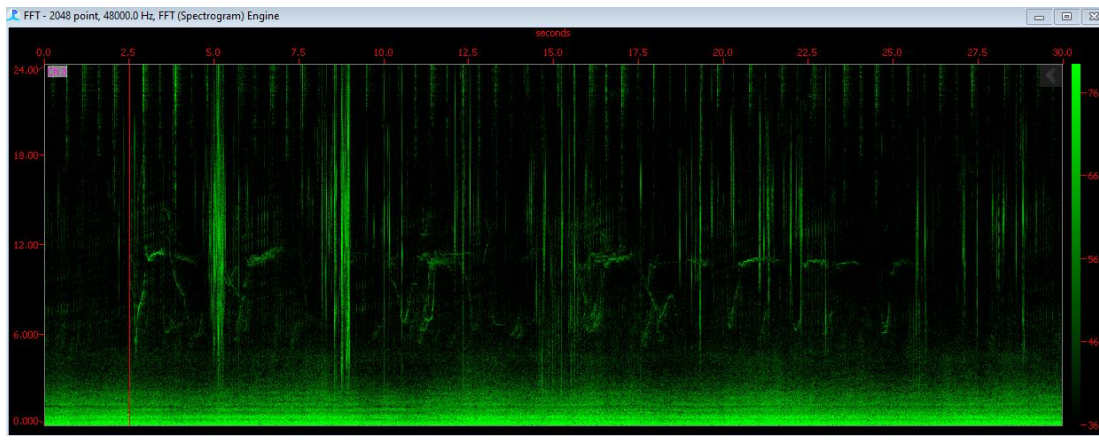


Figure I- 8: Acoustic Detection #13 - Common dolphin delphinid tonal vocalizations visualized in Pamguard Spectrogram

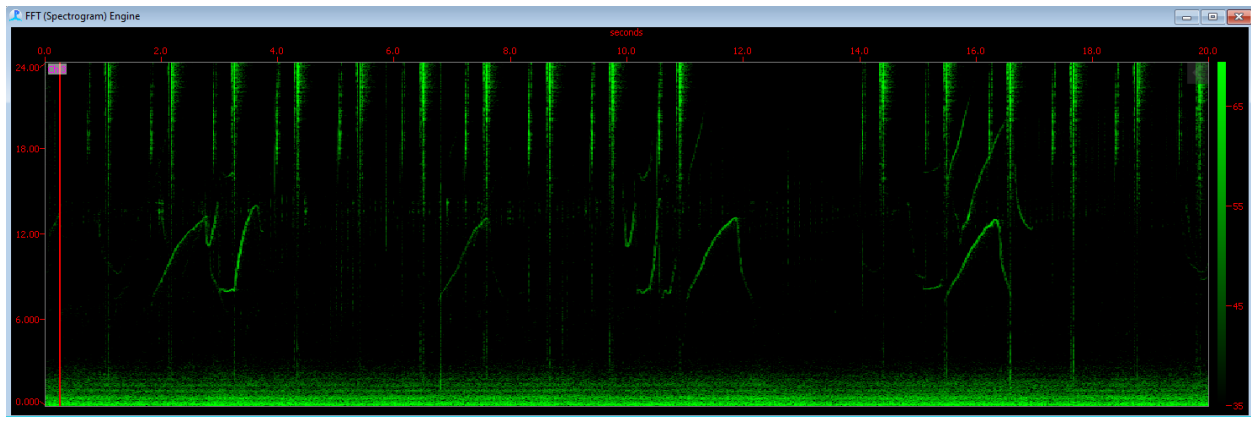


Figure I- 9: Acoustic Detection #14 - Common dolphin delphinid tonal vocalizations visualized in Pamguard Spectrogram

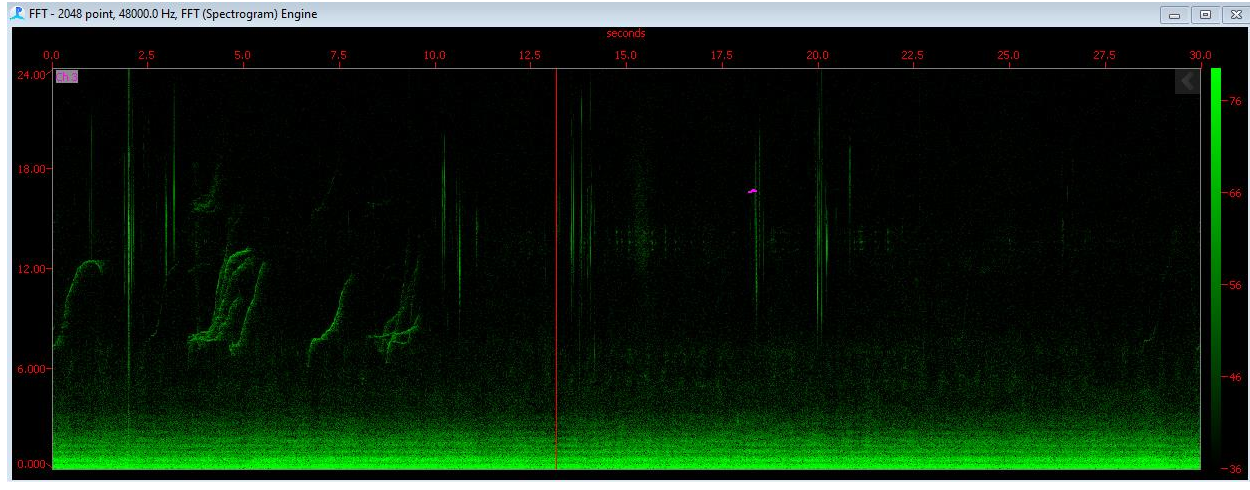


Figure I- 10: Acoustic Detection #16 - Common dolphin delphinid tonal vocalizations visualized in Pamguard Spectrogram

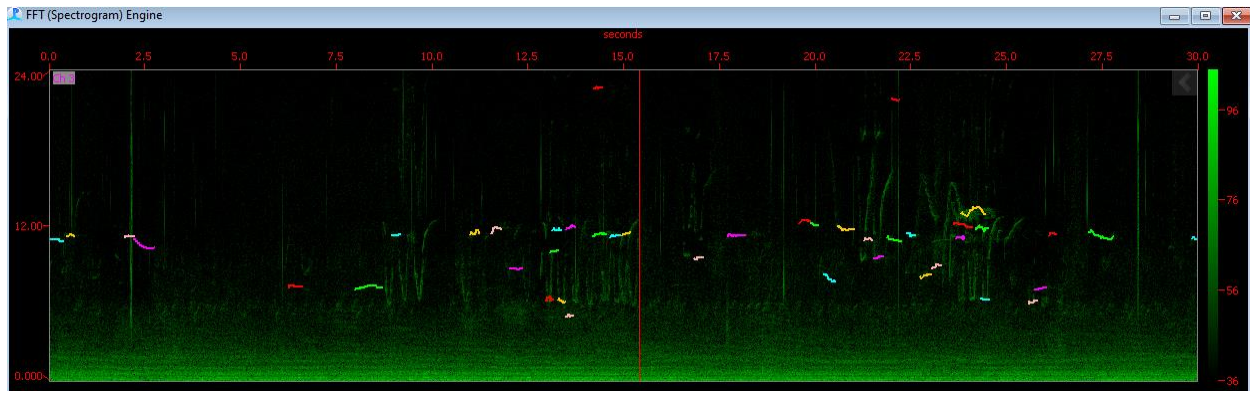


Figure I- 11: Acoustic Detection #20 - Common dolphin delphinid tonal vocalizations visualized in Pamguard Spectrogram

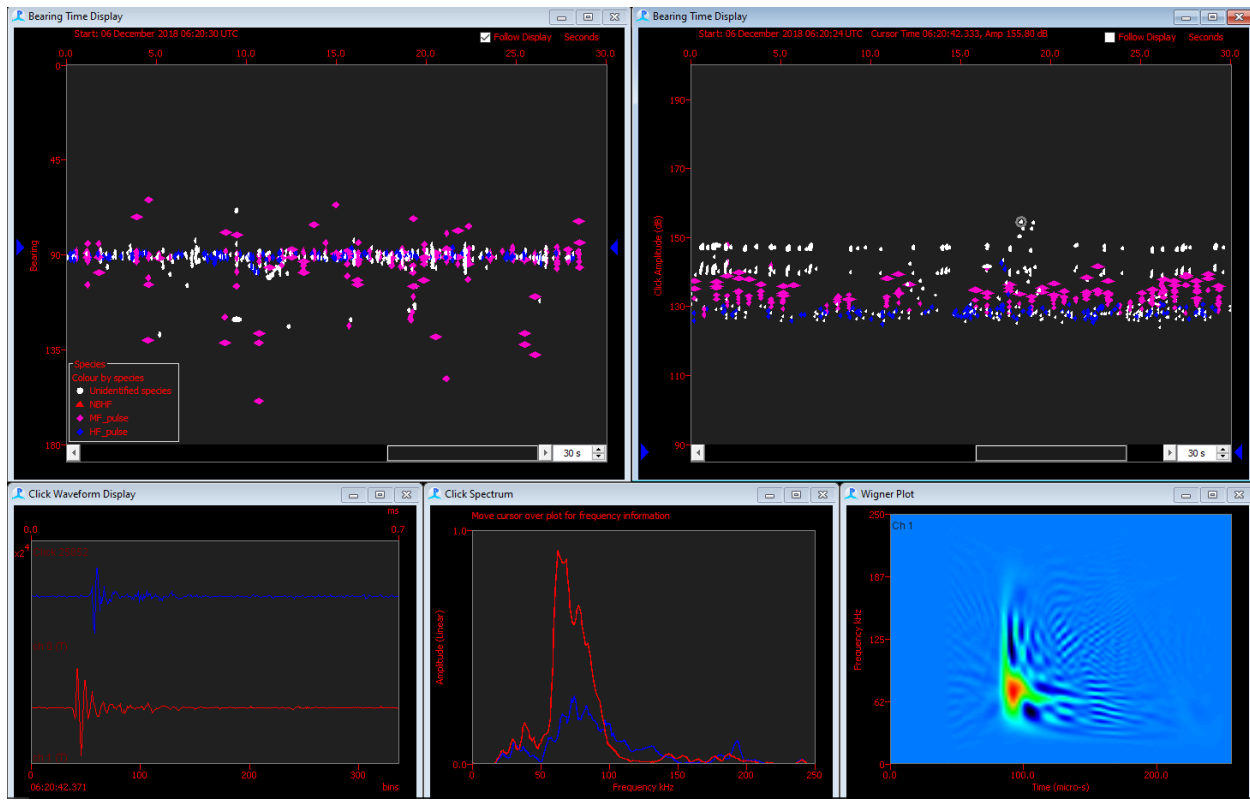


Figure I- 12: Acoustic Detection #21 - Common dolphin delphinid high frequency click trains visualized in Pamguard HF Click Detector with a click isolated in waveform and Wigner plot

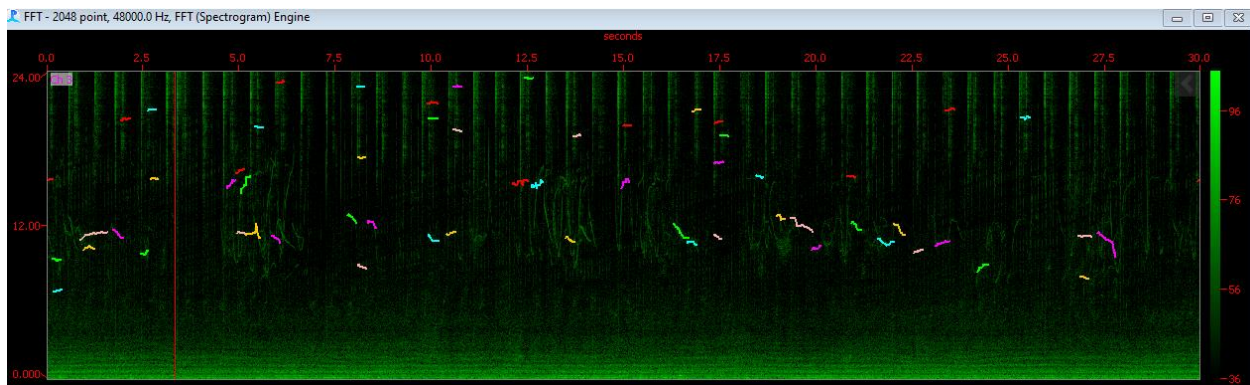


Figure I- 13: Acoustic Detection #25 - Common dolphin delphinid tonal vocalizations visualized in Pamguard Spectrogram

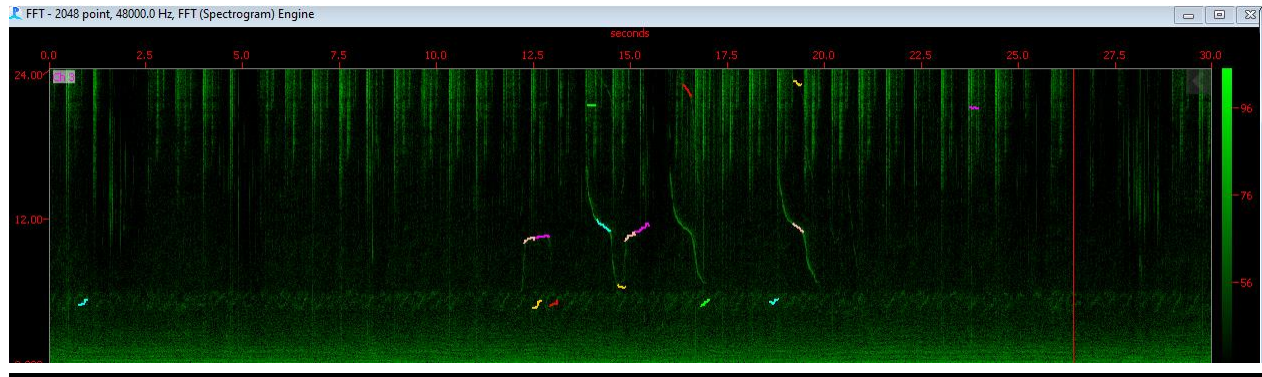


Figure I- 14: Acoustic Detection #27 - Common dolphin delphinid tonal vocalizations visualized in Pamguard Spectrogram

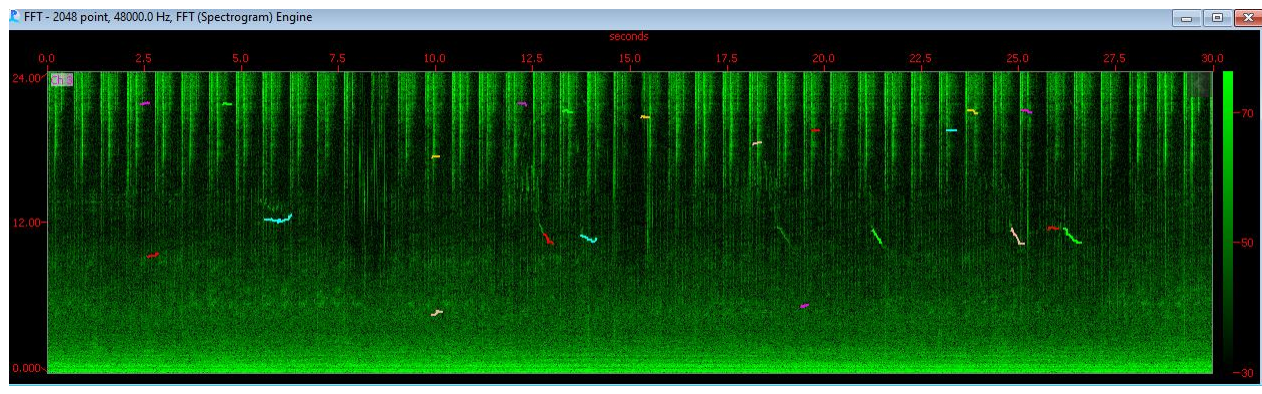


Figure I- 15: Acoustic Detection #30 – Unidentified delphinid tonal vocalizations visualized in Pamguard Spectrogram

APPENDIX J:

Summary of Mitigation Actions

Table J- 1: Summary of Mitigation Actions

Date	Visual or Acoustic Detection Number	Species	Group Size	Source Activity (initial detection)	Closest Approach to Active Source (m)	Number of animals considered to be a Level A "take"	Number of animals considered to be a Level B "take"	Mitigation Action	Total Duration of Production Loss
Survey Mitigation Actions									
11/12/2018	A3	Unidentified Dolphin	2	Full volume while not on survey line	100	0	0	Shut-down of active LF source(s)	0:00
11/12/2018	V4	Common dolphin	6	Full volume while not on survey line	10	0	6	Shut-down of active LF source(s)	0:00
11/13/2018	V6	Common dolphin	5	Full volume while not on survey line	15	0	5	Shut-down of active LF source(s)	0:00
11/18/2018	V7	Common dolphin	4	Source deployed but silent	N/A	0	0	Delay of LF source activation	0:40
11/18/2018	V8	Common dolphin	25	Full volume while on survey line	25	0	10	Shut-down of active LF source(s)	0:00
11/18/2018	V9	Common dolphin	4	Full volume while on survey line	10	0	4	Shut-down of active LF source(s)	0:00
11/18/2018	V10	Common dolphin	30	Full volume while on survey line	15	0	4	Shut-down of active LF source(s)	0:00
11/18/2018	V11	Common dolphin	4	Full volume while on survey line	15	0	4	Shut-down of active LF source(s)	0:00
11/19/2018	V13	Common dolphin	20	Full volume while on survey line	40	0	6	Shut-down of active LF source(s)	3:09
11/20/2018	V14	Common dolphin	4	Full volume while on survey line	10	0	3	Shut-down of active LF source(s)	0:52
11/20/2018	V15	Common dolphin	3	Full volume while on survey line	20	0	6	Shut-down of active LF source(s)	0:32
11/20/2018	V16	Common dolphin	7	Full volume while on survey line	10	0	3	Shut-down of active LF source(s)	0:00
11/20/2018	V17	Common dolphin	3	Full volume while on survey line	15	0	3	Shut-down of active LF source(s)	3:45
12/1/2018	V19	Common dolphin	3	Full volume while on survey line	10	0	3	Shut-down of active LF source(s)	1:57

Date	Visual or Acoustic Detection Number	Species	Group Size	Source Activity (initial detection)	Closest Approach to Active Source (m)	Number of animals considered to be a Level A "take"	Number of animals considered to be a Level B "take"	Mitigation Action	Total Duration of Production Loss
12/1/2018	V23	Common dolphin	9	Full volume while on survey line	8	0	5	Shut-down of active LF source(s)	0:41
12/2/2018	V26	Common dolphin	8	Full volume while on survey line	30	0	5	Delay of LF source activation	2:46
12/5/2018	V27	Common dolphin	7	Source deployed but silent	N/A	0	0	Shut-down of active LF source(s)	1:47
12/6/2018	V32	Common dolphin	4	Full volume while not on survey line	20	0	4	Shut-down of active LF source(s)	0:00
12/6/2018	V33	Common dolphin	7	Full volume while not on survey line	10	0	7	Shut-down of active LF source(s)	2:25
12/9/2018	V40	Common dolphin	3	Full volume while not on survey line	20	0	3	Shut-down of active LF source(s)	0:19
12/9/2018	V43	Common dolphin	14	Full volume while not on survey line	10	0	6	Shut-down of active LF source(s)	0:42
12/9/2018	V46	Common dolphin	3	Full volume while not on survey line	10	0	3	Shut-down of active LF source(s)	1:19
12/10/2018	V47	Common dolphin	8	Full volume while not on survey line	10	0	4	Shut-down of active LF source(s)	2:07
12/14/2018	V50	Common dolphin	6	Full volume while on survey line	30	0	4	Shut-down of active LF source(s)	0:52
12/15/2018	V52	Common dolphin	7	Full volume while not on survey line	15	0	8	Shut-down of active LF source(s)	1:50
12/26/2018	V58	Common Minke Whales	1	Full volume while not on survey line	150	0	0	Shut-down of active LF source(s)	0:00
12/26/2018	V59	Common dolphin	9	Source deployed but silent	N/A	0	0	Delay of LF source activation	0:00