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Protected Species Mitigation and Monitoring Report

Marine Geophysical (Seismic) Survey
North Pacific Ocean

Gulf of Alaska
08 June 2019 – 24 June 2019

R/V *Marcus G. Langseth*

Prepared for:

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for submission to:

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1. EXECUTIVE SUMMARY

The U.S. National Science Foundation (NSF) owned research vessel (R/V) *Marcus G. Langseth* (*Langseth*), operating under an existing cooperative agreement by Columbia University's Lamont-Doherty Earth Observatory (L-DEO), conducted a two-dimensional (2D) survey in the Gulf of Alaska, off the Alaska Peninsula and the eastern Aleutian Islands from 08 June 2019 to 24 June 2019. The operational activities were conducted in support of an NSF research grant awarded to Principal Investigator (PI) Dr. G. Abers (Cornell University). The Chief Scientist for the survey was Dr. A. Bécel, L-DEO.

The purpose of the survey was to collect reflection and refraction data along the seismically active plate tectonic boundary of the Alaska Peninsula subduction zone to provide unique new constraints that can be used to address questions about the geometry and properties of the area which has produced large earthquakes and tsunamis in the past. The survey data collected was also intended to supplement the overall project goals of the Alaska Amphibious Community Seismic Experiment (AACSE), which involved imaging the architecture of and understanding the variability in slip behavior of the Alaska Peninsula subduction zone.

This report serves to comply with the reporting obligations for the survey required by the Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA). On 14 November 2018, L-DEO applied to the National Marine Fisheries Service (NMFS) for an Incidental Harassment Authorization (IHA) that would allow for the potential harassment of a small number of marine mammals impacted by the seismic survey. On 31 May 2019, NMFS issued an IHA, an Incidental Take Statement (ITS), and a Biological Opinion (BO). An Environmental Assessment (EA) was also prepared pursuant to the National Environmental Policy Act for the project and a Finding of No Significant Impact (FONSI) issued. In addition, the U.S. Fish and Wildlife Service (USFWS) issued a Letter of Concurrence (LOC) on 7 May 2019 that the proposed seismic surveys "may affect", but were not likely to "adversely affect", the endangered short-tailed albatross (*Phoebastria albatrus*), the endangered Steller's eider (*Polysticta stelleri*) or its critical habitat, and the threatened southwest distinct population segment of the northern sea otter (*Enhydra lutris kenyoni*). Mitigation measures were implemented to minimize potential impacts to marine mammals and identified endangered or threatened sea turtles and sea birds during the survey program. These measures included, but were not limited to, the use of NMFS approved Protected Species Observers (PSOs) for both visual and acoustic monitoring, the establishment of a 1,000 meter buffer zone from any source element (where operators would be alerted to the presence of the animal(s)), a 500 meter exclusion zone from any source element (where the source would be powered-down or shut down depending on the species present), a 100 meter exclusion zone from a single operating source element (where the source would be shut-down), and the implementation of ramp-up procedures.

Continuous protected species observation coverage during the survey was provided by RPS, the environmental consulting company contracted by L-DEO for the project. PSOs monitored and reported on the presence and behavior of protected species and directed the implementation of the mitigation measures as described in the EA and FONSI, the IHA and ITS issued by NMFS, and the USFWS LOC. Additionally, PSO activities were consistent with the PSO standards identified in the Programmatic Environmental Impact Statement (EIS) / Overseas Environmental Impact Statement (OEIS) for Marine Seismic Research funded by the NSF or Conducted by the U.S. Geological Survey and Record of Decision (referred to herein as the PEIS), to which the NSF EA tiered. Six PSOs, including one Lead PSO and one Lead Passive Acoustic Monitoring (PAM) operator, were present on board the R/V *Langseth* for the survey.

Over the course of the survey program, PSOs conducted visual observations for a total of 311 hours and acoustic monitoring for a total of 339 hours 34 minutes. Visual and acoustic monitoring was conducted simultaneously for a total of 270 hours 18 minutes.

The acoustic source was active for a total of 330 hours two minutes throughout the survey program, which occurred during 85% (263 hours 46 minutes) of the total visual monitoring and during 96% (325 hours 13 minutes) of the total acoustic monitoring.

There were a total of 48 protected species detections during the survey program. This total included 47 visual detections and one simultaneous visual and acoustic detection. There were no acoustic only detections of protected species.

Visual detections included 38 detections of whales, one detection of dolphins, one detection of porpoises, four detections of pinnipeds, and three detections of mustelids. Visual detections of positively identified protected species included: 12 sightings of fin whales (*Balaenoptera physalus*), two sightings of humpback whales (*Megaptera novaeangliae*), one sighting of killer whales (*Orcinus orca*), one sighting of Dall's porpoise (*Phocoenides dalli*), one sighting of northern fur seals (*Callorhinus ursinus*), and three sightings of northern sea otters (*Enhydra lutris*). There were also 24 sightings of unidentified whales and three sightings of unidentified pinnipeds. The simultaneous visual and acoustic detection consisted of Dall's porpoise.

Protected species detections resulted in the implementation of six mitigation actions throughout the survey program. These mitigation actions consisted only of shut-downs that totaled six hours 11 minutes, all of which was considered to be production loss.

NMFS issued an IHA and ITS authorizing a total of 34,540 takes for 21 species of marine mammals (including seven whale species and one pinniped species listed as endangered) for the survey program. Of this total, 33,936 individuals from all 21 species were authorized for Level B takes, and 604 individuals from 13 species were authorized for Level A takes. Takes for endangered species totaled 6,867 individuals, of which 27 were authorized for Level A takes and 6,840 were authorized for Level B takes. Authorized Level A takes for endangered species included two blue whales (*Balaenoptera musculus*), 16 fin whales (*Balaenoptera physalus*), four humpback whales (*Megaptera novaengliae*), two sei whales (*Balaenoptera borealis*), and three Steller sea lions (*Eumetopias jubatus*). Authorized Level B takes for endangered species included 47 blue whales, 3,897 fin whales, 627 humpback whales, 11 north pacific right whales (*Eubalaena japonica*), seven sei whales, 86 sperm whales (*Physeter macrocephalus*), and 2,165 Steller sea lions. No takes were issued for protected sea turtles, sea birds, or northern sea otters for the survey program.

During acoustic source operations, six protected marine mammals, including six Dall's porpoises, 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 takes. A total of 69 protected marine mammals were observed within the predicted 160 decibel radius (where there is potential for behavioral response), constituting potential Level B takes. This total included 22 fin whales, one humpback whale, 10 killer whales, one northern fur seal, 33 unidentified whales, and two unidentified pinnipeds.

There were no visual detections of sea turtles or protected seabirds during the survey program.

There were three sightings of northern sea otters consisting of eight individuals observed during the survey program. All three sightings occurred while the acoustic source was silent and on board while the vessel was transiting in and out of port at the beginning and end of the survey program.

A summary sheet of observation, detection, and operational totals for the survey program can be found in Appendix B.

2. INTRODUCTION

The following report details protected species monitoring and mitigation as well as seismic survey operations undertaken as part of a 2D marine geophysical survey on board the *R/V Langseth* in the Gulf of Alaska along the Alaska Peninsula and the eastern Aleutian Islands from 08 to 24 June 2019.

This document serves to meet the reporting requirements dictated in the IHA and ITS issued to L-DEO by NMFS on 31 May 2019. The IHA and ITS authorized "takes" of Level A and Level B harassment of specific marine mammals, incidental to the marine seismic survey. NMFS has stated that seismic source received sound levels equal to or greater than 160 dB re 1 µPa (root mean square (rms)) could potentially disturb marine mammals, temporarily disrupting behavior, such that they could be considered 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 ESA, NMFS has stated that received sound levels equal to or greater than 175 dB re 1 µPa (root mean square (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 µPa (root mean square (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. A 1,000-meter buffer zone, a 500-meter exclusion zone, and a 100-meter exclusion zone were established from any single element on the acoustic source array as areas where the presence of a marine mammal requires the implementation of a mitigation action. This included delayed operations for all three zones, a power-down or a shut-down of the acoustic source for the 500-meter EZ (depending on the detected species – see section 3.1) and a shut-down of the acoustic source for the 100-meter EZ. The 500-meter EZ is intended to be precautionary as it encompasses the zones for most species within which auditory injury (Level A harassment) could occur on the basis of instantaneous exposure. It also provides additional protection of potentially more severe behavioral reactions for marine mammals at relatively close range to the acoustic source. The EZ provides a consistent area for PSOs to conduct effective observational effort and is a distance within which detection probabilities are reasonably high for most species under typical conditions. For sea turtles, the occurrence of an individual detected approaching, entering, or within the 195-decibel radius for the full volume source and the 100-meter EZ for a single active 40 in^3 element would require the implementation of a shut-down of the acoustic source. For norther sea otters, the occurrence of an individual detected approaching, entering, or within the 500 meter and 100-meter EZs would require a power-down and shut-down respectively. For protected sea birds, the detection of one foraging or diving within the 500-meter and 100-meter EZs would require a power-down and shut-down respectively.

2.1. PROJECT OVERVIEW AND LOCATION

The survey program was comprised of one 2D survey in the Gulf of Alaska along the Alaska Peninsula subduction zone and the eastern Aleutian Islands between approximately 52-58 degrees North and approximately 150 to 162 degrees West. The survey location was within the U.S. Exclusive Economic Zone (EEZ) in water depths of approximately 15 to 6,184 meters. Approximately 13% of the survey lines occurred in shallow water depths (less than 100 meters), approximately 27% occurred in intermediate water depths (100 to 1,000 meters), and approximately 60% occurred in deep water depths (greater than 1,000 meters).

The primary goal of the survey was to collect seismic reflection and refraction data to better constrain the geometry and properties of the active plate tectonic boundary, which has produced large earthquakes and tsunamis that are damaging to the Alaska region and the west coast of the US and Hawaii. The survey utilized 75 ocean bottom seismometers (OBSs) deployed in the survey area in 2017 by the Alaska Amphibious Community Seismic Experiment (AACSE). The data collected through this survey would supplement the data collected by the AACSE and contribute to their goals of imaging the architecture for the Alaska Peninsula subduction zone and understanding the structures controlling how and where the planet's largest earthquakes occur. In addition, the information gained by this survey would provide unique higher resolution constraints on the structure of the subduction zone that cannot be obtained by the AACSE data alone.

All seismic survey operations were conducted by the *R/V Marcus G. Langseth*. The vessel is 72 meters (235 feet) in length and utilizes a particularly quiet propulsion system to avoid interference with the seismic signals. The *Langseth*'s cruising speed was approximately 10 to 11 knots during transit, and approximately five knots on the survey lines.

Seismic acquisition was conducted from 08 to 23 June 2019. There were 23 survey lines acquired during the program, including 13 multi-channel seismic (MCS) streamer lines and ten ocean bottom seismometer (OBS) lines, totaling 3,185 kilometers. Data acquisition along several planned survey lines could not be completed within the scheduled survey time frame (Figure 1).

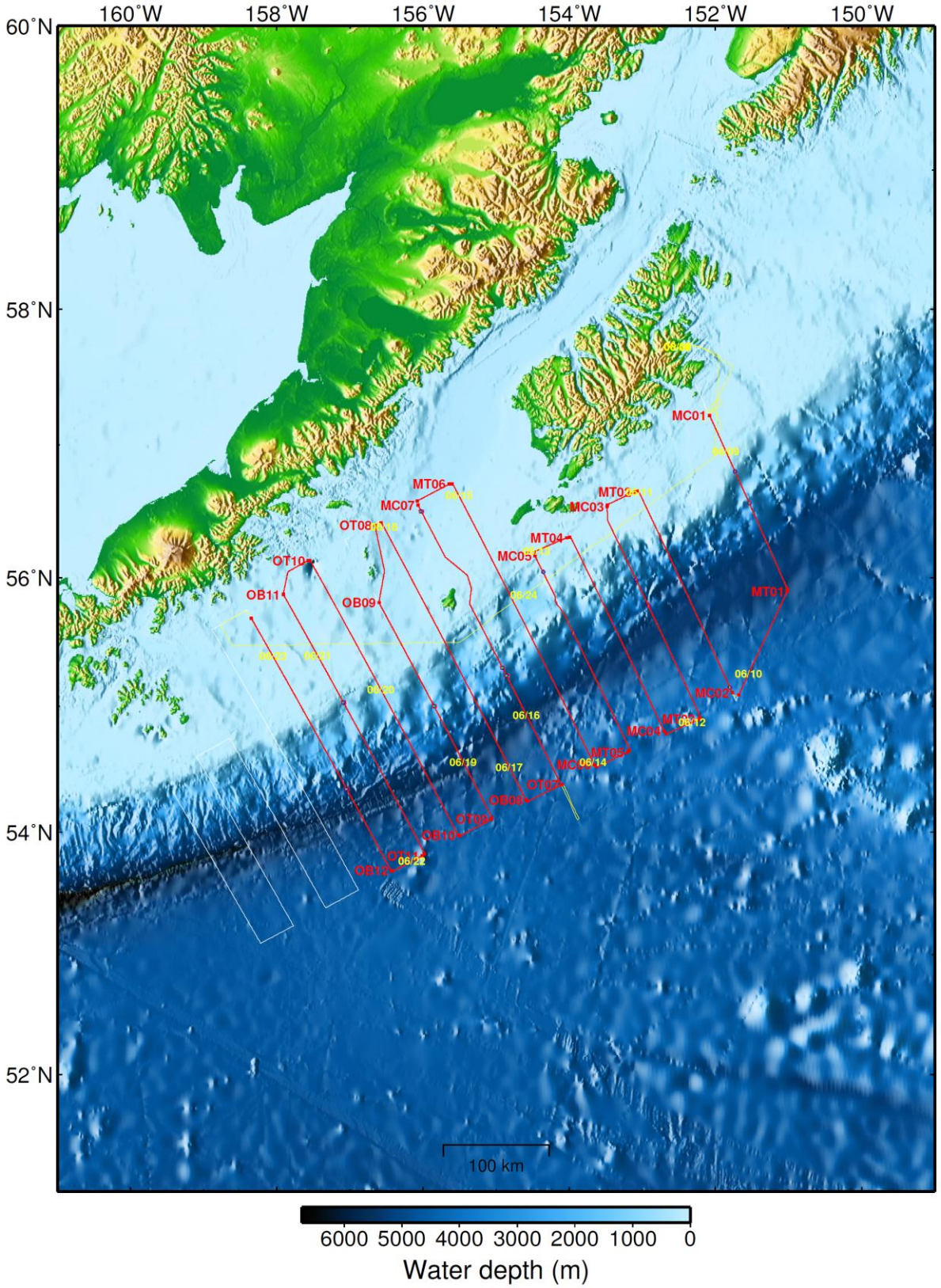

Figure 1. Location and survey lines of the Gulf of Alaska marine geophysical survey.

2.1.1. Energy Source and Receiving Systems

The energy source utilized during the surveys consisted of four towed acoustic source sub-arrays, each with ten source elements (for a total of 40 source elements), deployed just aft of the vessel. During survey production operations, only 36 elements were active at any time, with the additional elements utilized as spares. The source elements were towed at a depth of 12 meters. The center of the source was situated 230 meters from the Navigational Reference Point (NRP) located on the PSO observation tower, which positioned the first elements on the arrays approximately 193 meters from the stern of the vessel.

The source array utilized a mixture of Bolt 1500LL and Bolt 1900LLX elements ranging in size from 40 to 360 cubic inches (in^3), with an operating pressure of 1,950 pounds per square inch. The dominant frequency components ranged from 2 to 188 Hertz (Hz) and nominal source levels ranged from 259 to 265 dB re: 1 µPa (peak-to-peak). The total volume of the seismic source array with all 36 source (mains only) elements active was 6600 in^3. During times when acoustic source arrays were brought on board for maintenance or repair, the total source volume was reduced from 6600 in^3 to varying lower volumes depended on how many of the elements and arrays were disabled. The overall source volume would also be reduced if a main element was switched with a spare element of a smaller volume.

The shot point interval for the survey was approximately 399.3 meters (approximately 155 seconds) for both MCS survey lines and OBS survey lines. During acquisition, the source elements would emit a brief (approximately 0.1 second) pulse of sound. During the intervening periods of operations, the source elements would be silent.

The receiving system for the survey program consisted of a four-kilometer hydrophone streamer and 75 ocean bottom seismometers (OBSs). As the acoustic source array was towed along the track lines, the hydrophone streamer received the returning acoustic signals and transferred the data to the onboard processing system. In addition, an on-shore 400-450 element nodal array was deployed on Kodiak Island to record a ship-to-shore dataset.

Additional sound sources included a Kongsberg EM 122 multi-beam echosounder (MBES), Knudsen Chirp 3260 sub-bottom profiler (SBP), and a Teledyne RDI 75 kHz Ocean Surveyor acoustic Doppler current profiler (ADCP). The hull-mounted MBES operated at frequencies between 10.5 and 13 (usually 12) kilohertz. Each ping consists of eight (in water greater than 1,000 meters) or four (in water less than 1,000 meters) successive fan-shaped transmissions. The transmitting beam width is one or two degrees fore-aft and 150 degrees perpendicular to the ship's line of travel. The maximum source level is 242 dB re: 1 µPa (root mean square [rms]). The hull-mounted SBP beam is transmitted as a 27-degree cone, which is directed downward by a 3.5 kilohertz transducer. The nominal power output is 10 kilowatts; however, the actual maximum radiated power is three kilowatts or 222 dB re: 1 µPa m (rms). The ping duration is 64 seconds at a one second interval. The hull-mounted ADCP operates at a frequency of 75 kilohertz and a maximum source level of 224 dB re: 1 µPa m (rms) over a conically-shaped 30-degree beam. The MBES and SBP operated simultaneously to provide information about near sea floor sedimentary features and to map the topography of the ocean floor. The ADCP was used to measure water current velocities. The *Langseth* also towed a Geometrics G822 Cesium magnetometer approximately 113 meters off the starboard stern of the vessel to map the sea floor.

3. MITIGATION AND MONITORING METHODS

The PSO monitoring program on the R/V *Langseth* meets the standards set forth in the PEIS, NSF EA, IHA and ITS documents. Survey mitigation measures were designed to minimize potential impacts of the *Langseth*'s seismic 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 to provide real-time sighting data, allowing for the implementation of mitigation procedures as required.
- A Passive Acoustic Monitoring (PAM) system was operated continuously day and night to augment visual observations and provide additional marine mammal detection data.
- Effects of marine mammals and sea turtles exposed to sound levels constituting a take were observed and documented. The nature of the probable consequences was discussed when possible.

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

3.1. MITIGATION METHODOLOGY

Mitigation actions were implemented for visual and acoustic detections of protected species, to include marine mammals, sea turtles, and protected sea birds, as outlined in the IHA, ITS, BO and USFWS LOC. These actions included the establishment of a 1,000-meter buffer zone (BZ), 500-meter and 100-meter EZs. The actions also included the implementation of delayed operations, power-downs (during which the source volume was reduced to a single active 40 cubic inch element), and shut-downs (during which the source was fully silenced) for protected species detected approaching, entering, or within the designated EZ.

Before the acoustic source could be activated after a period of silence, during daylight hours or during hours of darkness, two PSOs and one PAM operator conducted a 30-minute clearance survey of the BZ and EZs. In the event of a detection of protected species, a delay of source operations would be implemented **if**: (1) a marine mammal was detected approaching, entering, or within the 1,000 meter BZ; (2) if a northern sea otter was observed approaching, entering or within the 500 meter EZ, (3) if a protected seabird was detected foraging or diving within the 500 meter EZ; or (4) if a sea turtle was detected approaching, entering or within the 175 decibel radius. Source operations would not be cleared to begin until the protected species were observed exiting their designated BZ or EZs. If the animals were not observed leaving their designated BZ or EZs (i.e. if they dove within the zone and were not re-sighted), operations would not be cleared to begin until a specific time following the final detection of the animals. For detections of small odontocetes, pinnipeds, sea turtles, or sea birds, this time was 15 minutes following last sighting. For detections of mysticetes, large odontocetes, this time was 30 minutes following last sighting.

Once the acoustic source was active, the 1,000-meter buffer zone from any element on the acoustic source arrays was established as an area in which the presence of a protected species would initiate an alert to the seismic operators that the animal was detected, and that the implementation of a mitigation action may soon be required. PSOs and the PAM operator would keep in frequent contact with each other and the seismic team, relaying information on the location and movement of the animal(s), and the implementation of any mitigation actions, if required.

The 500-meter EZ from any active element on the full volume acoustic source array, and the 100-meter EZ from any single active 40 in^3 element were established as areas in which the presence of a marine mammal (with the exception of a few delphinid species) observed approaching, entering, or within the zones would initiate a shut-down of the acoustic source. A shut-down was also required for an acoustic only detection of marine mammal(s) (other than delphinids) that were confirmed to be within the 500-meter EZ. The 500-meter and 100-meter EZ were also utilized for protected sea otters and sea birds. If a

northern sea otter was observed approaching, entering, or within these EZs, the acoustic source would be powered-down (500-meter EZ) or shut-down (100-meter EZ). If a protected sea bird was visibly observed foraging or diving within these EZs, the acoustic source would be powered-down (500-meter EZ) or shut-down (100-meter EZ). For sea turtles, the acoustic source would be shut-down, if an individual was observed approaching, entering, or within the 195-decibel radius for the full volume source and the 100-meter EZ for a single active 40 in^3 element.

The shut-down requirement was waived for small dolphins of the genera *Lagenorhynchus* and *Grampus*. If PSOs could positively identify the dolphins sighted as one of these species, which included the Pacific white-sided dolphin (*Lagenorhynchus obliquidens*) and Risso's dolphin (*Grampus griseus*) from the species authorized for takes in the IHA and ITS, the acoustic source would be powered-down instead of shut-down if they were observed approaching, entering, or within the 500-meter EZ. However, if there was any doubt on the species identification, the source would be shut-down. If the acoustic source was powered-down due to the presence of one of the dolphin species for which the shut-down requirement was waived, the EZ was reduced to 100-meters around the single active element. If any other protected species were the observed approaching, entering, or within, the smaller 100-meter EZ, the acoustic source would then be shut-down. Visual PSOs could elect to waive the power-down requirement for these specific dolphin species if the individuals appeared to be voluntarily approaching the vessel for the purpose of interacting with the vessel or towed gear. However, if the PSOs observed the dolphins exhibiting any adverse behavior reactions, then a power-down was required.

Once the acoustic source had been powered-down for a detection of dolphins for which the shut-down requirement was waived, the source had to remain powered-down until the dolphins were no longer observed within the 500-meter EZ or the 30-minute time limit on power-downs had been reached. If the dolphns were no longer visually observed within the 500-meter EZ for less than 30 minutes after the power-down was initiated, source operations could be resumed at the previous operating volume without a ramp-up.

Once the acoustic source had been shut-down for a detection of protected species, a ramp-up was required to resume full volume operations, which would be cleared to begin once the protected species were confirmed to have exited their designated EZs. If the protected species were last observed within their designated EZs, ramp-up would not be cleared to begin until a specific time elapsed after the last sighting (either 15 or 30 minutes depending on the species).

The IHA and ITS also outlined several extra mitigation actions required for specific detections of protected species while the acoustic source was active, and for the vessel's activities within designated critical habitats within the survey area:

1. A shut-down was required when a large whale with a calf was observed at any distance from the vessel. Ramp-up would be cleared to begin 30 minutes after the whales last sighting.
2. A shut-down was required when an aggregation of large whales was observed at any distance from the vessel. An aggregation was defined as six or more mysticetes or sperm whales together in a group. Ramp-up would be cleared to begin 30 minutes after the whales last sighting.
3. A shut-down was required when a North Pacific right whale was observed at any distance from the vessel. Ramp-up would be cleared to begin 30 minutes after the whales last sighting.
4. A shut-down was required when a fin whale or group of fin whales was observed within the species' Gulf of Alaska feeding Biologically Important Area (BIA), within 1,500 meters of the acoustic source. Ramp-up would be cleared to begin 30 minutes after the whales last sighting.
5. A shut-down was required upon observation of any marine mammals' species not authorized for take that is entering or approaching the 160-decibel radius. Ramp-up would be cleared to begin 15 or 30 minutes after the last sighting of the individuals, depending on the species.
6. A shut-down was required upon observation of any authorized marine mammal species that had reached its total allotted number of takes that is entering or approaching the 160-decibel radius. Ramp-up would be cleared to begin 15 or 30 minutes after the last sighting of the individuals, depending on the species.

7. The vessel could not approach within three nautical miles of all known Steller sea lion rookeries and major haul-outs.
8. When transiting through the North Pacific right whale habitat during hours of darkness or conditions of similar limited visibility, the vessel was required to reduce speed to five knots.
9. Survey operations within the North Pacific right whale habitat could only be conducted during daylight.

Table 1 describes the predicted 160 decibel radius (Level B harassment zone for marine mammals), the predicted 175 decibel radius (Level B harassment zone for sea turtles), and the 195-decibel radius (Level A harassment zone for sea turtles). Table 2 describes the predicted Level A harassment zones for each marine mammal hearing group per the NMFS new guidelines, and the species that could occur in the survey areas assigned to each group. No specific harassment radii were designated for northern sea otters.

Table 1: Predicted 160/175/195 Decibel Zones* implemented during the survey program.

Source	Volume (in^3)	Water Depth (m)	160 dB radius – Level B harassment zone for marine mammals	175 dB radius – Level B harassment zone for sea turtles	195 dB radius – Level A harassment zone for sea turtles
1 element	40	<100	1,041	170	14
1 element	40	100-1,000	647	116	11
1 element	40	<1,000	431	77	8
36 elements	6600	<100	25,494	4,123	344
36 elements	6600	100-1,000	10,100	2,796	272
36 elements	6600	<1,000	6,733	1,864	181
*Distances are from any single element on the array					

Table 2: Predicted Level A Harassment Zones* for each marine mammal hearing group implemented during the survey program.

Source	Volume (in^3)	Low Frequency Cetaceans (m)	Mid Frequency Cetaceans (m)	High Frequency Cetaceans (m)	Otariid Pinnipeds (m)	Phocid Pinnipeds (m)
1 element	40	1.76	N/A	12.5	1.98	N/A
36 elements	6600	40.1	13.6	268.3	10.6	43.7
Species anticipated that could occur in the survey area: **Distances were from any single element on the acoustic source arrays*		• North Pacific Right Whale • Humpback Whale • Blue Whale • Fin Whale • Sei Whale • Minke Whale • Gray Whale	• Sperm Whale • Cuvier's Beaked Whale • Baird's Beaked Whale • Stenjeger's Beaked Whale • Killer Whale • Pacific White-Sided Dolphin • Risso's Dolphin	• Dall's Porpoise • Harbor Porpoise	• Steller Sea Lion • California Sea Lion • Northern Fur Seal	• Northern Elephant Seal • Harbor Seal

3.2. VISUAL MONITORING SURVEY METHODOLOGY

There were six trained and experienced PSOs on board the *Langseth* for each survey during the program to conduct the monitoring for protected species, record and report detections, and request mitigation actions in accordance with the PEIS, EA, USFWS LOC, IHA and ITS. The PSOs on board were NMFS approved and held certifications from a recognized Bureau of Ocean Energy Management (BOEM) course, and/or an approved Joint Nature Conservation Committee (JNCC) course. Visual monitoring was primarily carried out from an observation tower (Figure 2) located 18.9 meters above the surface of the water, which allowed a 360-degree view of the vessel and acoustic source.

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

The PSO tower was equipped with Fujinon 7x50 and Steiner Marine 7x50 binoculars, as well as two mounted 25x150 Big-eye binoculars, and a D-300-2MS Night Optics USA, Inc. monocular (for visual clearance and monitoring of night time ramp-ups). In addition, a Butler Creek PVS-7-night vision monocular was secured in the bridge and could be requested for use by the PSOs as needed. Inside the tarpaulin tent located in the middle of the platform was a laptop for data collection, and a telephone for communication with the PAM station, bridge, and main lab. There was also a monitor that 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 tower; however, during severe weather or when the ships exhaust was blowing on the tower, observations would be conducted from the bridge (approximately 12.8 meters above sea level) or the catwalk (approximately 12.3 meters above sea level) around the bridge.

Visual monitoring methods were implemented in accordance with the survey requirements outlined in the IHA and ITS. Two PSOs always visually monitored for protected species during daylight hours 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 was conducted to gather baseline data on the presence and abundance of protected species in the areas. When the acoustic source was activated from silence at dawn or dusk, two PSOs would begin or end visual monitoring earlier or later to ensure that the entire 30-minute pre-clearance and ramp-up were monitored. When the acoustic source was activated from silence during hours of darkness, two PSOs would visually monitor the 30-minute pre-clearance and ramp-up

until the source reached full volume. Visual monitoring during dawn, dusk and night hours was conducted using the two night-vision monoculars.

Monitoring was conducted each day from 30 minutes before sunrise until 30 minutes after sunset as required by the IHA and ITS. Observation times ranged between approximately 12:30 to 07:30 Coordinated Universal Time (UTC) (approximately 04:30 to 23:30 local time). 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 followed by at least one hour of scheduled break time.

Visual observations were conducted around the entire area of the vessel and acoustic source, with each PSO on watch focused on a specific half of the area. The smaller monitoring area for each observer increased the probability of protected species being sighted. 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, such as the acoustic source arrays and streamer head floats. 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 ITS 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 two provided Canon EOS 80D cameras that had 300-millimeter telephoto lenses. Marine mammal identification manuals were consulted, and photos were examined during observation breaks to confirm identifications.

3.3. PASSIVE ACOUSTIC MONITORING (PAM) SURVEY METHODOLOGY

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 seismic operations and to the maximum extent possible during periods of acoustic source silence. When the acoustic source was activated from any period of silence, acoustic monitoring was conducted for at least 30 minutes prior to the activation of the source along with visual monitoring for the pre-clearance survey.

In accordance with the IHA and ITS, in the event of an issue with any of the PAM equipment, acoustic source activity could continue for 30 minutes without acoustic monitoring while the PAM operator diagnosed the issue. If the diagnosis indicated that the PAM system needed maintenance, operations could continue for an additional five hours without acoustic monitoring provided that no marine mammals (excluding delphinids) were detected solely by PAM within the EZs in the previous two hours, operations without acoustic monitoring did not exceed a total of five hours in any 24 hour period, and NMFS was notified as soon as practicable of the time and location operations without PAM began.

One PSO trained and experienced with the PAM system was designated as the Lead PAM Operator and oversaw all PAM operations during each survey. Other PSOs trained in the use of the PAM system also conducted acoustic monitoring to ensure continuous PAM operations. PAM shifts were no longer than four hours in duration followed by at least a one-hour break.

The PAM system was located in the main science lab to provide space for the system, allow for quick communication with the visual PSOs and seismic technicians, and provide 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.

3.3.1. Passive Acoustic Monitoring (PAM) Parameters

A PAM system designed to detect most species of marine mammals was installed onboard the *Langseth*. 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, RME Fireface 800 unit and computer; two desktop monitors; acoustic analysis software package; and headphones for aural monitoring. On this project, the PAM operators used two pre-installed, wall-mounted computer monitors supplied by the *Langseth*. A spare hydrophone cable, deck cable, rack-mounted DPU and computer, monitors, and headphones were

also present onboard in the event the main system components became damaged or inoperable. The diagram in Figure 3 is a simplified depiction of the PAM system installed on the *Langseth*, and further PAM system specifications can be found in Appendix C.

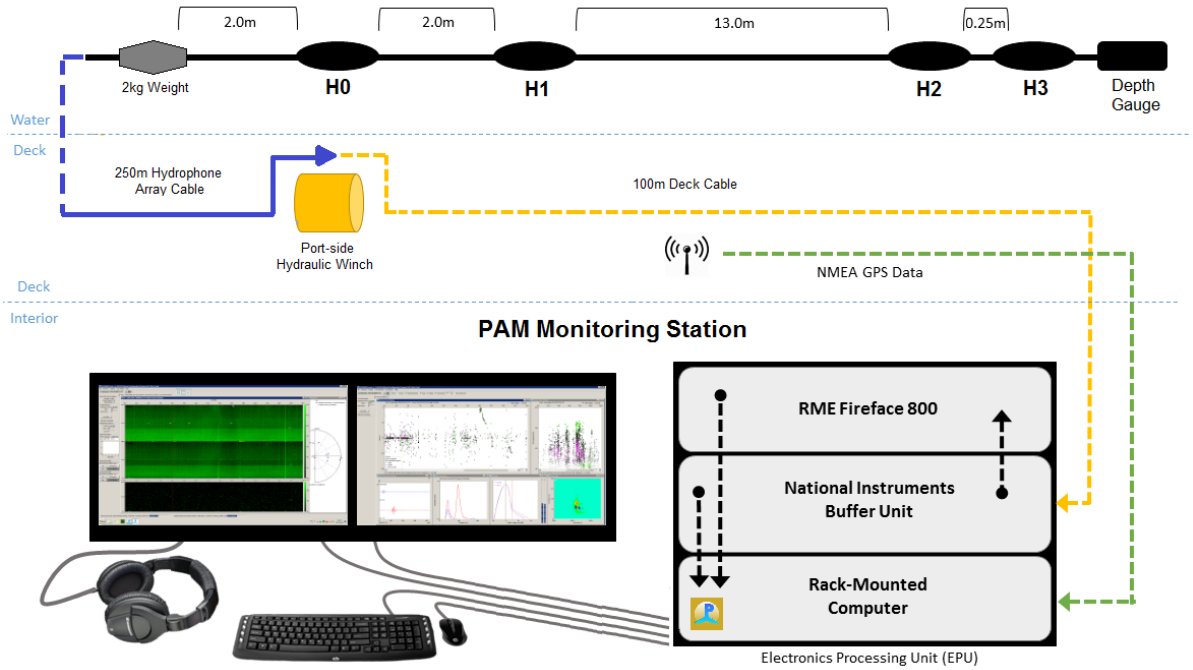

Figure 3: Simplified pathway of data through the PAM system on board the *Langseth*.

The hydrophone cable contained four hydrophone elements and a depth gauge molded into a 20 m section of the cable. The four-element linear hydrophone array allowed the system to sample a large range of marine mammal vocalization frequencies. The first two hydrophones (H0 and H1) were broadband elements, with a frequency response of 200 hertz to 200 kilohertz. The third and fourth hydrophones (H2 and H3) were standard elements, with a frequency response of two kilohertz to 200 kilohertz.

The deck cable interfaced between the hydrophone cable and the electronics processing unit (EPU) located in the main science lab. The hydrophone cable was installed on a winch on the main back deck of the vessel. 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 Seapath 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* version 1.15.11 was the software version utilized for the survey.

Raw feed from the two standard hydrophone elements (H2 and H3) 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. Clicks were measured at sixth order (Butterworth) with a high-pass digital pre-filter of 30 kilohertz and a high-pass trigger filter of 40 kilohertz. *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 was designated for displaying *Pamguard* HF click detector and sound recorder modules.

Raw feed from the two broadband hydrophone elements (H0 and H1) was routed from the buffer unit to the RME Fireface 800 unit, where it was digitized at a sampling rate of 48 kilohertz. The 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 on 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* contained 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 the clicks or whistles and plotted on a map display. 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.

3.3.2. Hydrophone Deployment

The hydrophone cable was deployed from a hydraulic winch on the portside of the vessel's stern where the acoustic source arrays were deployed. Two deck cables, a main and a spare, were installed along the deck-head running from the winch to the main science lab. The hydrophone cable was attached via tow rope to the port side boom to move the cable further away from the vessel and source arrays. This deployment placed the trailing end of the hydrophone cable 100 meters from the port stern of the vessel, and 93 meters forward of the first elements on the source arrays (Figure 4). A more detailed description of the hydrophone deployment method, including photos of the installation, can be found in Appendix D.

There were several adjustments to the deployment position of the PAM cable between 11 and 21 June 2019. Due to rough seas throughout the survey program, the hydrophone cable became entangled with the source array on three occasions. The deployment of the cable was adjusted between the port and starboard stern of the vessel on five occasions throughout the survey in order to prevent further entanglements with the seismic equipment.

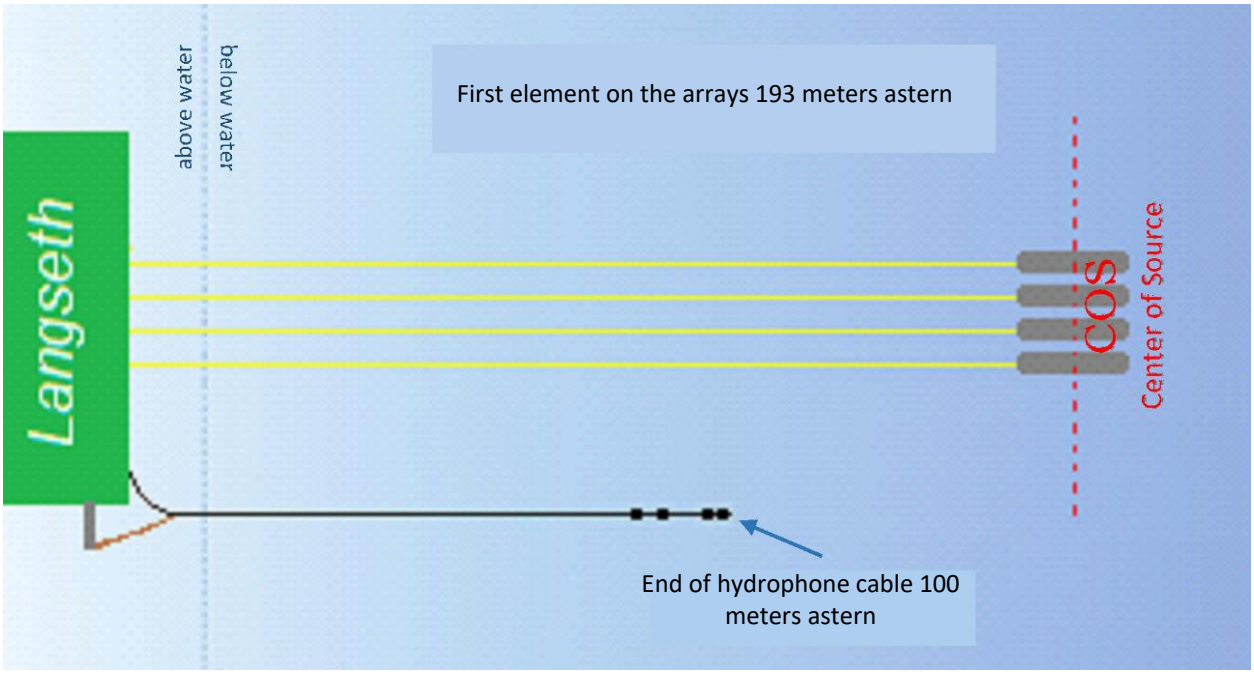

Figure 4. Location of the PAM cable in relation to the seismic gear during the survey program.

4. MONITORING EFFORT SUMMARY

4.1. SURVEY OPERATIONS SUMMARY

4.1.1. General survey parameters

The Gulf of Alaska seismic survey program was conducted in one 2D survey (Table 3). The dates and times of acquisition for each survey line can be found in Appendix E.

Table 3: Survey parameters of the program.

Survey Parameter	Date	Time (UTC)	Location
Mobilization	08 June 2019	01:00	Kodiak, Alaska
First Source Activity	08 June 2019	14:55	-
Start of Acquisition	08 June 2019	20:21	-
End of Acquisition	23 June 2019	03:53	-
Demobilization	24 June 2019	21:30	Kodiak, Alaska

During the program, data was acquired continuously according to the survey plan, with survey operations only suspended when operationally necessary, as outlined in Table 4.

Table 4: Suspension of survey operations during the survey program.

Date	Time Source silenced	Time Ramp-up Initiated	Reason for Interruption in Acquisition
16 Jun 19	07:03	16:04	Retrieval of streamer due to weather
21 Jun 19	08:08	14:42	PAM cable became entangled with the acoustic source arrays twice due to rough sea conditions. Survey operations suspended until seas calmed enough to allow the PAM cable to be re-deployed and acoustic monitoring to resume.

4.1.2. MBES, SBP and ADCP operations

The multi-beam echosounder (MBES), sub-bottom profiler (SBP), and the Acoustic Doppler current profiler (ADCP) were active throughout the majority of the survey program while the vessel was in the permitted survey area. The systems were initiated for the first time at 16:54 UTC on 08 June 2019 and disabled for the last time at 09:13 UTC on 23 June 2019 at the end of survey operations.

4.1.3. Acoustic source operations

The acoustic source was active for a total of 330 hours two minutes throughout the survey program. This total includes ramp-up of the acoustic source, full and reduced volume operations on a survey line, full and reduced volume operations not on a survey line and testing of the acoustic source elements. Table 5 summarize the acoustic source operations over the course of the seismic survey program.

The acoustic source was ramped-up nine times totaling two hours 39 minutes. After the initial ramp-up of the survey to commence acquisition operations, there was one ramp-up conducted to resume operations after a period of silence for retrieving and deploying seismic equipment. There was one ramp-up conducted to resume operations after a period of silence due to an entanglement of the PAM cable with the seismic gear. There were six ramp-ups conducted after a mitigation shut-down for protected species.

Ramp-ups averaged 22 minutes in duration and were conducted using the automated controller program, DigiShot, which added source elements sequentially to achieve the full source volume over the required

period. Ramp-ups were performed by cycling each source element two times at a shot point interval of 17 seconds, adding an additional element after each cycle until all 18 or 36 elements were operating. All nine ramp-ups initiated during daylight hours were cleared and monitored both visually and acoustically as required. One of the ramp-ups after a mitigation shut-down for protected species was only two minutes in duration because a second shut-down was initiated for another mitigation action.

There were no operations with only a single 40 in^3 source element throughout the survey. In accordance with the IHA and ITS, operation of a single 40 in^3 source element was limited to 30 minutes in duration, after which the source would be resumed at full volume or silenced depending on if the protected species remained in the EZ at that time or not.

There was one occasion of acoustic source testing during the survey program totaling one minute. The test was conducted on 08 June 2019, with a volume of 220 in^3 over one element.

Figure 5 shows the geospatial data for source operations conducted during each of the three surveys of the program.

Table 5. Total acoustic source operations during the survey program.

Acoustic Source Operation	Number	Duration
Source Tests	1	00:01
Ramp-up	9	02:39
Day-time ramp-ups from source silence	9	02:39
Night-time ramp-ups from source silence	0	00:00
Full 6600 in^3/Reduced Volume on a Survey Line[1]		318:39
Full 6600 $in^{3)}$/Reduced Volume not on a Survey Line[2]		08:43
Single Source Element (40 in^3)		00:00
Total Time Acoustic Source Was Active		330:02
1. **On a Survey Line:** 277:08 (full volume), 41:31 (reduced volume) 2. **Not on a Survey Line:** 08:19 (full volume), 00:24 (reduced volume)		

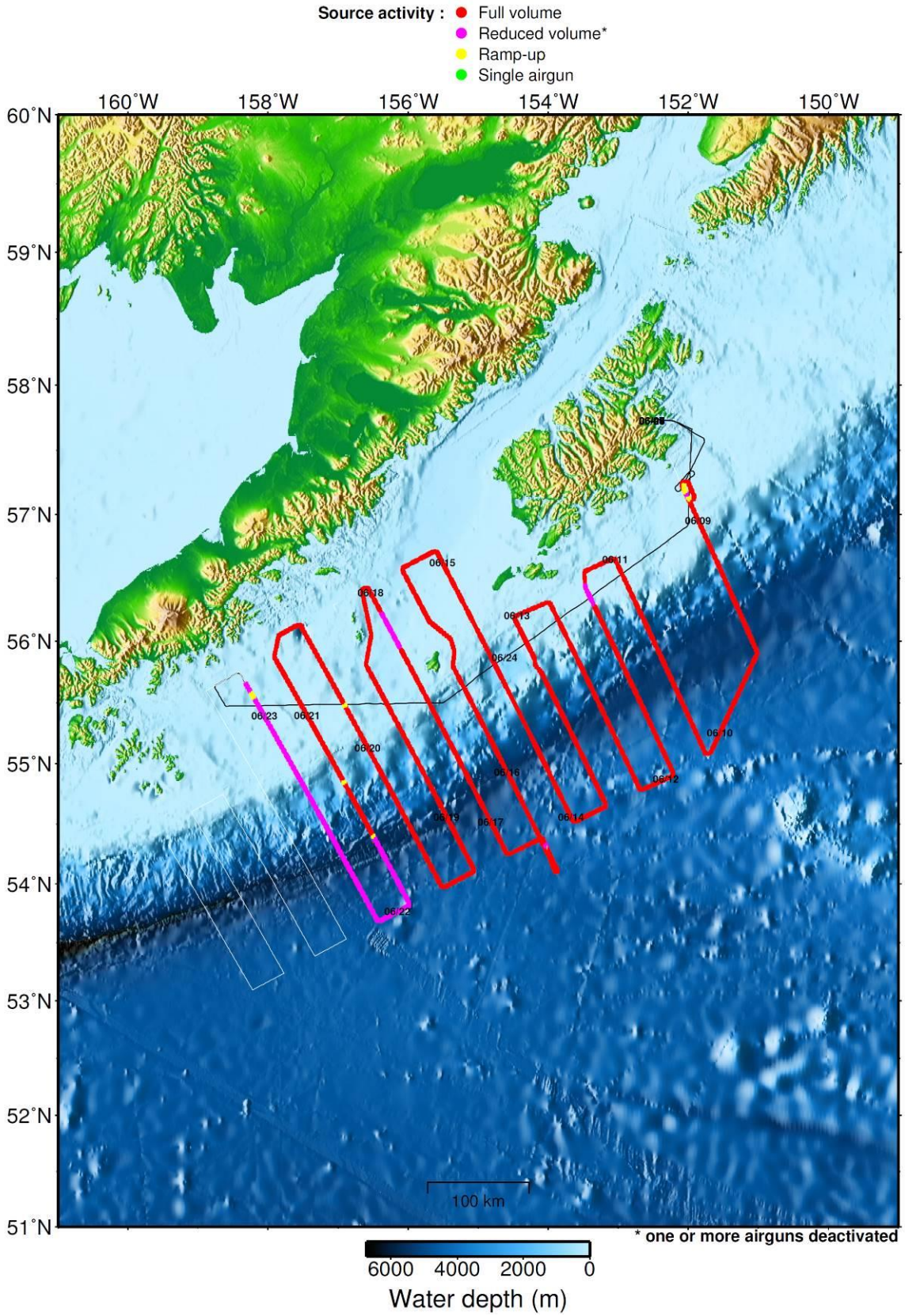

Figure 5: Geospatial data of source operations for the Gulf of Alaska survey area.

In addition to operations outlined in Table 4, the acoustic source was silenced for mechanical / technical reasons on one occasion during the survey (Table 6) and a ramp-up of the source was necessary to resume operations. Per the IHA, brief periods (less than 30 minutes) of operational silence due to mechanical/technical shut-downs did not require a ramp-up to resume full volume source operations provided that: (1) PSOs have maintained constant visual and/or acoustic observation, and (2) no visual or acoustic detections of protected species occurred within the applicable exclusion zone. For any brief mechanical/technical shut-down at night or in periods of poor visibility (e.g. BSS of four or greater), a ramp-up was required, but if the constant observation was maintained, a pre-clearance watch of 30 minutes was not required. For any longer shut-down, both a 30 pre-clearance watch and a ramp-up were required.

Table 6: Mechanical and technical source silence.

Date	Reason for Source Silence	Time Acoustic Source Silenced (UTC)	Time Acoustic Source Resumed (UTC)
08 Jun 19	Communication error on sub-array one during first ramp-up of the project	15:08	16:44

The volume of the acoustic source was changed (reduced or increased) on multiple occasions during the Gulf of Alaska survey program for a variety of reasons including, but not limited to, issues with individual source elements, routine source maintenance, entanglement of the PAM cable with the source arrays, and operations being suspended for rough seas. However, source volumes never exceeded the maximum full volume considered under the IHA. Specific information about each instance where acoustic source volume changed can be found in Appendix F.

4.1.4. Interactions with Other Vessels

In addition to visually monitoring for protected species, PSOs also observed and documented interactions with other vessels. 16 other vessels were observed in the vicinity of the R/V *Langseth*, including two cargo vessels, one ferry, eight fishing vessels, three recreation vessels, one research vessel, and one tourist vessel. These vessels had an average closest distance of 7,155 meters to the *Langseth*, ranging between 100 and 20,370 meters. Table 7 lists the number of each vessel type observed during the survey program as well as the closest, farthest, and average distances each vessel type was observed to the *Langseth*.

Table 7: Other vessels observed during the survey program.

Vessel Type	Total Number Observed	Recorded Distance to the *Langseth* (meters)		
		Average	Closest	Farthest
Cargo	2	12,338	10,600	14,075
Ferry	1	20,370	20,370	20,370
Fishing	8	5,952	200	11,112
Recreation	3	866	100	1,500
Research	1	17,223	17,223	17,223
Tourist	1	2,000	2,000	2,000

There were no occasions where other vessels, or another vessels gear/equipment, were observed having some type of interaction with the *Langseth's* seismic gear. There was one occasions on 13 June 2019 when the Langseth had to deviate approximately 1,000 meters from a survey line due to fishing gear sighted ahead of the vessel.

4.2. VISUAL MONITORING SURVEY SUMMARY

Visual monitoring during survey program was conducted by two PSOs during all daylight hours, beginning 30 minutes before sunrise and ended 30 minutes after sunset each day. Watches started when the vessel left the dock and terminating upon return to port upon completion of the survey (Table 8). This included times when the vessel was in transit and deploying and retrieving equipment. Visual monitoring during times with no source operations was conducted to collect baseline data about protected species abundance in the survey areas.

Table 8: Initiation and termination of visual monitoring during the survey program

Visual Monitoring	Date	Time (UTC)
Initiation for the survey program	08 June 2019	01:01
Termination for the survey program	24 June 2019	21:30

Visual monitoring was conducted over a period of 17 days for a total of 311 hours. Of the overall total visual monitoring effort, 85% (263 hours 46 minutes) was undertaken while the acoustic source was active, and 15% (47 hours 14 minutes) was undertaken while the acoustic source was 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 9 details visual monitoring with acoustic source operations throughout the survey program.

Table 9. Total visual monitoring effort during the survey program

Visual Monitoring Effort	Duration (hh:mm)	% of Overall Visual Monitoring Effort
Total monitoring while acoustic source active	263:46	85%
Total monitoring while acoustic source silent	47:14	15%
Total monitoring effort	**311:00**	**100%**

PSOs conducted visual monitoring from the bridge (87.74%) more often than any other location. The majority of the monitoring from the bridge was conducted due to the exhaust blowing out of the engine stacks and into the tower. Bridge monitoring was also conducted due to several days having high winds and large swells which made monitoring from the tower unsafe. Monitoring was conducted from the bridge and the catwalk and tower and catwalk simultaneously when the ships exhaust was only blowing on part of the tower but monitoring conditions were otherwise favorable (Table 10).

Table 10: Total visual monitoring effort from observation locations during the survey program

Observation Location During Visual Effort	Duration (hh:mm)	% of Overall Effort
Tower	11:13	3.61%
Bridge	272:52	87.74%
Catwalk	8:28	2.72%
Tower/Bridge	1:56	0.62%
Tower/Catwalk	1:00	0.32%
Bridge/Catwalk	15:31	4.99%

4.3. ACOUSTIC MONITORING SURVEY SUMMARY

Acoustic monitoring was conducted continuously throughout acoustic source operations and to the maximum extent possible while the acoustic source was silent from the first deployment of the PAM cable to the final retrieval of the cable upon completion of a survey program (Table 11). Brief periods of source activity without acoustic monitoring were conducted for any needed assessments, adjustments, or maintenance to the PAM system. Periods without source activity or acoustic monitoring occurred when

the PAM hydrophone cable was secured on board the vessel during transits, during deployment and recovery of the seismic gear, and during times when operations were suspended due to rough weather and sea conditions.

Table 11: Initiation and termination of acoustic monitoring watches during the survey program.

Acoustic Monitoring	Date	Time (UTC)
Initiation for the survey program	08 June 2019	10:16
Termination for the survey program	23 June 2019	08:45

Acoustic monitoring was conducted on 16 days for a total of 339 hours 34 minutes. Of the overall total acoustic monitoring effort, 96% (325 hours 13 minutes) was undertaken while the acoustic source was active, and 4% (14 hours 21 minutes) was undertaken while the acoustic source was silent. Acoustic monitoring while the acoustic source was silent was conducted during the brief periods of time between recovery/deployment of the seismic gear and recovery/deployment of the PAM cable. Table 12 details acoustic monitoring with acoustic source operations throughout the program.

Table 12. Total Passive Acoustic Monitoring (PAM) effort during the survey program.

Acoustic Monitoring Effort	Duration (hh:mm)	% of Overall Acoustic Monitoring Effort
Total night time monitoring	69:16	20%
Total day time monitoring	270:18	80%
Total monitoring while the acoustic source was active	259:23	96%
Total monitoring while the acoustic source was silent	14:21	4%
Total acoustic monitoring	**339:34**	**100%**

Acoustic monitoring was suspended six times for rough seas, entanglement of the PAM cable with the seismic equipment, adjusting the deployment of the PAM cable to prevent an entanglement, and deployment and retrieval of the seismic equipment. Acoustic monitoring downtime was calculated as any time acoustic monitoring was not conducted between when the hydrophone cable was deployed for the first time at the beginning of the survey, and when the hydrophone cable was retrieved for the final time at the end of the survey.

Acoustic monitoring downtime totaled 18 hours 55 minutes. Most of the downtime was due to rough seas/entanglements of the PAM cable and deployment and retrieval of seismic equipment (Table 13). Each instance of acoustic monitoring downtime is recorded in Appendix G. In accordance with the IHA and ITS, acoustic monitoring downtime occurred during acoustic source activity only when the need was unavoidable. Throughout the entire survey program, only four hours 49 minutes of acoustic monitoring downtime occurred while the acoustic source was still active. These occurrences were attributed to adjusting the deployment of the cable to prevent further entanglements.

Table 13. Passive Acoustic Monitoring (PAM) downtime during the survey program.

Cause of Downtime	Duration (hh:mm)	% of Overall Downtime
Rough Seas/Entanglement	**08:55**	**47%**
Adjustment of the PAM Cable Deployment	**01:36**	**9%**
Seismic Gear Deployment/Retrieval	**08:24**	**44%**
Total Passive Acoustic Monitoring Downtime	**18:55**	**100%**

4.4. SIMULTANEOUS VISUAL AND ACOUSTIC MONITORING SUMMARY

Simultaneous visual and acoustic monitoring was conducted to the maximum extent possible for a total of 270 hours 18 minutes. Of the overall simultaneous monitoring effort, 96% were conducted while the acoustic source was active (Table 14). Additional visual monitoring conducted during transit periods was not accompanied by acoustic monitoring as the increased vessel speed caused the hydrophone cable to change depth and move out of the ideal tow position. The high placement in the water increased background noise which impaired acoustic detection capabilities.

Table 14: Simultaneous visual and acoustic monitoring effort during the survey program.

Simultaneous Visual and Acoustic Monitoring	Duration (hh:mm)	% of Overall Downtime
Source Active	**259:23**	**96%**
Source Silent	**10:55**	**4%**
Overall Total	**270:18**	**100**

4.5. ENVIRONMENTAL CONDITIONS

Environmental conditions can have an impact on the probability of detecting protected species in a survey area. The environmental conditions during visual observations were generally considered to be moderate.

Visibility was classified as 'excellent' if it extended to 10 kilometers or greater, 'good' if it was between six and nine meters, 'moderate' if it was between two and five kilometers, and 'poor' if it was less than two kilometers. Throughout the survey program, the visibility was highly variable, with only 20% and 23% of monitoring effort conducted during 'excellent' and 'good' visibility levels respectively (Table 15).

Table 15. Visibility during the survey program.

Total	<2 km	2-5 km	6-9 km	>10 km
Duration (HH:MM)	**81:11**	**97:48**	**69:54**	**62:07**
% of effort	**26%**	**31%**	**23%**	**20%**

Reduced visibility was mainly attributed to periods of rain and fog, and the brief periods of reduced lighting before sunrise and after sunset. Precipitation was recorded during 63% of visual monitoring, for a total of 197 hours 40 minutes. The majority of the precipitation was fog (51%, 159 hours 27 minutes) (Table 16).

Table 16. Precipitation during the survey program.

Total	None	Light Rain	Heavy Rain	Squall	Fog
Duration (HH:MM)	**113:20**	**38:13**	**00:00**	**00:00**	**159:27**
% of effort	**37%**	**12%**	**0%**	**0%**	**51%**

During visual monitoring, the entire predicted 160 decibel radius was not visible for 250 hours 50 minutes (80% of all visual monitoring effort), mainly due to precipitation and the large size of the radii, which in shallow water was never fully visible. The entire 1,000 meter buffer zone was not visible for 59 hours 18 minutes, the entire 500 meter exclusion zone was not visible for 35 hours 46 minutes, and the entire 100 meter exclusion zone was not visible for 25 hours 18 minutes ((Table 17).

Table 17. Duration radii were NOT fully visible during the survey program.

Total	160 dB	1000 m	500 m	100 m
Duration (HH:MM)	**250:50**	**59:18**	**35:46**	**25:18**
% of effort	**80%**	**19%**	**12%**	**8%**

The Beaufort Sea state recorded during visual monitoring ranged from level one to level six over the course of the survey program. The majority of visual observations (206 hours 45 minutes, 67%) were undertaken in conditions where the Beaufort state was level 3 or less, which were considered good conditions for the detection of protected species (Table 18).

Table 18. Beaufort Sea State during the survey program.

Total	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
Duration (HH:MM)	**08:11**	**88:39**	**109:34**	**75:10**	**27:47**	**01:20**	**00:00**	**00:00**	**00:00**	**00:00**
% of effort	**3%**	**29%**	**35%**	**24%**	**8%**	**1%**	**0%**	**0%**	**0%**	**0%**

The Beaufort wind force recorded during visual monitoring ranged from one (one to three knots) to eight (34 to 40 knots). The majority of visual monitoring occurred during a recorded wind force of four (11 to 16 knots) for a total of 120 hours 59 minutes (39% of all visual monitoring effort). The highest wind speeds, between 28 and 40 knots (levels seven and eight), were recorded for a total of 17 hours 27 minutes (6% of the overall project total) (Table 19).

Table 19. Beaufort Wind Force during the survey program.

Total	B1 (1-3 knots)	B2 (4-6 knots)	B3 (7-10 knots)	B4 (11-16 knots)	B5 (17-21 knots)	B6 (22-27 knots)	B7 (28-33 knots)	B8 (34-40 knots)	B9 (41-47 knots)	B10 (48-55 knots)
Duration (HH:MM)	**07:57**	**25:54**	**41:38**	**120:59**	**49:49**	**47:16**	**14:20**	**30:07**	**00:00**	**00:00**
% of effort	**3%**	**8%**	**13%**	**39%**	**16%**	**15%**	**5%**	**1%**	**0%**	**0%**

Swell heights during visual observations were generally low, with swells of less than two meters recorded for the majority of visual observations (232 hours 17 minutes, 75% of the total visual effort, (Table 20).

Table 20. Swell height during the survey program.

Total	<2m	2-4m	>4m
Duration (HH:MM)	**232:17**	**78:43**	**00:00**
% of effort	**75%**	**25%**	**0%**

The majority of visual monitoring effort was conducted while no glare was present, for a total of 228 hours 43 minutes (74%, Table 21). During times of moderate to severe glare, it is possible that the detection of protected species was hindered.

Table 21. Glare during the survey program.

Total	None	Little	Moderate	Severe
Duration (HH:MM)	**228:43**	**28:28**	**21:09**	**32:40**
% of effort	**74%**	**9%**	**7%**	**10%**

5. MONITORING AND DETECTION RESULTS

5.1. VISUAL DETECTIONS

Visual monitoring efforts during the survey program resulted in a total of 48 detections of protected species (summarized in Appendix H). This total included: 38 detections of whales, one detection of dolphins, two detections of porpoises (one of which occurred concurrently with an acoustic detection of the animals), four detections of pinnipeds, and three detections of mustelids. Table 22 lists the total number of detections and total number of animals recorded for each protected species observed during the survey program. Photographs taken of visual detections can be found in Appendix J. More detailed information about each sighting event can be found in Appendix H.

Table 22. Number of visual detection records collected for each protected species during the survey program.

Species	Total Number Detection Records	Total Number Animals Recorded
Whales		
Fin Whale	12	32
Humpback Whale	2	2
Unidentified Whale	24	38
Dolphins		
Killer Whale	1	10
Porpoise		
Dall's Porpoise	2*	9
Pinnipeds		
Northern Fur Seal	1	1
Unidentified Pinniped	3	3
Mustelids		
Northern Sea Otter	3	8
TOTAL	48	103

***One of the detections occurred simultaneously with an acoustic detection of the species and were not counted as separate detections towards the overall project total.**

Unidentified whales were the most frequent and numerous observed species, totaling 50% of all detections and 37% of all individuals observed. Fin whales were the second most frequent and numerous species observed, totaling 25% of all detections and 31% of all individuals observed. Killer whales and fin whales had the largest pods observed during the survey program. The one sighting of killer whales included 10 individuals, and there were two sightings of fin whale pods that included nine and eight individuals respectively. Group sizes for unidentified whales ranged between one and four individuals. The two sightings of Dall's porpoise consisted of six and three individuals, respectively. Humpback whales, northern fur seals, and unidentified pinnipeds were only observed with one individual per detection, while northern sea otter detections varied between one and five individuals.

The majority of the protected species detections occurred while the vessel was on a survey line (38 detections, 79% of all protected species detections) (Figure 6). The three detections of northern sea otters all occurred while the vessel was transiting in and out of port at the beginning and end of the survey program. The majority of the whale detections, and all of the pinniped, dolphin, and porpoise detections occurred south-west of Kodiak, during the last several survey lines of the project (Figure 7).

There was a large variability in weather conditions. However, in general, days with high numbers of visual detections corresponded with days with high visibility, small swells, and calm seas (Figure 8).

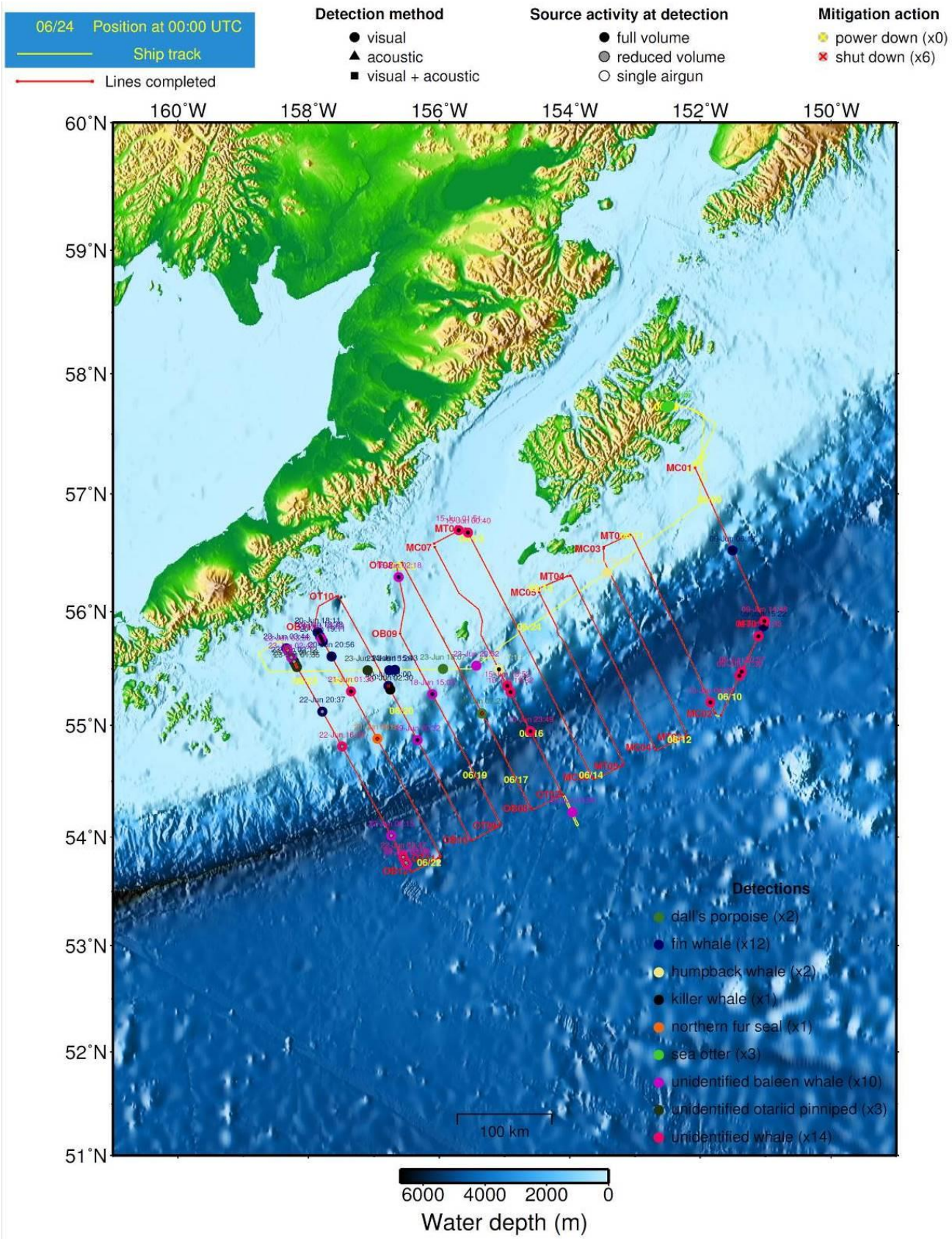

Figure 6: Protected species detections and vessel track lines during the survey.

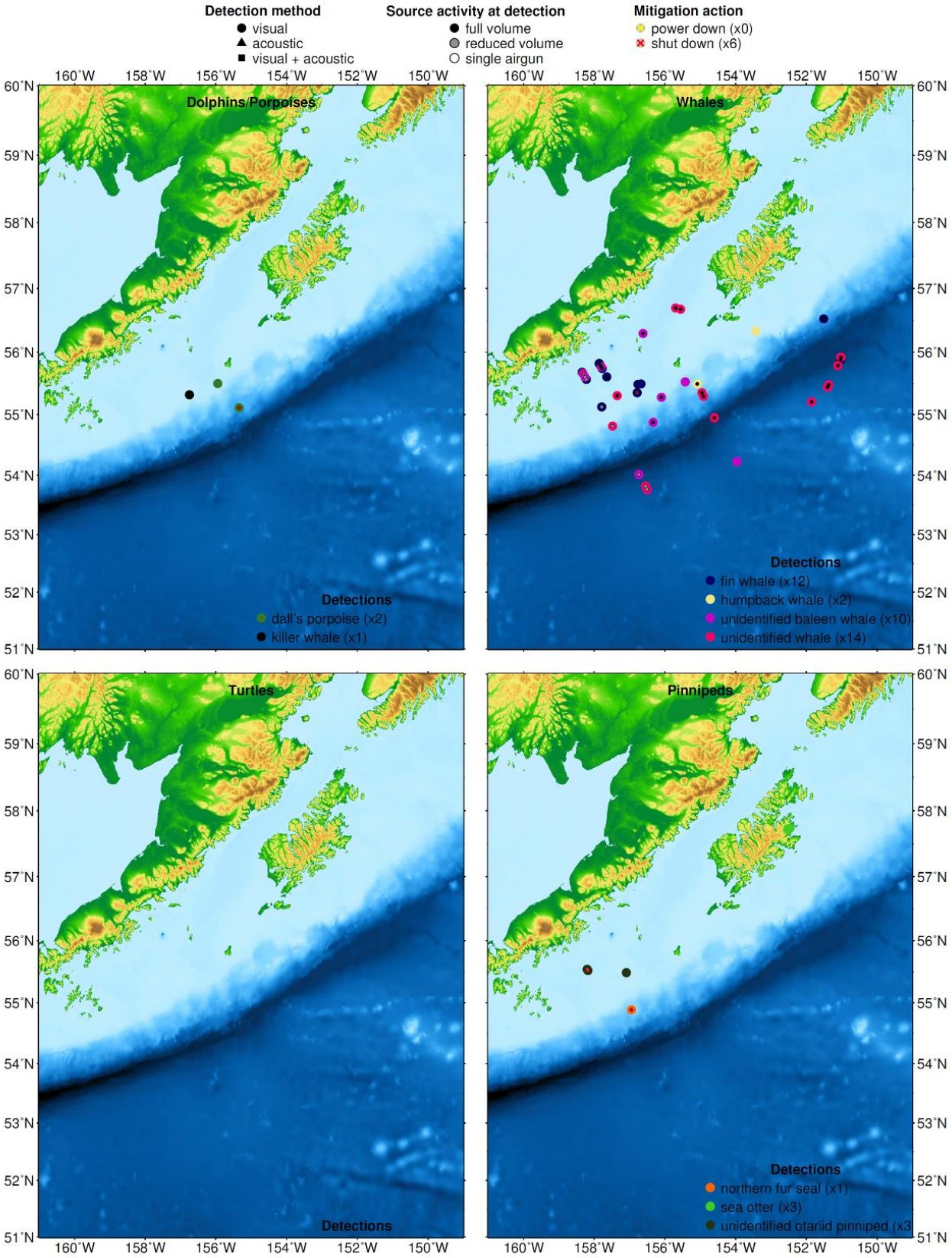

Figure 7: All protected species observed during the survey by species group.

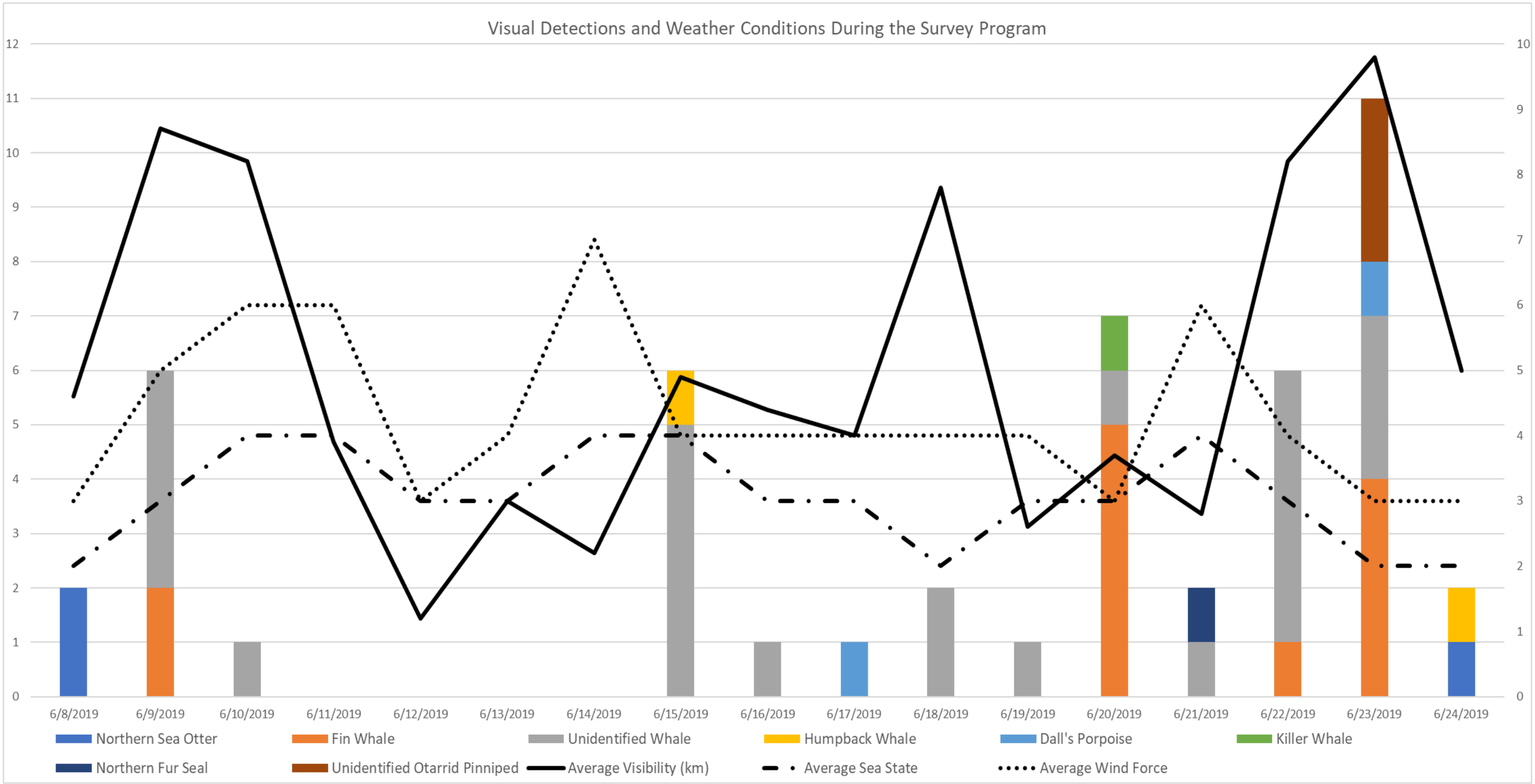

Figure 8: Number of protected species detections each day of the survey program and corresponding weather data for each day.

Of the 48 visual detections of protected species, 36 detections (75% occurred/began while the acoustic source was active at full volume on a survey line, two detections (4%0 occurred/began while the acoustic source was being ramped-up, and 10 detections (21%) occurred while the acoustic source was silent.

The 36 detections of protected species that began/occurred while the acoustic source was active at full or reduced volume on a survey line included: nine sightings of fin whales, one sighting of a humpback whales, 22 sightings of unidentified whales, one sighting of killer whales, one sighting of a northern fur seal, and one sighting of an unidentified pinniped. Of these species, Dall's porpoise, northern fur seal, and unidentified pinnipeds had the closest observed distances to the acoustic source, with closest distances of 246 meters, 323 meters, and 230 meters respectively. These three detections also resulted in a shut-down of the acoustic source, and after the source was silenced, these species had closest observed distances of 190 meters, 202 meters, and 230 meters respectively. Fin whales had and average closest distance of 1,564 meters, ranging between 427 meters and 4,650 meters. The detection where the closest distance to the active source was 427 meters resulted in a shut-down of the acoustic source, and the whales then had a closest observed distance of 350 meters to the silent array. The humpback whale had a closest observed distance of 793 meters to the active source, while the killer whales had a closest distance of 1,574 meters. Unidentified whales had an average closest distance of 2,664 meters, ranging between 483 meters and 4,600 meters.

The two detections that began/occurred while the acoustic source was being ramped-up included one sighting of fin whales and one sighting of an unidentified pinniped. The fin whale had a closest distance of 1,836 meters while the pinniped had a closest distance of 270 meters.

The 10 detections that occurred while the acoustic source was silent included two sightings of fin whales, one sighting of a humpback whales, two sightings of unidentified whales, one sighting of Dall's porpoise, and three sightings of northern sea otters. All off these detections occurred while the acoustic source was silent and on board the vessel during transit to or from port. Had the acoustic source arrays been deployed, fin whales would have had closest distances of 190 meters and 699 meters. The humpback whale would have had a closest distance of 1,100 meters, while the Dall's porpoise would have had a closest distance of 265 meters. Unidentified whales would have had closest distances of 1,748 meters and 2,650 meters, while unidentified pinnipeds would have had a closest distance of 313 meters. Finally, northern sea otters would have had closest distances of 100 meters, 150 meters, and 200 meters.

Table 23. Average closest approach of protected species to the acoustic source at various volumes during the survey program.

Species Detected	Full or Reduced Volume on a Survey Line		Full or Reduced Volume Not on a Survey Line		Single 40 in³ Element		Ramp-up		Source Silent and Deployed[1]		Source Silent and Onboard[2]	
	Number of detections	Average closest approach to source (meters)	Number of detections	Average closest approach to source (meters)	Number of detections	Average closest approach to source (meters)	Number of detections	Average closest approach to source (meters)	Number of detections	Average closest approach to source (meters)	Number of detections	Average closest approach to source (meters)
Fin Whale	9	1,564	-	-	-	-	1	1,836	-	350	2	444
Humpback Whales	1	793	-	-	-	-	-	-	-	-	1	2,199
Unidentified Whale	22	2,664	-	-	-	-	-	-	-	-	2	1,100
All Whales	**32**	**2,296**	**-**	**-**	**-**	**-**	**1**	**1,836**	**-**	**350**	**5**	**1,277**
Killer Whales	1	1,574	-	-	-	-	-	-	-	-	-	-
All Dolphins	**1**	**1,574**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Dall's Porpoise	1	246	-	-	-	-	-	-	-	190	1	265
All Porpoise	**1**	**246**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**190**	**1**	**265**
Northern Fur Seal	1	323	-	-	-	-	-	-	-	303	-	-
Unidentified Pinniped	1	230	-	-	-	-	1	270	-	-	1	313
All Pinnipeds	**2**	**276**	**-**	**-**	**-**	**-**	**1**	**270**	**-**	**303**	**1**	**313**
Northern Sea Otter	-	-	-	-	-	-	-	-	-	-	3	150
All Mustelids	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**150**
All Protected Species	**36**	**2,367**	**-**	**-**	**-**	**-**	**2**	**1,053**	**-**	**375**	**10**	**741**

1. For distances without a corresponding number of detections in the previous cell, the detections began while the acoustic source was active, and these are the closest distances of the individuals to the source after it had been shut-down for a mitigation action.
2. For detections which occurred during acoustic source silence while the arrays were onboard during transits, the closest distance to the source was calculated as if the arrays had been deployed.

5.1.1. Other Wildlife

Observations of other wildlife during the survey program included 23 species of birds and three species of marine invertebrates. A complete list of birds and other marine wildlife observed and identified, in addition to the approximate number of individuals observed and the number of days on which they were observed, can be found in Appendix L. No impacts to any other wildlife species as a result of research activities were observed during the survey program.

There were no sightings of protected bird species during the survey program.

5.2. ACOUSTIC DETECTIONS

There was one acoustic detection of protected species. The detection consisted of Dall's porpoises, and was concurrent with a visual detection of the individuals. A summary of the acoustic detection details can be found in Appendix I, and screenshots taken of acoustic detection can be found in Appendix K.

Table 24. Number of acoustic detection records collected for each protected species during the survey program.

Species	Total Number Detection Records	Total Number Animals Recorded
Concurrent Visual and Acoustic Detections		
Dall's Porpoise	1	6
Acoustic-Only Detections		
-	-	-
Total	1	6

6. MITIGATION ACTION SUMMARY

There were six mitigation actions implemented due to protected species being observed approaching, entering, or within their designated exclusion zones. This total included two shut-downs for whales, one shut-down for porpoises, and three shut-downs for pinnipeds. There were no delayed operations or power-down mitigation actions implemented during the survey. Overall, mitigation actions implemented during the survey program totaled six hours 11 minutes (Table 25). All of the mitigation actions were implemented during acquisition of a survey line, which resulted in a total production loss of six hours 11 minutes during the survey program.

Table 25. Number and duration of mitigation actions implemented during the survey program.

Mitigation Action	Delayed Operation		Power-down		Shut-down		All Mitigation Actions	
	Number	Duration (hh:mm)	Number	Duration (hh:mm)	Number	Duration (hh:mm)	Number	Duration (hh:mm)
Whales	-	-	-	-	2	04:02	2	04:02
Dolphins	-	-	-	-	-	-	-	-
Porpoises	-	-	-	-	1	00:41	1	00:41
Pinnipeds	-	-	-	-	3	01:28	3	01:28
Total	-	-	-	-	6	06:11	6	06:11

Of the total mitigation actions implemented, the majority were implemented for fin whales and pinnipeds, with two mitigation actions each. Fin whale detections resulted in the greatest duration of mitigation actions of all protected species detected, with two mitigation actions totaling four hours two minutes (65% of all downtime for mitigation actions) (Table 26). One of the mitigation actions totaled three hours three minutes in duration and was implemented for an aggregation of nine fin whales. Mitigation actions implemented are summarized in Table 27.

Table 26: Mitigation actions and downtime duration by species during the survey program.

Species	Number of Delayed Operations	Number of Power-downs	Number of Shut-downs	Duration of Mitigation action (h:mm)	Percentage of Mitigation Downtime
Dall's Porpoise	-	-	1	**00:41**	**12%**
Fin whales	-	-	2	**04:02**	**65%**
Northern fur seal	-	-	1	**00:36**	**10%**
Unidentified pinniped	-	-	2	**00:52**	**14%**

Table 27. Summary of each mitigation action implemented during the survey program.

Date	Visual or Acoustic Detection Number	Species	Group Size	Source Activity (initial detection)	Closest Approach to Active Source (m)	Mitigation Action	Total Duration of Mitigation Event	Total Duration of Production Loss
2019-06-17	VD#17 and AD#1	Dall's Porpoise	6	Full volume online	246	Shut-down	00:41	00:41
2019-06-20	VD#23	Fin Whale	2	Full volume online	427	Shut-down	00:59	00:59
2019-06-21	VD#29	Northern fur seal	1	Full volume online	323	Shut-down	00:36	00:36
2019-06-23	VD#36	Unidentified Pinniped	1	Reduced volume online	230	Shut-down	00:17	00:17
2019-06-23	VD#37	Unidentified Pinniped	1	Ramp-up	270	Shut-down	00:35	00:35
2019-06-23	VD#41	Fin Whale (aggregation)	9	Reduced volume online	4,670	Shut-down	03:03	03:03

6.1. PROTECTED SPECIES KNOWN TO HAVE BEEN EXPOSED TO 160 DECIBELS OR GREATER OF RECEIVED SOUND LEVELS

Numerous protected species are known to occur within the survey area, including several species listed as endangered or threatened under the endangered species act (ESA). ESA-listed marine mammal species included: North Pacific right whales, blue whales, fin whales, sei whales, sperm whales, the Western North Pacific distinct population segment (DPS) of humpback whales, the Central North Pacific Mexico DPS of humpback whales, the Western and Eastern US DPS of Steller sea lions, and the southwest DPS of the northern sea otter. ESA-listed seabirds included the short-tailed albatross and the Steller's eider.

NMFS granted an IHA and ITS for the marine seismic survey allowing Level B harassment takes for 21 marine mammal species during the survey program. Of this total, 13 of the species were also authorized for Level A harassment takes. No takes were authorized for sea turtles, sea otters, or protected seabirds. For sea turtles, behavioral 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. No specific zones were designated for sea otters or sea birds; however, mitigation actions were implemented for this species at the 500-meter (power-down) and 100-meter (shut-down) exclusion zones. For sea birds, the mitigation action was only implemented if the individual was observed diving or foraging within the zones.

A total of 34,540 individuals from 21 species (including six whale species and one pinniped species listed as endangered or threatened species) were authorized for takes in the IHA and ITS. Of this total, 33,936 individuals from all 21 species were authorized for Level B takes, and 604 individuals from 13 species were authorized for Level A takes. During the survey program, 69 protected species were observed within the Level B Harassment zone and six protected species were observed within the Level A harassment zone whale the acoustic source was active (Table 28).

Of the 69 animals observed inside the level B harassment zone, 34 were identified to species (22 fin whales, one humpback whale, 10 killer whales, and one northern fur seal), and there were also a number of whales and pinnipeds which were not identifiable to species level. All six of the animals that were observed within the Level A harassment zone while the acoustic source was active were identified to species- Dall's porpoise (Table 29).

Table 28. Number of authorized and potential Level A and B Harassment Takes during the survey program.

Species	IHA Authorized Level A Takes	Potential Level A Takes / PTS During the Program	IHA Authorized Level B Takes	Potential Level B Takes / TTS During the Program	Total IHA Authorized Takes	Total Potential Takes During the Program
ESA Listed Species						
Blue Whale	2	-	47	-	49	-
Fin Whale	16	-	3,897	22	3,193	22
Humpback Whale	25	-	5706	1	5731	1
North Pacific Right Whale	0	-	11	-	11	-
Sei Whale	2	-	7	-	9	-
Sperm Whale	0	-	86	-	86	-
Steller Sea Lion	3	-	2,165	-	2,168	-
Non-Listed Species						
Minke Whale	2	-	52	-	54	-
Gray Whale	9	-	2,174	-	2,183	-
Cuvier's Beaked Whale	0	-	195	-	195	-
Baird's Beaked Whale	0	-	45	-	45	-
Steneger's Beaked Whale	0	-	64	-	64	-

Species	IHA Authorized Level A Takes	Potential Level A Takes / PTS During the Program	IHA Authorized Level B Takes	Potential Level B Takes / TTS During the Program	Total IHA Authorized Takes	Total Potential Takes During the Program
Killer Whale	0	-	587	10	587	10
Pacific White-Sided Dolphin	0	-	1,838	-	1,838	-
Risso's Dolphin	0	-	16	-	16	-
Harbor Porpoise	57	-	2,033	-	2,090	-
Dall's Porpoise	481	6	13,196	-	13,677	6
California Sea Lion	1	-	1	-	2	-
Northern Fur Seal	2	-	1,182	1	1,184	1
Norther Elephant Seal	2	-	193	-	195	-
Harbor Seal	2	-	441	-	443	-
Unidentified species						
Unidentified Whale	-	-	-	33	-	33
Unidentified Dolphin	-	-	-	-	-	-
Unidentified Pinniped	-	-	-	2	-	2
Unidentified Sea Turtle	-	-	-	-	-	-

Table 29. Number of potential Level A and B Harassment Takes by species during the survey program.

Species	Potential Level A Takes	Potential Level B Takes
ESA Listed Species		
Fin Whale	-	22
Humpback Whale	-	1
Non-Listed Species		
Killer Whales	-	10
Dall's Porpoise	6	-
Northern Fur Seal	-	1
Unidentified Species		
Unidentified Whale	-	33
Unidentified Pinniped	-	2

The number of potential takes 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 sea turtles that were not close enough to the surface to be sighted from the vessel, and 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. There were many days where Beaufort Sea states (greater than level 4) may have resulted in some missed protected species detections. Only 67% of all visual monitoring observations throughout the survey program were conducted during Beaufort Sea states of level three or less.

Additionally, beyond hours of dawn, dusk and darkness, there were several occasions where the entire predicted 160 dB radii, 1,000-meter buffer zone, 500-meter exclusion zone, and 100-meter exclusion zone were not fully visible, which would have prevented sightings of protected species within those areas around the vessel. In addition, when the vessel was in shallow water, the entire 160 dB radii for the full volume source was never visible due to the large range of the area (24,494 meters for a source volume of 6600 in^3), which was not fully visible even with utilizing the provided big eye binoculars. Throughout the survey program, the entirety of the 160 decibel radii were not visible for 250 hours 50 minutes during

visual monitoring efforts. The entire 1,000-meter buffer zone was not visible for 59 hours 18 minutes, the entire 500 meter exclusion zone was not visible for 35 hours 46 minutes, and the entire 100 meter exclusion zone was not visible for 25 hours 18 minutes.

Previous analysis of R/V *Langseth* source received levels collected via hydrophone streamers in shallow waters (Crone 2014 and 2017), demonstrated that the measured mitigation zones were substantially smaller than those predicted. Therefore, animals observed within the predicted mitigation zones in shallow water for this survey may similarly not have experienced received levels at those predicted levels. Furthermore, as described in the PEIS, Lloyd's mirror and surface release effects ameliorate the effects for animals at or near the sea surface.

Table 30 describes the behavior of all animals, including unidentified species, which were visually observed within the predicted Level A and Level B harassment zones during the survey program. There were no highly distinctive behavioral reactions observed in relation to the vessel or acoustic source during the seismic survey.

Table 30: Behaviour of species visually observed to be exposed to sound pressure levels of 160 dB or greater during the survey program.

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
Fin Whale	3	2	160	Blowing	Parallel to the vessel in the opposite direction	Blowing	Parallel to the vessel in the opposite direction
Unidentified Whale	4	2	160	Blowing	Perpendicular to the vessel ahead	Blowing	Stationary
Fin Whale	5	1	160	Blowing	Perpendicular to the vessel ahead	Blowing	Parallel to the vessel in the opposite direction
Unidentified Whale	6	3	160	Blowing	Stationary	Blowing	Stationary
Unidentified Whale	7	2	160	Blowing	Perpendicular to the vessel ahead	Blowing	Away from the vessel
Unidentified Whale	8	1	160	Blowing	Unknown	Blowing	Unknown
Unidentified Whale	9	1	160	Blowing	Unknown	Blowing	Unknown
Unidentified Whale	10	1	160	Blowing	Unknown	Blowing	Unknown
Unidentified Whale	11	1	160	Blowing	Parallel to the vessel in the opposite direction	Blowing	Away from the vessel
Humpback Whale	12	1	160	Blowing	Parallel to the vessel in the opposite direction	Blowing	Away from the vessel
Unidentified Whale	13	1	160	Blowing	Unknown	Blowing	Unknown

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
Unidentified Whale	14	1	160	Blowing	Parallel to the vessel in the opposite direction	Blowing	Parallel to the vessel in the opposite direction
Unidentified Whale	15	1	160	Blowing	Unknown	Blowing	Unknown
Dall's Porpoise	17	6	Level A	Surfacing, splashing	Towards the vessel	Surfacing, swimming under the water surface, fast travel	Parallel to the vessel in the opposite direction
Unidentified Whale	18	4	160	Blowing	Parallel to the vessel in the opposite direction	Blowing, fast travel, surfacing	Parallel to the vessel in the opposite direction
Unidentified Whale	19	3	160	Blowing	Away from the vessel	Blowing, slow travel	Away from the vessel
Unidentified Whale	20	1	160	Blowing	Unknown	Blowing	Parallel to the vessel in the opposite direction
Killer Whale	21	10	160	Surfacing	Parallel to the vessel in the opposite direction	Normal swimming, diving, spy-hopping	Parallel to the vessel in the opposite direction
Fin Whale	22	2	160	Blowing	Perpendicular to the vessel ahead	Blowing, normal swimming, surfacing	Parallel to the vessel in the opposite direction
Fin Whale	23	1	160	Blowing	Parallel to the vessel in the opposite direction	Blowing, fast travel	Parallel to the vessel in the opposite direction
Fin Whale	24	2	160	Blowing	Away from the vessel	Blowing, normal swimming	Away from the vessel
Unidentified Whale	25	2	160	Blowing	Parallel to the vessel in the opposite direction	Blowing, normal swimming	Parallel to the vessel in the opposite direction
Fin Whale	26	1	160	Blowing	Perpendicular to the vessel ahead	Blowing, fast travel	Parallel to the vessel in the opposite direction
Fin Whale	27	1	160	Blowing	Parallel to the vessel in the opposite direction	Blowing, fast travel	Parallel to the vessel in the opposite direction
Unidentified Whale	28	1	160	Blowing	Away from the vessel	Blowing, fast travel	Away from the vessel
Northern Fur Seal	29	1	160	Surfacing	Parallel to the vessel in the opposite direction	Surfacing, normal swimming	Parallel to the vessel in the opposite direction

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
Unidentified Whale	30	1	160	Blowing	Unknown	Blowing	Unknown
Unidentified Whale	31	1	160	Blowing	Parallel to the vessel in the opposite direction	Blowing, fast travel	Parallel to the vessel in the opposite direction
Unidentified Whale	32	1	160	Blowing	Parallel to the vessel in the opposite direction	Blowing	Parallel to the vessel in the opposite direction
Unidentified Whale	33	1	160	Blowing	Parallel to the vessel in the opposite direction	Blowing	Parallel to the vessel in the opposite direction
Unidentified Whale	34	1	160	Blowing	Unknown	Blowing	Unknown
Fin Whale	35	2	160	Blowing	Away from the vessel	Blowing, fast travel, feeding	Away from the vessel
Unidentified Pinniped	36	1	160	Milling	Unknown	Surfacing, diving	Unknown
Unidentified Pinniped	37	1	160	Resting at the surface	Unknown	Surfacing	Unknown
Fin Whale	38	1	160	Blowing	Away from the vessel	Blowing, fast travel	Away from the vessel
Unidentified Whale	39	2	160	Blowing	Away from the vessel	Blowing	Away from the vessel
Unidentified Whale	40	1	160	Blowing	Parallel to the vessel in the opposite direction	Blowing, fast travel	Parallel to the vessel in the opposite direction
Fin Whale	41	9	160	Blowing	Parallel to the vessel in the opposite direction	Blowing, milling, surface active, feeding, fast travel, normal swimming	Parallel to the vessel in the opposite direction

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

In order to minimize the potential impacts to marine mammals and sea turtles during the Gulf of Alaska seismic survey program, LDEO and PSOs were prepared to implement mitigation measures whenever these protected species were detected approaching, entering, or within the exclusion zones designated in the IHA and ITS. There were six mitigation actions implemented for protected species during the survey program, all of them resulted in shut-down of the acoustic source, totaling six hours 11 minutes. The confirmation of the implementation of each Term and Condition of the Biological Opinion's Incidental Take Statement are described within this report.

As noted in Section 3.1, additional mitigation measures were required in the IHA and ITS.

Only one of these additional mitigation measures was required to be implemented. On 23 June 2019, a shut-down was implemented for an aggregation of fin whales (nine individuals) sighted feeding in a group initially 4,400 meters ahead of the vessel (visual detection #41). Per the IHA, a shut-down of the acoustic source was required for a visual sighting of six or more large whales at any distance from the vessel. The detection totaled three hours 12 minutes in duration. When the vessel was operating within the fin whale Gulf of Alaska feeding BIA, there were three detections of unidentified whales (visual detections #10 and #11 on 15 June 2019, and visual detection #18 on 18 June 2019). These whales could have been fin whales; however, due to the distance of the whales from the vessel, the species of the whales could not be determined, and the extra mitigation action was not implemented.

The IHA and ITS also waived the shut-down requirements for small dolphins of the Lagenorhynchus and Grampus genera. If PSOs could positively identify the delphinids as one of these species upon initial detection, the acoustic source could be powered-down instead of shut-down if the individuals were observed approaching, entering, or within the 500-meter exclusion zone. However, if there was any uncertainty to the species identification, the source would instead be shut-down. In addition, PSOs could elect to waive the power-down requirement if the delphinids of these genera appeared to be voluntarily approaching the vessel for the purpose of interacting with the vessel or the towed gear. However, if any adverse reactions were observed from any of the individuals, then a power-down was required. However, during the survey program, there were no instances where the shut-down exemption for these species was implemented.

In the event that an injured or dead protected species was discovered, the occurrence was to be reported as soon as possible. The report would include a detailed description of the animal, including the species and pictures whenever possible, the condition of the animal (or carcass if it was deceased), observed behaviors of the animal if it was alive, and the general circumstances under which the animal was discovered. Throughout the survey program, there were no sightings of a dead protected species.

In order to prevent the occurrence of the vessel striking a marine mammal during transits, the vessel speed was reduced to 10 knots or less when mother/calf pairs or large assemblages of any marine mammal was observed near the vessel. The vessel was required to maintain a minimum separation of 100 meters from large whales and 50 meters from all other marine mammals, with the exception made for those individuals that approach the vessel. The vessel was required to take action as necessary to avoid violating the relevant separation distance until the animals were clear of the area. These regulations did not apply when the vessel was towing gear. There were no occurrences where the vessel altered their speed or course to avoid interaction with marine mammals.

In the event of the vessel striking a marine mammal, the incident was to be immediately reported. The report was to include: the date, time and location of the incident; the species of the animal (if known); the vessel's speed during and leading up to the incident; the vessel's heading and operations being conducted; the status of all sound sources in use; a description of avoidance measures/requirements that were in place and what, if any, measures were taken to avoid the strike; the environmental conditions at the time of the incident; a description of the animals size and behavior, before and after the strike; a description of the presence and behavior of other marine mammals immediately before the strike (if

available); the estimated fate of the animal; and any pictures or videos of the incident if possible. There were no instances of the vessel striking and marine mall during the survey program.

Passive acoustic monitoring was conducted throughout the survey and the majority of acoustic monitoring was 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. This prevented baseline acoustic data from being collected on the survey site and during transit while visual monitoring was ongoing for baseline data collection purposes. There was one acoustic detection of protected species during this survey program, consisting of a detection of Dall's porpoise that was concurrent with a visual detection of the species.

A total of 34,540 individuals from 21 species (including six whale species and one pinniped species listed as endangered or threatened species) were authorized for takes in the IHA and ITS. Of this total, 33,936 individuals from all 21 species were authorized for Level B takes, and 604 individuals from 13 species were authorized for Level A takes. During the survey program, a total of 69 protected species were observed within the predicted Level B harassment radius and a total of six protected species were observed within the predicted Level A harassment zone. These totals represent less than one percent of each set of authorized takes, and less than one percent of all takes authorized for the survey program. The species composition of this total, in relation to the total allowed takes is shown in Table 28 and Table 29. There were no takes authorized for sea turtles, sea otters, or protected sea birds. Throughout the survey program, there were no detections of sea turtles within the 175-decibel radius (Level B harassment) and no detections of sea turtles in the 195-decibel radius (Level A harassment). No harassment radii were defined for sea otters or protected sea birds. There were no protected sea birds observed during the survey program. However, there were three sightings of sea otters while the vessel was transiting to and from the dock with the seismic gear silent and on board the vessel.

PSOs likely did not detect all animals present, however, it is 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 and ITS appear to have been an effective means to protect the marine species encountered during survey operations.

7. LITERATURE CITED

NOAA, 2019. Endangered Species Act Section 7 Consultation Biological Opinion for a marine seismic survey by Lamont-Doherty Earth Observatory in the North Pacific Ocean and NFMS IHA issuance.

Crone, T.J., M. Tolstoy, and H. Carton. 2014. Estimating shallow water sound power levels and mitigation radii for the R/V Marcus G. Langseth using an 8 km long MCS streamer. Geochem., Geophys., Geosyst. 15(10):3793-3807.

APPENDIX A: **Incidental Harassment Authorization for the Gulf of Alaska Marine Geophysical Survey.**

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

Sean Higgins
Director, Office of Marine Operations
Lamont-Doherty Earth Observatory
61 Rt. 9W
Palisades, NY 10964

Dear Mr. Higgins:

Enclosed is an Incidental Harassment Authorization (IHA) issued to Lamont-Doherty Earth Observatory, under the authority of Section 101(a)(5)(D) of the Marine Mammal Protection Act (16 U.S.C. 1361 *et seq.*) to take, by Level A harassment and Level B harassment only, small numbers of marine mammals incidental to a marine geophysical survey in the Gulf of Alaska, 2019.

You are required to comply with the conditions contained in the IHA, including all mitigation, monitoring and reporting requirements. Along with mitigation measures, the IHA requires monitoring for the presence and behavior of marine mammals during all activities associated with the project.

If you have any questions concerning the IHA or its requirements, please contact Amy Fowler, Office of Protected Resources, National Marine Fisheries Service, at (301) 427-8401.

Sincerely,

MAY 31 2019

Donna S. Wieting

Donna S. Wieting, Director
Office of Protected Resources

Enclosure

INCIDENTAL HARASSMENT AUTHORIZATION

The Lamont-Doherty Earth Observatory of Columbia University (L-DEO) is hereby authorized under section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA; 16 U.S.C. 1371(a)(5)(D)) to harass marine mammals incidental to a marine geophysical survey in the Gulf of Alaska, when adhering to the following terms and conditions.

1. This Incidental Harassment Authorization (IHA) is valid from June 1, 2019 to May 31, 2020.

2. This IHA is valid only for marine geophysical activity as specified in L-DEO's IHA application and using an array aboard the R/V *Langseth* with characteristics specified in the IHA application, in the Gulf of Alaska.

3. General Conditions

(a) A copy of this IHA must be in the possession of L-DEO, the vessel operator, the lead protected species observer (PSO) and any other relevant designees of L-DEO operating under the authority of this IHA.

(b) The species authorized for taking are listed in Table 1

(c) The taking, by Level A and B harassment, is limited to the species listed in condition 3(b). Table 1 provides the authorized number of takes per species and stock.

(d) The taking, by serious injury or death of any of species listed in condition 3(b) of this IHA is prohibited.

(e) The taking, by Level A harassment, Level B harassment, serious injury, or death, of marine mammal species not identified in condition 3(b) is prohibited.

4. Mitigation Measures

The holder of this IHA is required to implement the following mitigation measures:

(a) L-DEO must use at least six dedicated, trained, NMFS-approved Protected Species Observers (PSOs). The PSOs must have no tasks other than to conduct observational effort, record observational data, and communicate with and

instruct relevant vessel crew with regard to the presence of marine mammals and mitigation requirements.

(b) At least one of the visual and two of the acoustic PSOs aboard the vessel must have a minimum of 90 days at-sea experience working in those roles, respectively, during a deep penetration seismic survey, with no more than 18 months elapsed since the conclusion of the at-sea experience

(c) Visual Observation

(i) During survey operations (e.g., any day on which use of the acoustic source is planned to occur, and whenever the acoustic source is in the water, whether activated or not), a minimum of two visual PSOs must be on duty and conducting visual observations at all times during daylight hours (i.e., from 30 minutes prior to sunrise through 30 minutes following sunset) and 30 minutes prior to and during ramp-up, including nighttime ramp-ups, of the airgun array.

(ii) Visual PSOs must coordinate to ensure 360° visual coverage around the vessel from the most appropriate observation posts, and must conduct visual observations using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner.

(iii) Visual PSOs must immediately communicate all marine mammal observations to the acoustic PSO(s) on duty, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.

(iv) During good conditions (e.g., daylight hours; Beaufort sea state (BSS) 3 or less), visual PSOs must conduct observations when the acoustic source is not operating for comparison of sighting rates and behavior with and without use of the acoustic source and between acquisition periods, to the maximum extent practicable.

(v) Visual PSOs may be on watch for a maximum of four consecutive hours followed by a break of at least one hour between watches and may conduct a maximum of 12 hours of observation per 24-hour period. Combined observational duties (visual and acoustic but not at same time) may not exceed 12 hours per 24-hour period for any individual PSO

(d) Acoustic Monitoring

(i) The source vessel must use a towed passive acoustic monitoring system (PAM) which must be monitored by, at a minimum, one on duty acoustic PSO beginning at least 30 minutes prior to ramp-up and at all times during use of the acoustic source.

(ii) Acoustic PSOs must immediately communicate all detections to visual PSOs, when visual PSOs are on duty, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.

(iii) Acoustic PSOs may be on watch for a maximum of four consecutive hours followed by a break of at least one hour between watches and may conduct a maximum of 12 hours of observation per 24-hour period. Combined observational duties may not exceed 12 hours per 24-hour period for any individual PSO.

(iv) Survey activity may continue for 30 minutes when the PAM system malfunctions or is damaged, while the PAM operator diagnoses the issue. If the diagnosis indicates that the PAM system must be repaired to solve the problem, operations may continue for an additional five hours without acoustic monitoring during daylight hours only under the following conditions:

a. Sea state is less than or equal to BSS 4;

b. With the exception of delphinids, no marine mammals detected solely by PAM in the applicable exclusion zone in the previous two hours;

c. NMFS is notified via email as soon as practicable with the time and location in which operations began occurring without an active PAM system; and

d. Operations with an active acoustic source, but without an operating PAM system, do not exceed a cumulative total of five hours in any 24-hour period.

Exclusion zone and buffer zone

(i) PSOs must establish and monitor a 500 m exclusion zone and 1,000 m buffer zone. The exclusion zone encompasses the area at and below the sea surface out to a radius of 500 meters from the edges of the airgun array (0–500 meters). The buffer zone encompasses the area at and below the sea surface from the edge of the 0–500 meter exclusion zone, out to a radius of 1,000 meters from the edges of the airgun array (500–1,000

meters). PSOs must monitor beyond 1,000 meters and enumerate any takes that occur beyond the buffer zone.

(f) Pre-clearance and Ramp-up

(i) A ramp-up procedure must be followed at all times as part of the activation of the acoustic source, except as described under 4(f)(vi).

(ii) Ramp-up must not be initiated if any marine mammal is within the exclusion or buffer zone. If a marine mammal is observed within the exclusion zone or the buffer zone during the 30 minute pre-clearance period, ramp-up may not begin until the animal(s) has been observed exiting the zone or until an additional time period has elapsed with no further sightings (15 minutes for small odontocetes and pinnipeds and 30 minutes for mysticetes and large odontocetes all other species).

(iii) Ramp-up must begin by activating a single airgun of the smallest volume in the array and must continue in stages by doubling the number of active elements at the commencement of each stage, with each stage of approximately the same duration. Duration must not be less than 20 minutes.

(iv) PSOs must monitor the exclusion and buffer zones during ramp-up, and ramp-up must cease and the source must be shut down upon observation of a marine mammal within the exclusion zone. Once ramp-up has begun, observations of marine mammals within the buffer zone do not require shutdown or powerdown, but such observation must be communicated to the operator to prepare for the potential shutdown or powerdown.

(v) Ramp-up may occur at times of poor visibility, including nighttime, if appropriate acoustic monitoring has occurred with no detections in the 30 minutes prior to beginning ramp-up.

(vi) If the acoustic source is shut down for brief periods (i.e., less than 30 minutes) for reasons other than that described for shutdown and powerdown (*e.g.*, mechanical difficulty), it may be activated again without ramp-up if PSOs have maintained constant visual and/or acoustic observation and no visual or acoustic detections of marine mammals have occurred within the applicable exclusion zone. For any longer shutdown, pre-clearance observation and ramp-up are required. For any shutdown at night or in periods of poor visibility (e.g., BSS 4 or greater), ramp-up is required, but if the shutdown period was brief and constant observation was maintained, pre-clearance watch of 30 min is not required.

(vii) Testing of the acoustic source involving all elements requires ramp-up. Testing limited to individual source elements or strings does not require ramp-up but does require pre-clearance of 30 min.

(g) Shutdown and Powerdown

(i) Any PSO on duty has the authority to delay the start of survey operations or to call for shutdown or powerdown of the acoustic source if a marine mammal is detected within the 500 m exclusion zone (100 m when shutdown has been waived as described in 4(g)(v).

(ii) The operator must establish and maintain clear lines of communication directly between PSOs on duty and crew controlling the acoustic source to ensure that shutdown and powerdown commands are conveyed swiftly while allowing PSOs to maintain watch.

(iii) When the airgun array is active (i.e., anytime one or more airguns is active, including during ramp-up and powerdown) and (1) a marine mammal (excluding delphinids) appears within or enters the exclusion zone and/or (2) a marine mammal is detected acoustically and localized within the exclusion zone, the acoustic source must be shut down. When shutdown is called for by a PSO, the airgun array must be immediately deactivated. Any questions regarding a PSO shutdown must be resolved after deactivation.

(iv) Shutdown must occur whenever PAM alone (without visual sighting), confirms presence of marine mammal(s) (other than delphinids) in the 500 m exclusion zone. During daylight hours, if the acoustic PSO cannot confirm presence within exclusion zone, visual PSOs must be notified but shutdown is not required.

(v) The shutdown requirement shall be waived for small dolphins of the following genera: *Lagenorhynchus* and *Grampus*.

a. The acoustic source must be powered down to 40-in^3 airgun if an individual belonging to these genera is visually detected within the 500 m exclusion zone.

b. When the acoustic source is powered down to the 40-in^3 airgun due to the presence of dolphins specified in 4(g)(v), an exclusion zone of 100 m and Level B harassment zone of 430 m will be in effect for species other than specified dolphin genera that may approach the survey vessel.

c. Powerdown conditions must be maintained until delphinids, for which shutdown is waived, are no longer observed within the 500 m exclusion zone, following which full-power operations may be resumed without ramp-up. Visual PSOs may elect to waive the powerdown requirement if delphinids for which shutdown is waived appear to be voluntarily approaching the vessel for the purpose of interacting with the vessel or towed gear, and must use best professional judgment in making this decision.

d. If PSOs observe any behaviors in delphinids for which shutdown is waived that indicate an adverse reaction, then powerdown must be initiated.

e. Visual PSOs must use best professional judgment in making the decision to call for a shutdown if there is uncertainty regarding identification (i.e., whether the observed marine mammal(s) belongs to one of the delphinid genera for which shutdown is waived).

(vi) L-DEO must implement a shutdown when a large whale with a calf or an aggregation of large whales (defined as 6 or more mysticetes or sperm whales) is observed regardless of the distance from the *Langseth*.

(vii) L-DEO must implement a shutdown when a North Pacific right whale or group of North Pacific right whales is observed at any distance.

(viii) L-DEO must implement a shutdown when a fin whale or group of fin whales is observed, within the species' Gulf of Alaska feeding Biologically Important Area (BIA), within 1,500 m of the acoustic source.

(ix) L-DEO must implement a shutdown upon observation of any marine mammal species not authorized for take that is entering or approaching the vessel's respective Level B harassment zone.

(x) L-DEO must implement a shutdown upon observations of any authorized marine mammal species that has reached its total allotted number of takes by Level B harassment that is entering or approaching the vessel's respective Level B harassment zone.

(xi) Upon implementation of shutdown, the source may be reactivated after the marine mammal(s) has been observed exiting the applicable exclusion zone (i.e., animal is not required to fully exit the buffer zone where applicable) or following a clearance period (15 minutes for small odontocetes and pinnipeds and 30 minutes for mysticetes and large odontocetes) with no further observation of the marine mammal(s).

(h) Vessel operators and crews must maintain a vigilant watch for all marine mammals and slow down, stop their vessel, or alter course, as appropriate and regardless of vessel size, to avoid striking any marine mammal. A visual observer aboard the vessel must monitor a vessel strike avoidance zone around the vessel (specific distances detailed below), to ensure the potential for strike is minimized.

(i) Vessel speeds must be reduced to 10 kn or less when mother/calf pairs, pods, or large assemblages of any marine mammal are observed near a vessel.

(ii) Vessels must maintain a minimum separation distance of 100 m from large whales (i.e., sperm whales and all baleen whales.

(iii) Vessels must attempt to maintain a minimum separation distance of 50 m from all other marine mammals, with an exception made for those animals that approach the vessel.

(iv) When marine mammals are sighted while a vessel is underway, the vessel must take action as necessary to avoid violating the relevant separation distance. If marine mammals are sighted within the relevant separation distance, the vessel must reduce speed and shift the engine to neutral, not engaging the engines until animals are clear of the area. This recommendation does not apply to any vessel towing gear.

(i) Actions to Minimize Additional Harm to Live Stranded (or Milling) Marine Mammals – In the event of a live stranding (or near-shore atypical milling) event within 50 km of the survey operations, where the NMFS stranding network is engaged in herding or other interventions to return animals to the water, the Director of OPR, NMFS (or designee) will advise L-DEO of the need to implement shutdown procedures for all active acoustic sources operating within 50 km of the stranding. Shutdown procedures for live stranding or milling marine mammals include the following:

(i) If at any time, the marine mammal(s) die or are euthanized, or if herding/intervention efforts are stopped, the Director of OPR, NMFS (or designee) will advise the IHA-holder that the shutdown around the animals' location is no longer needed.

(ii) Otherwise, shutdown procedures will remain in effect until the Director of OPR, NMFS (or designee) determines and advises the IHA-holder that all live animals involved have left the area (either of their own volition or following an intervention).

(ii) If further observations of the marine mammals indicate the potential for re-stranding, additional coordination with the IHA-holder will be required

to determine what measures are necessary to minimize that likelihood (*e.g.*, extending the shutdown or moving operations farther away) and to implement those measures as appropriate.

(j) Sensitive Habitat Measures

(i) L-DEO must not approach within 3 n. mi. of all known Steller sea lion rookeries and major haul-outs.

(ii) L-DEO must conduct survey operations in the North Pacific right whale critical habitat during daylight hours only.

(iii) L-DEO must reduce vessel speed to at most 5 kn (knots) when transiting through North Pacific right whale critical habitat during darkness, or conditions of similarly limiting visibility.

(iv) While in the fin whale Gulf of Alaska feeding BIA, L-DEO must implement a shutdown if a fin whale or group of fin whales is observed within a 1,500 meter radius from the acoustic source.

(k) L-DEO must conduct outreach with subsistence communities near the planned seismic survey to identify and avoid areas of potential conflict.

5. Monitoring Measures

The holder of this IHA is required to abide by the following marine mammal and acoustic monitoring measures:

(a) The operator must provide PSOs with bigeye binoculars (e.g., 25 x 150; 2.7 view angle; individual ocular focus; height control) of appropriate quality (i.e., Fujinon or equivalent) solely for PSO use. These must be pedestal-mounted on the deck at the most appropriate vantage point that provides for optimal sea surface observation, PSO safety, and safe operation of the vessel.

(b) The operator must work with the selected third-party observer provider to ensure PSOs have all equipment (including backup equipment) needed to adequately perform necessary tasks, including accurate determination of distance and bearing to observed marine mammals. Such equipment, at a minimum, must include:

(i) PAM must include a system that has been verified and tested by the acoustic PSO that will be using it during the trip for which monitoring is required.

(ii) At least one night-vision device suited for the marine environment for use during nighttime pre-clearance and ramp-up that features automatic brightness and gain control, bright light protection, infrared illumination, and/or optics suited for low-light situations (e.g., Exelis PVS-7 night vision goggles; Night Optics D-300 night vision monocular; FLIR M324XP thermal imaging camera or equivalents).

(iii) Reticle binoculars (e.g., 7 x 50) of appropriate quality (i.e., Fujinon or equivalent) (at least one per PSO, plus backups).

(iv) Global Positioning Units (GPS) (at least one per PSO, plus backups).

(v) Digital single-lens reflex cameras of appropriate quality that capture photographs and video (i.e., Canon or equivalent) (at least one per PSO, plus backups).

(vi) Compasses (at least one per PSO, plus backups).

(vii) Radios for communication among vessel crew and PSOs (at least one per PSO, plus backups).

(viii) Any other tools necessary to adequately perform necessary PSO tasks.

(c) Protected Species Observers (PSOs, Visual and Acoustic) Qualifications

(i) PSOs must be independent, dedicated, trained visual and acoustic PSOs and must be employed by a third-party observer provider.

(ii) PSOs must have no tasks other than to conduct observational effort (visual or acoustic), collect data, and communicate with and instruct relevant vessel crew with regard to the presence of protected species and mitigation requirements (including brief alerts regarding maritime hazards), and

(iii) PSOs must have successfully completed an approved PSO training course appropriate for their designated task (visual or acoustic). Acoustic PSOs are required to complete specialized training for operating PAM systems and are encouraged to have familiarity with the vessel with which they will be working.

(iv) PSOs can act as acoustic or visual observers (but not at the same time) as long as they demonstrate that their training and experience are sufficient to perform the task at hand.

(v) NMFS must review and approve PSO resumes.

(vi) NMFS shall have one week to approve PSOs from the time that the necessary information is submitted, after which PSOs meeting the minimum requirements shall automatically be considered approved.

(vii) One visual PSO with experience as shown in 4(b) shall be designated as the lead for the entire protected species observation team. The lead must coordinate duty schedules and roles for the PSO team and serve as primary point of contact for the vessel operator. To the maximum extent

practicable, the lead PSO must devise the duty schedule such that experienced PSOs are on duty with those PSOs with appropriate training but who have not yet gained relevant experience.

(viii) PSOs must successfully complete relevant training, including completion of all required coursework and passing (80 percent or greater) a written and/or oral examination developed for the training program.

(ix) PSOs must have successfully attained a bachelor's degree from an accredited college or university with a major in one of the natural sciences, a minimum of 30 semester hours or equivalent in the biological sciences, and at least one undergraduate course in math or statistics.

(x) The educational requirements may be waived if the PSO has acquired the relevant skills through alternate experience. Requests for such a waiver must be submitted to NMFS and must include written justification. Requests must be granted or denied (with justification) by NMFS within one week of receipt of submitted information. Alternate experience that may be considered includes, but is not limited to (1) secondary education and/or experience comparable to PSO duties; (2) previous work experience conducting academic, commercial, or government-sponsored protected species surveys; or (3) previous work experience as a PSO; the PSO should demonstrate good standing and consistently good performance of PSO duties.

(d) Data Collection

(i) PSOs must use standardized data collection forms, whether hard copy or electronic. PSOs must record detailed information about any implementation of mitigation requirements, including the distance of animals to the acoustic source and description of specific actions that ensued, the behavior of the animal(s), any observed changes in behavior before and after implementation of mitigation, and if shutdown was implemented, the length of time before any subsequent ramp-up of the acoustic source. If required mitigation was not implemented, PSOs should record a description of the circumstances.

(ii) At a minimum, the following information must be recorded:

a. Vessel names (source vessel and other vessels associated with survey) and call signs;

b. PSO names and affiliations;

c. Date and participants of PSO briefings (as discussed in General Requirement);

d. Dates of departures and returns to port with port name;

e. Dates and times (Greenwich Mean Time) of survey effort and times corresponding with PSO effort;

f. Vessel location (latitude/longitude) when survey effort began and ended and vessel location at beginning and end of visual PSO duty shifts;

g. Vessel heading and speed at beginning and end of visual PSO duty shifts and upon any line change;

h. Environmental conditions while on visual survey (at beginning and end of PSO shift and whenever conditions changed significantly), including BSS and any other relevant weather conditions including cloud cover, fog, sun glare, and overall visibility to the horizon;

i. Factors that may have contributed to impaired observations during each PSO shift change or as needed as environmental conditions changed (e.g., vessel traffic, equipment malfunctions); and

j. Survey activity information, such as acoustic source power output while in operation, number and volume of airguns operating in the array, tow depth of the array, and any other notes of significance (i.e., pre-clearance, ramp-up, shutdown, testing, shooting, ramp-up completion, end of operations, streamers, etc.).

(iii) Upon visual observation of any protected species, the following information must be recorded:

a. Watch status (sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform);

b. PSO who sighted the animal;

c. Time of sighting;

d. Vessel location at time of sighting;

e. Water depth;

f. Direction of vessel's travel (compass direction);

g. Direction of animal's travel relative to the vessel;

h. Pace of the animal;

i. Estimated distance to the animal and its heading relative to vessel at initial sighting;

j. Identification of the animal (e.g., genus/species, lowest possible taxonomic level, or unidentified) and the composition of the group if there is a mix of species;

k. Estimated number of animals (high/low/best);

l. Estimated number of animals by cohort (adults, yearlings, juveniles, calves, group composition, etc.);

m. Description (as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics);

n. Detailed behavior observations (e.g., number of blows/breaths, number of surfaces, breaching, spyhopping, diving, feeding, traveling; as explicit and detailed as possible; note any observed changes in behavior);

o. Animal's closest point of approach (CPA) and/or closest distance from any element of the acoustic source;

p. Platform activity at time of sighting (e.g., deploying, recovering, testing, shooting, data acquisition, other); and

q. Description of any actions implemented in response to the sighting (e.g., delays, shutdown, ramp-up) and time and location of the action.

(iv) If a marine mammal is detected while using the PAM system, the following information should be recorded:

a. An acoustic encounter identification number, and whether the detection was linked with a visual sighting;

b. Date and time when first and last heard;

c. Types and nature of sounds heard (e.g., clicks, whistles, creaks, burst pulses, continuous, sporadic, strength of signal);

d. Any additional information recorded such as water depth of the hydrophone array, bearing of the animal to the vessel (if determinable), species or taxonomic group (if determinable), spectrogram screenshot, and any other notable information.

6. Reporting

(a) L-DEO must submit a draft comprehensive report to NMFS on all activities and monitoring results within 90 days of the completion of the survey or expiration of the IHA, whichever comes sooner. The draft report must include the following:

(i) Summary of all activities conducted and sightings of protected species near the activities;

(ii) Full documentation of methods, results, and interpretation pertaining to all monitoring;

(iii) Summary of dates and locations of survey operations and all protected species sightings (dates, times, locations, activities, associated survey activities);

(iv) Geo-referenced time-stamped vessel tracklines for all time periods during which airguns were operating. Tracklines should include points recording any change in airgun status (e.g., when the airguns began operating, when they were turned off, or when they changed from full array to single gun or vice versa);

(v) GIS files in ESRI shapefile format and UTC date and time, latitude in decimal degrees, and longitude in decimal degrees. All coordinates must be referenced to the WGS84 geographic coordinate system;

(vi) Raw observational data;

(vii) Summary of the information submitted in interim monthly reports as well as additional data collected as described above in Data Collection and the IHA;

(viii) Estimates of the number and nature of exposures that occurred above the harassment threshold based on PSO observations, including an estimate of those that were not detected in consideration of both the characteristics and behaviors of the species of marine mammals that affect detectability, as well as the environmental factors that affect detectability;

(ix) Certification from the lead PSO as to the accuracy of the report

a. The lead PSO may submit statement directly to NMFS concerning implementation and effectiveness of the required mitigation and monitoring.

(x) A final report must be submitted within 30 days following resolution of any comments on the draft report.

(b) Reporting Injured or Dead Marine Mammals

(i) Discovery of Injured or Dead Marine Mammal – In the event that personnel involved in the survey activities covered by the authorization discover an injured or dead marine mammal, L-DEO must report the incident to the Office of Protected Resources (OPR) (301-427-8401), NMFS and the NMFS Region Stranding Coordinator (907-586-7209) as soon as feasible. The report must include the following information: Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);

b. Species identification (if known) or description of the animal(s) involved;

c. Condition of the animal(s) (including carcass condition if the animal is dead);

d. Observed behaviors of the animal(s), if alive;

e. If available, photographs or video footage of the animal(s); and

f. General circumstances under which the animal was discovered.

(ii) Vessel Strike – In the event of a ship strike of a marine mammal by any vessel involved in the activities covered by the authorization, L-DEO must report the incident to OPR, NMFS and to regional stranding coordinators as soon as feasible. The report must include the following information:

a. Time, date, and location (latitude/longitude) of the incident;

b. Species identification (if known) or description of the animal(s) involved;

c. Vessel's speed during and leading up to the incident;

d. Vessel's course/heading and what operations were being conducted (if applicable);

e. Status of all sound sources in use;

f. Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike;

g. Environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike;

h. Estimated size and length of animal that was struck;

i. Description of the behavior of the marine mammal immediately preceding and following the strike;

j. If available, description of the presence and behavior of any other marine mammals immediately preceding the strike;

k. Estimated fate of the animal (e.g., dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared); and

l. To the extent practicable, photographs or video footage of the animal(s).

(iii) Additional Information Requests – If NMFS determines that the circumstances of any marine mammal stranding found in the vicinity of the activity suggest investigation of the association with survey activities is warranted (example circumstances noted below), and an investigation into the stranding is being pursued, NMFS will submit a written request to the IHA-holder indicating that the following initial available information must be provided as soon as possible, but no later than 7 business days after the request for information.

a. Status of all sound source use in the 48 hours preceding the estimated time of stranding and within 50 km of the discovery/notification of the stranding by NMFS; and

b. If available, description of the behavior of any marine mammal(s) observed preceding (i.e., within 48 hours and 50 km) and immediately after the discovery of the stranding.

c. In the event that the investigation is still inconclusive, the investigation of the association of the survey activities is still warranted, and the investigation is still being pursued, NMFS may provide additional information requests, in writing, regarding the nature and location of survey operations prior to the time period above.

7. This Authorization may be modified, suspended or withdrawn if the holder fails to abide by the conditions prescribed herein, or if NMFS determines the authorized taking is having more than a negligible impact on the species or stock of affected marine mammals.

8. Renewals - On a case-by-case basis, NMFS may issue a one-year IHA renewal with an expedited public comment period (15 days) when 1) another year of identical or nearly identical activities is planned or 2) the activities would not be completed by the time the IHA expires and a second IHA would allow for completion of the activities beyond that allowed for under this IHA, provided all of the following conditions are met:

(a) A request for renewal is received no later than 60 days prior to expiration of the current IHA.

(b) The request for renewal must include the following:

(i) An explanation that the activities to be conducted beyond the initial dates either are identical to the previously analyzed activities or include changes so minor (e.g., reduction in pile size) that the changes do not affect the previous analyses, take estimates, or mitigation and monitoring requirements.

(ii) A preliminary monitoring report showing the results of the required monitoring to date and an explanation showing that the monitoring results do not indicate impacts of a scale or nature not previously analyzed or authorized.

(c) Upon review of the request for renewal, the status of the affected species or stocks, and any other pertinent information, NMFS determines that there are no more than minor changes in the activities, the mitigation and monitoring measures remain the same and appropriate, and the original findings remain valid.

Donna S. Wieting

MAY 3 1 2019

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

Date

Table 1: Numbers of Instances of Incidental Take of Marine Mammals Authorized During Gulf of Alaska Survey.

	Stock	Level B	Level A
North Pacific Right Whale	Eastern North Pacific	11	0
Humpback Whale	Central North Pacific (Hawaii DPS)	5,079	21
	Central North Pacific (Mexico DPS)	599	3
	Western North Pacific	28	1
Blue whale	Eastern North Pacific	47	2
	Central North Pacific		
Fin Whale	Northeast Pacific	3,897	16
Sei Whale	Eastern North Pacific	7	2
Minke Whale	Alaska	52	2
Gray Whale	Eastern North Pacific	2,146[1]	9
	Western North Pacific	28[1]	0
Sperm Whale	North Pacific	86	0
Killer Whale	Alaska Resident	279[2]	0
	Gulf of Alaska, Aleutian Islands, and Bering Sea Transient	218[2]	0
	Offshore	90[2]	0
Pacific White-Sided Dolphin	North Pacific	1,838	0
Cuvier's Beaked Whale	Alaska	195	0
Baird's Beaked Whale	Alaska	45	0
Stejneger's Beaked Whale	Alaska	64	0
Risso's Dolphin	CA/OR/WA	16	0
Harbor Porpoise	Gulf of Alaska	1,830	51
	Southeast Alaska	203	6
Dall's Porpoise	Alaska	13,196	481
Steller Sea Lion	Eastern U.S.	2,165	3
	Western U.S.		
California Sea Lion	U.S.	1	1
Northern Fur Seal	Eastern Pacific	1,182	2
Northern Elephant Seal	California Breeding	193	2
Harbor Seal	South Kodiak	441	2
	Cook Inlet/Shelikof Strait		
	Prince William Sound		

[1] The authorized numbers of take attributed to the Eastern North Pacific and Western North Pacific stocks of Gray whale are approximations based on the relative sizes of these two stocks. The method is discussed more fully in the Federal Register Notices associated with this action.

[2] The authorized numbers of take attributed to the Alaska Resident, Gulf of Alaska, Aleutian Islands, and Bering Sea Transient, and Offshore stocks of killer whale are approximations based on the relative sizes of these two stocks. The method is discussed more fully in the Federal Register Notices associated with this action.

APPENDIX B: Basic Data Summary Form

BASIC DATA FORM					
LDEO Project Number			MGL1903		
Seismic Contractor			L-DEO		
Area Surveyed During Reporting Period	Line Number	Start Latitude	Start Longitude	End Latitude	End Longitude
	MC01	57.22220°N	152.08400°W	55.89937°N	151.01387°W
	MT01	55.88333°N	151.01906°W	55.08831°N	151.68739°W
	MC02	55.10688°N	151.77009°W	56.65517°N	153.08050°W
	MT02	56.64933°N	153.10817°W	56.54560°N	153.48117°W
	MC03	56.53813°N	153.48295°W	54.90600°N	152.21800°W
	MT03	54.89883°N	152.23183°W	54.78757°N	152.67724°W
	MC04	54.80379°N	152.70192°W	56.30826°N	153.99920°W
	MT04	56.30426°N	154.03127°W	56.18800°N	154.47783°W
	MC05	56.16400°N	154.46733°W	54.65200°N	153.17928°W
	MT05	54.63850°N	153.20612°W	54.52367°N	153.63633°W
	MC06	54.53950°N	153.65817°W	56.71183°N	155.60650°W
	MT06	56.70967°N	155.64083°W	56.57666°N	156.07723°W
	MC07	56.55031°N	156.06791°W	54.37410°N	154.10592°W
	OT07	54.38087°N	154.09575°W	54.25058°N	154.57525°W
	OB08	54.25777°N	154.59335°W	56.42233°N	156.58217°W
	OT08	56.39800°N	156.65650°W	55.79880°N	156.59415°W
	OB09	55.79645°N	156.59187°W	54.10298°N	155.06950°W
	OT09	54.10152°N	155.07140°W	53.97265°N	155.51025°W
	OB10	53.97490°N	155.51738°W	56.12870°N	157.55437°W
	OT10	56.12947°N	157.56802°W	55.87006°N	157.90823°W
	OB11	55.86678°N	157.90636°W	53.82288°N	155.98576°W
	OT11	53.80753°N	156.01146°W	53.68521°N	156.42364°W
	OB12	53.68866°N	156.43537°W	55.69023°N	158.35291°W
Survey Type			2D MCS and OBS		
Vessel and/or Rig Name			R/V *Marcus G. Langseth*		
Permit Number			IHA issues on 31 May 2019		
Location / Distance of Airgun Deployment			230 meters astern (from the NRP)		
Water Depth	**Min**		15		
	Max		6,184		
Dates of Project			08 June 2019	through	24 June 2019
Total time airguns operating – all power levels:			330:02		
Time airguns operating on survey lines:			318:39		
Time airguns operating not on a survey line:			08:43		
Amount of time mitigation gun (40 in³) operations:			00:00		
Amount of time in ramp-up:			02:39		
Number daytime ramp-ups:			9		
Number of night time ramp-ups:			0		
Number of ramp-ups from mitigation source:			0		
Amount of time conducted in airgun testing:			00:01		
Duration of visual observations:			311:00		
Duration of observations while source active:			263:46		
Duration of observation during source silence:			47:14		
Duration of acoustic monitoring:			339:34		
Duration of acoustic monitoring while source active:			325:13		
Duration of acoustic monitoring during source silence:			14:21		
Duration of simultaneous acoustic and visual monitoring:			270:18		

Lead Protected Species Observer:	Amanda Dubuque
Protected Species Observers:	Ana Salomon, Andrea Zavala, Bianca Mares, Yesenia Balderas
Lead Acoustic Observer:	Karla Rios
Number of Marine Mammals Visually Detected:	47
Number of Marine Mammals Acoustically Detected:	0
Number of Simultaneous Visual and Acoustic Detections:	1
Number of Sea Turtles detected:	0
Total Number of Protected Species Detections:	48
List Mitigation Actions	Six shut-downs totaling 06:11
Duration of operational downtime due to mitigation:	06:11

APPENDIX C: Passive Acoustic Monitoring System Specifications on *R/V Langseth*

1.1 Heavy Tow Cable with separate hydrophone array
Tow Cable serial number SM 4964

Mechanical Information
Length = 230 m
Outer diameter = 16.5 mm (+/- 0.5 mm)
Ship-side connector: ITT 19-way, male
Wet-end connector: Seiche, with 36-way Lemo insert, female.
Weight = approximately 94 kg (in air)

1.2 Hydrophone array cable
Cable serial number SM 4073

Mechanical Information
Type = Detachable 20 m, 4-ch Array
Length = 20 m
Diameter = 17 mm (over cable), 32 mm (over mouldings), 65 mm (over connector)
Connector = Seiche connector with 36-way Lemo insert, male.
Weight = approximately 10 kg (in air)

Hydrophone elements
Array elements = four spherical hydrophones / preamplifiers, one depth sensor
Hydrophone 1 = 200-200,000 Hz (-3 dB), sensitivity -166dB re 1V/uPa; 0.00 m
Hydrophone 2 = 200-200,000 Hz (-3 dB), sensitivity -166dB re 1V/uPa; at 2.00 m
Hydrophone 3 = 2,000-200,000 Hz (-3 dB), sensitivity -166dB re 1V/uPa; at 15.00 m
Hydrophone 4 = 2,000-200,000 Hz (-3 dB), sensitivity -166dB re 1V/uPa; at 15.25 m
Depth sensor = 10-bar pressure rating.

1.3 Deck cable
Deck serial number SM 4952

Mechanical Information
Length 100m
Diameter 14mm cable, 45mm at male connector, 65mm at female connector
Weight 25kg
Connectors ITT 19 pin

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

Deployment requires the PAM operator and at least one additional person to complete.

Overview

Two identical hydrophone cables were supplied for the Langseth consisting of a 230-meter steel reinforced tow cable with a detachable 20-meter hydrophone array. The arrays consist of two low-frequency hydrophones (200 Hz to 200 kHz), two high-frequency hydrophone elements (2 kHz to 200 kHz) and a depth gauge (100m capacity) potted directly into the cable. The four hydrophones have been positioned in two pairs, with the first pair positioned roughly 13m ahead of the second pair. A two-kilogram linked chain was taped onto the cable two meters forward of the innermost hydrophone element (Hyd 1) to aid in increasing the tow depth of the cable (Figure 1).

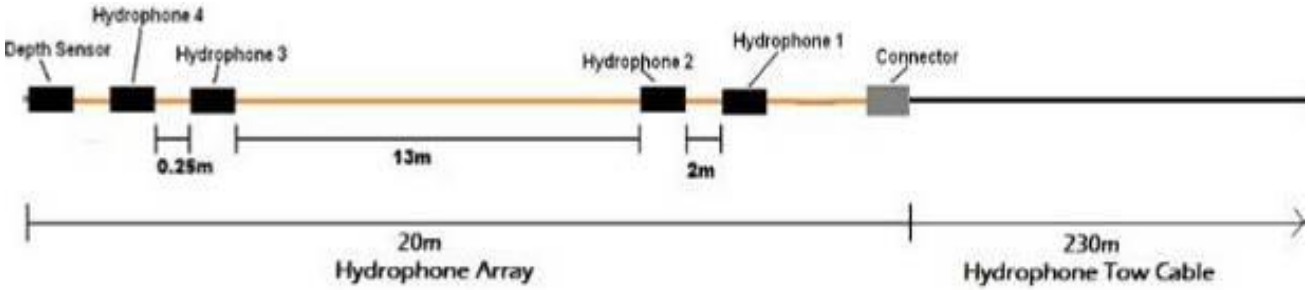

Figure 1: Two-part hydrophone cable with a 230-meter tow cable and detachable 20 meter hydrophone array

The hydrophone cable was spooled onto a hydraulic winch located on the port side of the gun deck (Figure 2). A 100-meter deck cable connects the hydrophone cable on the gun deck to the PAM station in the main science lab (Figure 3). Due to the structural design of the vessel, two 100-meter deck cables were installed in port, prior to the project. One of the deck cables was designated as the main cable and the other acted as a spare. The main deck cable was connected to an electronic processing unit (EPU) located, along with two monitors and other monitoring equipment, at the PAM station in the main science lab (Figure 4). The rack-mounted EPU was secured in the event of rough weather. A GPS feed (GNGGA string) was supplied to the system by the ships navigation Seapath 200.

The hydrophone cable was deployed directly off the stern of the vessel, just aft of the winch. To minimize the risk of entanglement with the seismic gear, the cable was attached, via a Yales grip, to a lifting rope, which offset the towing point of the cable approximately two meters to port (Figure 5). A Chinese finger was attached to the hydrophone cable as a tow point to reduce the tension on the cable that remained spooled on the winch when deployed. Approximately 100 meters of the hydrophone cable were towed astern of the vessel for the survey, which placed the end of the cable approximately 93 meters ahead of the acoustic source array.

Figure 2: PAM cable spooled onto the winch.

Figure 3: Hydrophone cable on the winch connected to the main deck cable.

Figure 4: Passive Acoustic Monitoring Station in the Main Science Lab

Figure 5: The PAM cable connecting to the offset rope via shackle.

Deployment Tasks

- Ensure that the data processing unit was powered down.
- Alert the bridge of the pending hydrophone deployment.
- Ensure that the deck cable was disconnected from the hydrophone tow cable. Do not allow connectors to rotate with the winches unless they are strapped down as they can impact or snag and snap.
- Power on the winch.
- Avoid excess tension on the cable.
- Deploy in a slow controlled manner to prevent crossover on the winch.
- Respect the cables minimum bend angles and ensure are not bent on either side of cable mouldings/pottings.
- Protect cable from abrasions and chaffing.
- Let out the proper length of hydrophone cable off the winch for the deployment method used.
- Connect the hydrophone cable to any needed sliding collars, offset ropes, etc. used for the deployment method via Chinese fingers.
- Power off the winch.
- Connect the hydrophone tow cable to the deck cable.
- Power on the data processing unit.

Retrieval Tasks

- Ensure that the data processing unit is powered down.
- Alert the bridge of the pending hydrophone able retrieval.
- Bring two adjustable wrenches to disconnect d-rings.
- Disconnect the hydrophone cable from the tow cable. Tape the connectors and ensure they are stowed/secured clear of the moving winch.
- Power on the winch.
- Disconnect the Chinese fingers on the cable from any utilized sliding collars or offset ropes.
- Retrieve the cable in a slow controlled manner to prevent crossover on the winch.
- Power off the winch.

<u>Always ensure that if the winch is powered on that the tow cable is disconnect from the deck cable and the connectors properly stowed.</u>

Health Safety and Environment (HSE) Requirements

Normal working deck Personal Protective Equipment (PPE) was required (hard hat, boots, gloves, eye protection). A life vest was required for any work involving items going over the side. The operation carried relatively low risk. Hazards included working close to the side of the vessel, trip hazards, and pinch points at the winch.

A Job Safety Analysis (JSA) was completed for this task. Further review of JSA was required in the event of modifications to the procedures.

APPENDIX E: Survey Lines Acquired

Survey Line	Date Acquisition Commenced	Time Acquisition Commenced (UTC)	Date Acquisition Completed	Time Acquisition Completed (UTC)
MGL1903MC01	2019-06-08	20:21	2019-06-09	15:01
MGL1903MT01	2019-06-09	15:08	2019-06-10	02:13
MGL1903MC02	2019-06-10	03:04	2019-06-11	00:08
MGL1903MT02	2019-06-11	00:24	2019-06-11	02:51
MGL1903MC03	2019-06-11	02:56	2019-06-11	23:13
MGL1903MT03	2019-06-11	23:21	2019-06-12	02:34
MGL1903MC04	2019-06-12	02:50	2019-06-12	21:09
MGL1903MT04	2019-06-12	21:23	2019-06-13	00:14
MGL1903MC05	2019-06-13	00:32	2019-06-13	20:08
MGL1903MT05	2019-06-13	20:24	2019-06-13	23:32
MGL1903MC06	2019-06-13	23:46	2019-06-15	01:12
MGL1903MT06	2019-06-15	01:25	2019-06-15	04:42
MGL1903MC07	2019-06-15	05:03	2019-06-16	07:03
MGL1903OT07	2019-06-16	17:07	2019-06-16	20:37
MGL1903OB08	2019-06-16	20:45	2019-06-18	00:27
MGL1903OT08	2019-06-18	01:05	2019-06-18	07:48
MGL1903OB09	2019-06-18	07:51	2019-06-19	05:40
MGL1903OT09	2019-06-19	05:44	2019-06-19	09:05
MGL1903OB10	2019-06-19	09:09	2019-06-20	13:35
MGL1903OT10	2019-06-20	13:40	2019-06-20	17:32
MGL1903OB11	2019-06-20	17:34	2019-06-21	22:35
MGL1903OT11	2019-06-21	22:53	2019-06-22	02:04
MGL1903OB12	2019-06-22	02:10	2019-06-23	03:53

APPENDIX F: Changes in Acoustic Source Volume During Survey Operations

Date	Time (UTC)	Start Volume (in^3)	Start Active Elements	End Volume (in^3)	End Active Elements	Comments
2019-06-11	03:57	6600	36	3300	18	Strings 3 & 4 disabled to untangle PAM cable from string 4
2019-06-11	05:40	3300	18	4950	27	String 4 re-enabled
2019-06-11	06:20	4950	27	6600	36	String 3 re-enabled
2019-06-17	18:27	6600	36	4950	27	String 2 disabled to fix gun 10 autofire
2019-06-17	21:59	4950	27	6600	36	String 2 re-enabled
2019-06-21	08:07	6600	36	3300	18	Strings 3 & 4 disabled to untangle PAM cable from string 4
2019-06-21	22:47	6540	35	3300	18	Strings 1 & 2 disabled during PAM cable retrieval from starboard stern
2019-06-21	22:50	3300	18	6540	35	Strings 1 & 2 re-enabled
2019-06-21	23:01	6540	35	3300	18	Strings 3 & 4 disabled during PAM deployment off port stern
2019-06-21	23:06	3300	18	6540	35	Strings 3 & 4 re-enabled

APPENDIX G: Acoustic Monitoring Downtime

Acoustic Monitoring Stopped		Acoustic Monitoring Resumed		Total Downtime	Total Downtime with Source Active	Total Downtime with Source Silent	Reason/Comment
Date	Time (UTC)	Date	Time (UTC)				
2019-06-11	03:58	2019-06-11	06:41	02:43	02:43	-	PAM cable became entangled with sub-array 4 due to swells from the port stern. Cable was re-deployed of the starboard side to prevent another entanglement until the vessel changed heading or the swells change direction.
2019-06-14	15:04	2019-06-14	15:33	00:29	00:29	-	PAM cable moved from starboard to port deployment due to risk of entanglement with swell direction
2019-06-15	05:04	2019-06-15	05:33	00:29	00:29	-	PAM cable moved from port to starboard deployment due to risk of entanglement with swell direction
2019-06-16	07:09	2019-06-16	15:33	08:24	-	08:24	PAM cable retrieved with source arrays to retrieve the streamer for the remainder of the survey program.
2019-06-21	07:38	2019-06-21	13:50	06:12	00:30	05:42	PAM cable moved from port to starboard deployment due to risk of entanglement with swell direction
2019-06-21	22:36	2019-06-21	23:14	00:38	00:38	-	PAM cable moved from starboard to port deployment due to risk of entanglement with swell direction

APPENDIX H: Summary of Visual Detections of Protected Species during the Gulf of Alaska Survey Program.

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

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

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behavior		CPA Source / Source Activity	Mitigation Action	Comments
1	2019-06-08	01:12	Northern Sea Otter	2	57.72489°N 152.52600°W	Silent	V; AV	DI, MI, BA, SR	150m/Silent	None	Acoustic source was silent and onboard during transit to survey area.
2	2019-06-08	01:57	Northern Sea Otter	5	57.73658°N 152.46563°W	Silent	TV; AV	NS, BA, FT, DI	200m/Silent	None	Acoustic source was silent and onboard during transit to survey area.
3	2019-06-09	06:18	Fin Whale	2	56.52267°N 151.50183°W	Full Volume Online	PV/OD	BV, NS	1304m/Full Volume Online	None	Whales last observed in the 160 dB radius. Both whales were potential Level B takes.
4	2019-06-09	14:48	Unidentified Whale	2	55.91601°N 151.01946°W	Full Volume Online	PE(AH); SA	BV	3700m/Full Volume Online	None	Whales last observed in the 160 dB radius. Both whales were potential Level B takes.
5	2019-06-09	15:22	Fin Whale	1	55.87191°N 151.03555°W	Full Volume Online	PE(AH); PV/OD	BV, SR, NS	958m/Full Volume Online	None	Whale last observed in the 160 dB radius. Whale was a potential Level B takes.
6	2019-06-09	16:34	Unidentified Whale	3	55.78333°N 151.10983°W	Full Volume Online	SA	BV	2774m/Full Volume Online	None	Whales last observed in the 160 dB radius. Both whales were potential Level B takes.
7	2019-06-09	20:58	Unidentified Whale	2	55.47533°N 151.36567°W	Full Volume Online	PE(AH); AV	BV	1952m/Full Volume Online	None	Whales last observed in the 160 dB radius. Both whales were potential Level B takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behavior		CPA Source / Source Activity	Mitigation Action	Comments
8	2019-06-09	21:30	Unidentified Whale	1	55.44021°N 151.39484°W	Full Volume Online	UN	BV	2096m/Full Volume Online	None	Whale last observed in the 160 dB radius. Whale was a potential Level B take.
9	2019-06-10	04:21	Unidentified Whale	1	55.20700°N 151.84912°W	Full Volume Online	UN	BV	3150m/Full Volume Online	None	Whale last observed in the 160 dB radius. Whale was a potential Level B take.
10	2019-06-15	00:40	Unidentified Whale	1	56.67679°N 155.55978°W	Full Volume Online	UN	BV	1200m/Full Volume Online	None	Detection occurred in fin whale BIA. Whale was last observed in the 160 dB radius. Whale was a potential Level B take.
11	2019-06-15	01:51	Unidentified Whale	1	56.69286°N 155.69774°W	Full Volume Online	PV/OD; AV	BV	1200m/Full Volume Online	None	Detection occurred in fin whale BIA. Whale was last observed in the 160 dB radius. Whale was a potential Level B take.
12	2019-06-15	17:14	Humpback Whale	1	55.49350N 155.08467°W	Full Volume Online	PV/OD; AV	BV	793m/Full Volume Online	None	Whale last observed in the 160 dB radius. Whale was a potential Level B take.
13	2019-06-15	18:53	Unidentified Whale	1	55.34755°N 154.95360°W	Full Volume Online	UN	BV	3200m/Full Volume Online	None	Whale last observed in the 160 dB radius. Whale was a potential Level B take.
14	2019-06-15	19:32	Unidentified Whale	1	55.29017°N 154.90233°W	Full Volume Online	PV/OD	BV	2120m/Full Volume Online	None	Whale last observed in the 160 dB radius. Whale was a potential Level B take.
15	2019-06-15	23:50	Unidentified Whale	1	54.94421°N 154.59665°W	Full Volume Online	UN	BV	3250m/Full Volume Online	None	Whale last observed in the 160 dB radius. Whale was a potential Level B take.
16	2019-06-16	14:57	Unidentified Whale	1	54.22664°N 153.96241°W	Silent	UN	BV	2650m/Silent	None	Acoustic source was silent during deployment of the arrays.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behavior		CPA Source / Source Activity	Mitigation Action	Comments
17	2019-06-17	07:22	Dall's Porpoise	6	55.11317°N 155.34667°W	Full volume online	TV; PV/OD	FT, SS, SR	246m/Full volume online and 190m/Silent	Shut-Down	Mitigation shut-down totaled 41 minutes, which were production loss. Simultaneous with AD#1. Porpoises last observed in the 500 meter EZ, and were considered to be potential Level A takes
18	2019-06-18	02:19	Unidentified Whale	4	56.29278°N 156.61770°W	Full volume online	PV/OD	BV, FT, SR	4200m/Full volume online	None	Whales last sighted in 160 decibel radius, and were considered potential Level B takes. Detection occurred in the fin whale BIA.
19	2019-06-18	15:03	Unidentified Whale	3	55.23420°N 156.06209°W	Full volume online	AV	BV, ST	4200m/Full volume online	None	Whales last sighted in 160 decibel radius, and were considered potential Level B takes.
20	2019-06-19	20:32	Unidentified Whale	1	54.87167°N 156.33217°W	Full volume online	UN; PV/OD	BV	1883m/Full volume online	None	Whale last sighted in 160 decibel radius, and was considered a potential Level B take.
21	2019-06-20	02:30	Killer Whale	10	55.31683°N 156.75019°W	Full volume online	PV/OD	BV, NS, DI, SH	1574m/Full volume online	None	Orcas last sighted in 160 decibel radius, and were considered potential Level B takes.
22	2019-06-20	03:00	Fin Whale	2	55.34617°N 156.77800°W	Full volume online	PE(AH); PV/OD	BV, NS, SR	427m/Full volume online and 350m/Silent	Shut-Down	Mitigation shut-down totaled 59 minutes, which were production loss. Whales last sighted in 500 meter EZ, and were considered potential Level B takes.
23	2019-06-20	18:12	Fin Whale	1	55.81677°N 157.85645°W	Full volume online	PV/OD	BV, FT	655m/Full volume online	None	Whale last sighted in 160 decibel radius, and was considered a potential Level B take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behavior		CPA Source / Source Activity	Mitigation Action	Comments
24	2019-06-20	18:39	Fin Whale	2	55.78165°N 157.82139°W	Full volume online	AV	BV, NS	3250m/Full volume online	None	Whales last sighted in 160 decibel radius, and were considered potential Level B takes.
25	2019-06-20	18:52	Unidentified Whale	2	55.76639°N 157.80608°W	Full volume online	PV/OD	BV, NS	2750m/Full volume online	None	Whales last sighted in 160 decibel radius, and were considered potential Level B takes.
26	2019-06-20	19:11	Fin Whale	1	55.74090°N 157.78057°W	Full volume online	PE(AH), PV/OD	BV, FT	650m/Full volume online	None	Whale last sighted in 160 decibel radius, and was considered a potential Level B take.
27	2019-06-20	20:57	Fin Whale	1	55.60556°N 157.64623°W	Full volume online	PV/OD	BV, FT	548m/Full volume online	None	Whale last sighted in 160 decibel radius, and was considered a potential Level B take.
28	2019-06-21	01:30	Unidentified Whale	1	55.29344°N 157.34085°W	Full volume online	AV	BV, FT	583m/Full volume online	None	Whale last sighted in 160 decibel radius, and was considered a potential Level B take.
29	2019-06-21	06:54	Northern Fur Seal	1	54.87794°N 156.94311°W	Full volume online	PV/OD	SR, NS, DI	323m/Full volume online and 303m/Silent	Shut-Down	Mitigation shut-down totaled 36 minutes, which were production loss. Pinniped last sighted in 500 meter EZ, and was considered a potential Level B takes.
30	2019-06-22	02:59	Unidentified Whale	1	53.74767°N 156.49283°W	Reduced volume online	UN	BV, NS	3332m/ Reduced volume online	None	Whale last sighted in 160 decibel radius, and was considered a potential Level B take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behavior		CPA Source / Source Activity	Mitigation Action	Comments
31	2019-06-22	03:09	Unidentified Whale	1	53.75700°N 156.50133°W	Reduced volume online	PV/OD	BV, FT	636m/ Reduced volume online	None	Whale last sighted in 160 decibel radius, and was considered a potential Level B take.
32	2019-06-22	03:48	Unidentified Whale	1	53.81650°N 156.55517°W	Reduced volume online	PV/OD	BV, NS	1745m/ Reduced volume online	None	Whale last sighted in 160 decibel radius, and was considered a potential Level B take.
33	2019-06-22	06:15	Unidentified Whale	1	54.01153°N 156.73358°W	Reduced volume online	PV/OD	BV, NS	3536m/ Reduced volume online	None	Whale last sighted in 160 decibel radius, and was considered a potential Level B take.
34	2019-06-22	16:30	Unidentified Whale	1	54.80833°N 157.48283°W	Reduced volume online	UN	BV	2122m/ Reduced volume online	None	Whale last sighted in 160 decibel radius, and was considered a potential Level B take.
35	2019-06-22	20:38	Fin Whale	2	55.12717°N 157.79233°W	Reduced volume online	AV	BV, FT, FF	1635m/ Reduced volume online	None	Whales last sighted in 160 decibel radius, and were considered potential Level B takes.
36	2019-06-23	01:35	Unidentified Otariid Pinniped	1	55.51942°N 158.18088°W	Reduced volume online	UN	MI, SR, DI	230m/ Reduced volume online	Shut-Down	Mitigation action totaled 17 minutes, which were production loss. Pinniped last sighted in 500m EZ, and was considered a potential Level B take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behavior		CPA Source / Source Activity	Mitigation Action	Comments
37	2019-06-23	01:53	Unidentified Otariid Pinniped	1	55.54053°N 158.20200°W	Ramp-Up	UN	BA, DI	270m/ Ramp-up	Shut-Down	Mitigation action totaled 35 minutes, which were production loss. Pinniped last sighted in 500m EZ, and was considered a potential Level B take.
38	2019-06-23	02:12	Fin Whale	1	55.56361°N 158.22518°W	Ramp-Up	AV	BV, FT	1836m/ Ramp-up	None	Whale last sighted in 160 decibel radius, and was considered a potential Level B take.
39	2019-06-23	02:42	Unidentified Whale	2	55.60337°N 158.26523°W	Reduced volume online	AV	BV	4600m/ Reduced volume online	None	Whales last sighted in 160 decibel radius, and were considered potential Level B takes.
40	2019-06-23	03:31	Unidentified Whale	1	55.66563°N 158.32800°W	Reduced volume online	PV/OD	BV, FT	4400m/ Reduced volume online	None	Whale last sighted in 160 decibel radius, and was considered a potential Level B take.
41	2019-06-23	03:44	Fin Whale	9	55.68259°N 158.34517°W	Reduced volume online	PV/OD	BV, FT, MI, FF, SA	4650m/ Reduced volume online and 658m/Silent	Shut-Down	Shut-down for aggregation of large whales. Mitigation action totaled three hours three minutes, which were production loss. Whales last sighted in 160 decibel radius, and were considered potential Level B takes.
42	2019-06-23	14:18	Unidentified Otariid Pinniped	1	55.48751°N 157.09516°E	Silent	PV/OD	BA, DI	313m/Silent	None	Acoustic source silent and on-board during transit back to port.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behavior		CPA Source / Source Activity	Mitigation Action	Comments
43	2019-06-23	15:27	Fin Whale	1	55.48775°N 156.75371°W	Silent	AV	BV, FT	699m/Silent	None	Acoustic source silent and on-board during transit back to port.
44	2019-06-23	15:43	Fin Whale	8	55.49002°N 156.67492°W	Silent	UN	BV, FT	190m/Silent	None	Acoustic source silent and on-board during transit back to port.
45	2019-06-23	18:07	Dall's Porpoise	3	55.49717°N 155.99133°W	Silent	PV/SD; AV	SV, FT	265m/Silent	None	Acoustic source silent and on-board during transit back to port.
46	2019-06-23	20:32	Unidentified Whale	4	55.52830°N 155.42986°W	Silent	UN	BV	1748m/Silent	None	Acoustic source silent and on-board during transit back to port.
47	2019-06-24	04:49	Humpback Whale	1	56.33954°N 153.41607°W	Silent	TV; PV/OD	BV, DF	1100m/Silent	None	Acoustic source silent and on-board during transit back to port.
48	2019-06-24	20:44	Northern Sea Otter	1	57.72191°N 152.50046°W	Silent	SA	BA	100m/Silent	None	Acoustic source silent and on-board during transit back to port.

APPENDIX I: Summary of Acoustic Detections of Protected Species during Gulf of Alaska Survey Program

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
1	2019-06-17	07:24	Dall's Porpoise	1	55.11412° N 155.34757° W	Full volume online	High frequency clicks 135 kilohertz, with amplitudes between 122 and 127 decibels.	246m/Full volume online and 190m/Silent	Shut-Down	Simultaneous with VD #17. Porpoises sighted visually first and totaled 6 individuals. Only one individual confirmed vocalizing in the acoustic detection. Source shut-down for the visual sighting of the porpoises in the 500m EZ. Mitigation action totaled 41 minutes, which were considered production loss, and the porpoises were considered to be potential Level A takes.

APPENDIX J: Photographs of Identified Protected Species Visually Detected during the Gulf of Alaska Survey Program.

Figure 6: Visual Detection #2; Sea otters sighted on 8 June 2019.

Figure 7: Visual Detection #4; UID whales sighted on 9 June 2019.

Figure 8: Visual Detection #5; Fin whale sighted on 9 June 2019.

Figure 9: Visual Detection #12; Humpback whale sighted on 15 June 2019.

Figure 10: Visual Detection #14; UID whale sighted on 15 June 2019.

Figure 11: Visual detection #17; Dall's porpoise; 17 June 2019.

Figure 12: Visual detection #18; Unidentified whales; 18 June 2019.

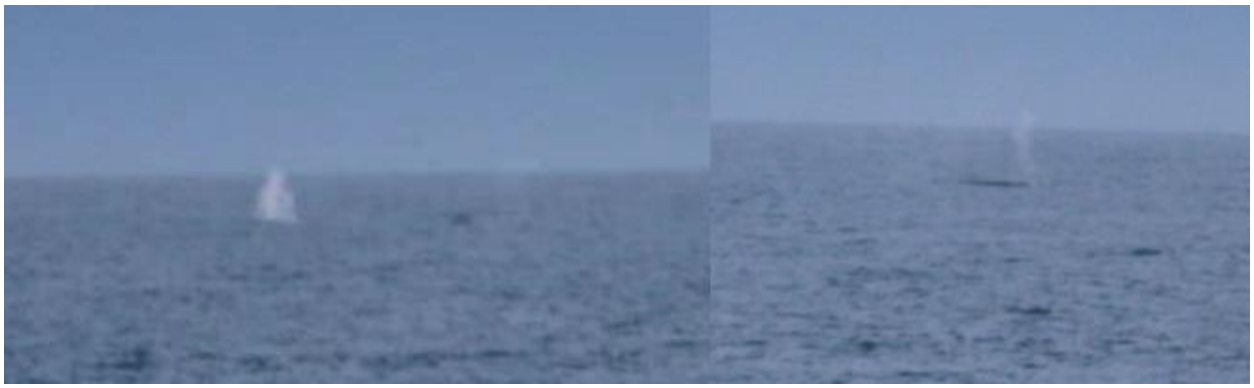

Figure 13: Visual detection #19; Unidentified whales, 19 June 2019.

Figure 14: Visual detection #21; Killer whales, 20 June 2019.

Figure 15: Visual detection #22; Fin whales, 20 June 2019.

Figure 16: Visual detection #23; Fin whale, 20 June 2019.

Figure 17: Visual detection #24; Fin whale, 20 June 2019.

Figure 18: Visual detection #26; Fin whale, 20 June 2019.

Figure 19: Visual detection #27; Fin whale, 20 June 2019.

Figure 20: Visual detection #29; Northern Fur Seal, 21 June 2019.

Figure 21: Visual detection #35, Fin whale, 22 June 2019.

Figure 22: Visual detection #36; Unidentified otariid pinniped, 23 June 2019.

Figure 23: Visual detection #38; Fin whale, 23 June 2019.

Figure 24: Visual detection #41; Fin whale, 23 June 2019.

Figure 25: Visual detection #43; Fin whale, 23 June 2019.

Figure 26: Visual detection #44; Fin whale, 23 June 2019.

Figure 27: Visual detection #45; Dall's porpoise, 23 June 2019

Figure 28: Visual detection #47; Humpback whale, 24 June 2019.

Figure 29: Visual detection #48; Sea otter, 24 June 2019.

APPENDIX K: Screenshots Taken during Acoustic Detections of Protected Species during the Gulf of Alaska Survey Program.

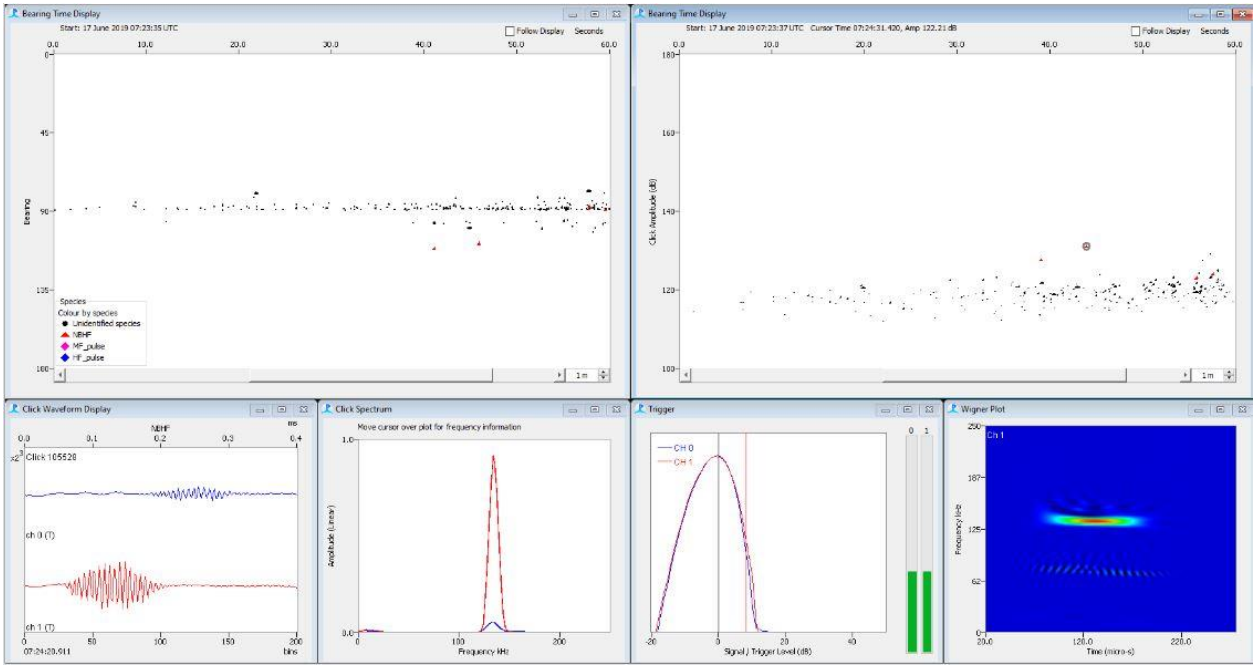

Figure 30: Acoustic detection #1; Dall's porpoise; 17 June 2019.

Appendix L: Species of Birds and Other Wildlife Observed during the Gulf of Alaska Survey Program

Birds: Common Name	Family	Genus	Species	Approximate Number Individuals Observed	Approximate Number of Days Species Was Observed
Ancient murrelet	Alcidae	*Synthliboramphus*	*antiquus*	24	1
Arctic tern	Laridae	*Sterna*	*paradisaea*	2	1
Belted Kingfisher	Alcedinidae	*Megaceryle*	*alcyon*	1	1
Black Oystercatcher	Haematopodidae	*Haematopus*	*bachmani*	2	1
Black-footed Albatross	Diomedeidae	*Phoebastria*	*nigripes*	84	16
Black-legged Kittiwake	Laridae	*Rissa*	*tridactyla*	53	8
Common Loon	Gaviidae	*Gavia*	*immer*	1	1
Common Murre	Alcidae	*Uria*	*aalge*	309	6
Common Redpoll	Fringillidae	*Acanthis*	*flammea*	1	1
Fork-tailed Storm-petrel	Hydrobatidae	*Oceanodroma*	*furcate*	33	13
Glaucous-winged Gull	Laridae	*Larus*	*hyperboreus*	357	9
Herring Gull	Laridae	*Larus*	*argentatus*	2	1
Horned Puffin	Alcidae	*Fratercula*	*corniculate*	43	7
Laysan Albatross	Diomedeidae	*Phoebastria*	*immutabilis*	24	13
Leach's Storm-petrel	Hydrobatidae	*Oceanodroma*	*leucorhoa*	10	5
Long-tailed Skua	Stercorariidae	*Stercorarius*	*longicaudus*	1	1
Northern Fulmar	Procellariidae	*Fulmarus*	*glacialis*	300	6
Pelagic Cormorant	Phalacrocoracidae	*Phalacrocorax*	*pelagicus*	4	2
Pigeon Guillemont	Alcidae	*Cepphus*	*columba*	70	4
Red Phalarope	Scolopacidae	*Phalaropus*	*fulicarius*	6	2
Short-tailed Shearwater	Procellariidae	*Puffinus*	*tenuirostris*	338	10
Tufted Puffin	Alcidae	*Fratercula*	*cirrhata*	126	16
White-winged Scoter	Anatidae	*Melanitta*	*fusca*	2	1

Marine Invertebrates: Common Name	Family	Genus	Species	Approximate Number Individuals Observed	Approximate Number of Days Species Was Observed
Lion's mane jellyfish	Cyaneidae	*Cyanea*	*capillata*	12	2
Moon jellyfish	Ulmaridae	*Aurelia*	*Aurita*	420	2
Pacific sea nettle jellyfish	Pelagiidae	*Chrysaora*	*fuscencens*	3	1