Protected Species Mitigation and Monitoring Report

Marine Geophysical (Seismic) Survey
Northeast Pacific Ocean

Heat Flow Survey
04 August 2022 – 19 August 2022

R/V *Marcus G. Langseth*

Prepared for:

Lamont-Doherty Earth Observatory of Columbia University
61 Route 9W, P.O. Box 1000, Palisades, NY 10964-8000

For submission to:

National Marine Fisheries Service, Office of Protected Resources
1315 East-West Hwy, Silver Spring, MD 20910-3282

Project No.	**218699**	**RPS**
Cruise ID No.	**MGL2208**	**20405 Tomball Parkway Building 2, Suite 200**
Authors	**Travis Lay**	**Houston, Texas 77070, USA**
		Tel: (281) 448-6188
Submittal Date	**05/ 7 2023**	**Fax: (281) 448-6189**
		E-mail: Travis.Lay@rpsgroup.com
		Website: www.rpsgroup.com

Final

Report Reviewer	
Name	Date of Review
Travis Lay	12 September 2022 and 20 September 2022
Katherine Gideon	13 September 2022
Kathryn Roy	08 February 2023

Final Report Approval	
Name	Kathryn Roy
Title	Senior Environmental Specialist
Signature	
Date	May 9, 2023

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

Appendix	Description
Appendix A	Incidental Harassment Authorization
Appendix B	Incidental Take Statement
Appendix C	Basic Data Summary Form
Appendix D	Summary of Visual Detections of Protected Species
Appendix E	Photographs of Protected Species Visually Detected
Appendix F	Birds and Other Wildlife Observed
Appendix G	Geospatial Shapefile for Source Operations

ACRONYMS AND ABBREVIATIONS

ADCP – Acoustic Doppler Current Profiler
BiOp – Biological Opinion (US)
BOEM – Bureau of Ocean Energy Management
BZ – Buffer Zones
dB - decibel
DSLR – Digital Single Lens Reflex
EA – Environmental Assessment (US)
ESA – Endangered Species Act (US)
EEZ – Economic Exclusion Zone
EZ – Exclusion Zone
Hz - Hertz
IHA – Incidental Harassment Authorization (US)
ITS – Incidental Take Statement (US)
kHz - kiloHertz
LDEO – Lamont-Doherty Earth Observatory (US)
MBES – Multibeam Echosounder
MCS - Multichannel Seismic
MMPA – Marine Mammal Protection Act (US)
NMFS – National Marine Fisheries Service (US)
NRP – Navigation Reference Point
NSF – National Science Foundation (US)
OEIS – Overseas Environmental Impact Statement
OPR - NMFS Office of Protected Resources
PEIS – Programmatic Environmental Impact Statement (US)
PI – Principal Investigator
PTS – Permanent threshold shift
PSO – Protected Species Observer
RMS – Root mean square
RPS – PSO Provider company name (not an acronym)
R/V – Research vessel
SBP – Sub bottom Profiler
US – United States
UTC – Coordinated Universal Time

1. EXECUTIVE SUMMARY

The R/V *Marcus G. Langseth* (*Langseth*), owned and operated by Columbia University's Lamont-Doherty Earth Observatory (LDEO), conducted a low-energy 2D seismic and heat flow survey in the Northeast Pacific Ocean off the coast of Oregon from 04 to 19 August 2022 (referred to herein as "survey"). The operational activities were conducted in support of research proposed by Principal Investigators (PIs) Dr. R. Harris and Dr. A. Trehu (Oregon State University), and Dr. G. Spinelli (New Mexico Institute of Mining and Technology).

The purpose of the research was to study geological processes at the Cascadia Subduction Zone, where the slow ongoing descent of the Juan de Fuca plate beneath the northwestern coast of North America has generated large earthquakes and associated tsunamis in the past.

This report was prepared to meet the reporting requirements for the survey required under the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA). On 4 November2021, L-DEO applied to the US National Marine Fisheries Service (NMFS) for an Incidental Harassment Authorization (IHA) that would allow for the potential harassment of small numbers of protected marine mammals incidental to the seismic survey. On 11 July 2022 National Science Foundation (NSF) released their final Environmental Assessment (EA) and 01 august 2022 NMFS released their IHA and Biological Opinion (BiOp) for the survey.

Mitigation measures were implemented to minimize potential impacts to marine mammals, and endangered or threatened sea turtles and sea birds during the survey. These measures included, but were not limited to, the use of NMFS approved Protected Species Observers (PSOs) for visual monitoring of the designated buffer zones (BZ) and exclusion zones (EZ) (where the presence of a protected species would trigger a mitigation action), and the implementation of ramp-up procedures, mitigation actions (including delayed operations and shut-downs), and vessel strike avoidance maneuvers. Continuous protected species observation coverage during the survey was provided by RPS, the environmental consulting company contracted by LDEO 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 regulatory documents issued for the survey.

PSO activities were consistent with the PSO standards identified in the Programmatic Environmental Impact Statement (PEIS) / 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 is tiered. Six PSOs, one of which was designated as the Lead, were present on board the *Langseth* throughout the survey to conduct visual monitoring.

Throughout the survey, PSOs conducted visual observations for a total of 259 hours 36 minutes. The acoustic source was active for a total of 87 hours 47 minutes,

There was a total of 28 visual detections of protected species during the survey. Visual detections included 20 detections of whales (one sighting of a Baird's beaked whale, one sighting of a minke whale, three sightings of fin whales, six sightings of humpback whales, one sighting with both a fin whale and a humpback whale, two sightings of sei whales, and six sightings of unidentifiable whales), two detections of dolphins (one detection of northern right-whale dolphins and one detection of Pacific white-sided dolphins), one detection of porpoises (Dall's porpoise), and five detections of pinnipeds (three detections of California sea lions, one detection of a Steller sea lion, and one detection of an unidentifiable fur seal).

Protected species detections did not result in the implementation of any mitigation actions during the survey. There was one vessel strike avoidance maneuvers implemented for large whales which required the vessel to remain stationary during equipment retrieval operations.

NMFS issued an IHA, and ITS authorizing 766 Level B takes for 24 species and one species groups of marine mammals, including seven species listed as endangered. There were no Level A takes authorized for any species. For this report, Level A and Level B are used in the same definition as found in the

MMPA and the NMFS issued BiOp description. Takes for endangered species totaled 66 individuals, including two humpback whales, two blue whales, four fin whales, two sei whales, seven sperm whales, and 49 Guadalupe fur seals. There were no specific number of takes issued for ESA-listed sea turtle or seabird species.

During the survey program, one marine mammal, a Baird's beaked whale, was observed within the predicted 160 decibel (dB) radius (where there is a potential for a behavioral response) while the acoustic source was active, constituting a potential Level B take. There were no sea turtles observed within the predicted 175 dB (where there is a potential for a behavioral response) while the source was active, constituting potential Level B exposures. There were no protected species observed within the predicted radius at which there is a 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/exposures.

2. INTRODUCTION

The following report details protected species monitoring and mitigation as well as seismic survey operations undertaken as part of the low energy 2D marine geophysical and heat flow survey on board the *Langseth* in the Northeast Pacific Ocean off the coast of Oregon from 04 to 19 August 2022.

This document serves to meet the reporting requirements dictated in the IHA and ITS issued to LDEO by NMFS on 01 August 2022. The IHAs and ITSs authorized takes of specific protected species, 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) (160 dB) 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, Level A harassment (auditory injury), for marine mammal species. Predicted distances to Level A harassment vary based on species specific hearing groups – low frequency cetaceans, mid frequency cetaceans, high frequency cetaceans, phocid pinnipeds, otariid pinnipeds, sea otters, and sea turtles – 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 represents the current best understanding of the threshold at which they exhibit behavioral responses.

NMFS require that measures such as BZ, EZ, delayed operations, ramp-ups, and shutdowns be implemented to mitigate for potentially adverse effects of the acoustic source sounds on protected species. The BZs and EZs were established from any element on the acoustic source array as areas where the presence of a protected species would trigger the implementation of a mitigation action (see section 3). For marine mammals, the occurrence of an individual detected approaching, entering, or within their designated EZ would trigger the implementation of a shut-down of the seismic source. NMFS specified a 100-meter EZ for most marine mammals, as it encompasses all zones within which auditory injury (Level A harassment) could occur on the basis of instantaneous exposure. This provides additional protection from the potential for more severe behavioral reactions for marine mammals at relatively close range to the acoustic source, 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. The 100-meter EZ was also implemented for sea turtles and protected sea birds, where the occurrence of an individual detection approaching, entering, or within the EZ (sea turtles), or diving or foraging within the EZ (protected sea birds) would trigger the implementation of a shut-down of the seismic source.

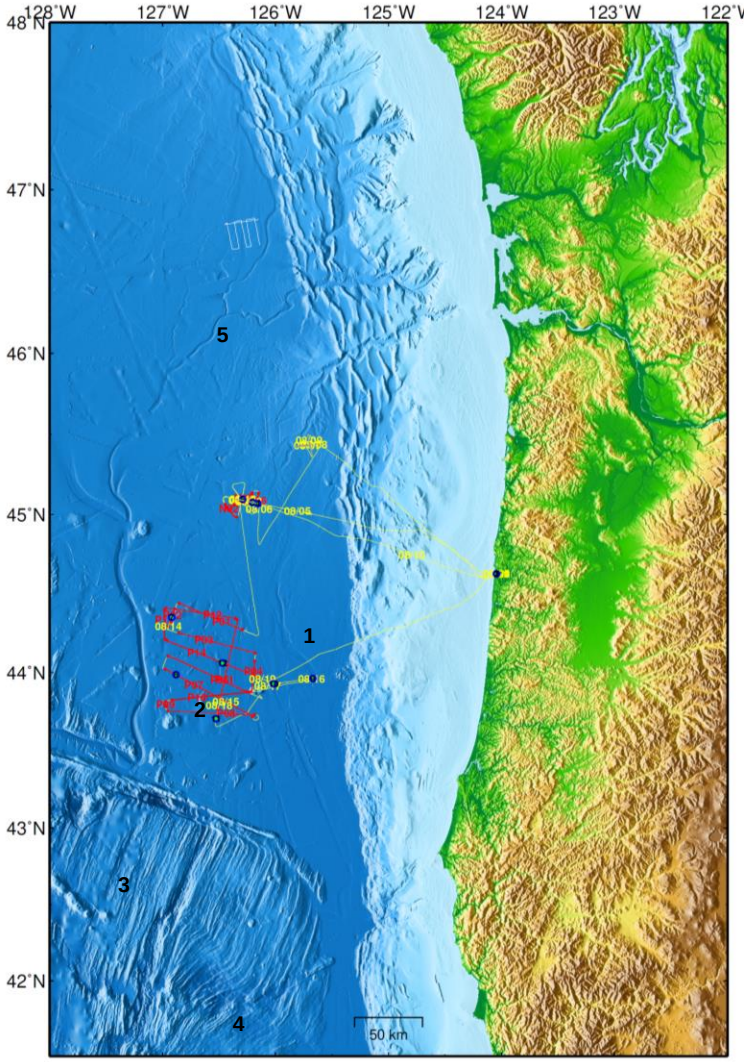
The IHA and the ITS is attached as Appendix A and Appendix B.

2.1. PROJECT OVERVIEW AND LOCATION

The research activities involved a 2D multichannel seismic (MCS) and heat flow measurement survey in the Northeast Pacific Ocean off the coast of Oregon between approximately 42 to 47 degrees North and 125 to 127 degrees West. All of the survey lines occurred within the US Exclusive Economic Zones (EEZ) in water depths greater than 1,600 meters (Figure 1).

The purpose of the research was to collect 2D seismic reflection data and heat flow measurements to understand the thermal structure of the Juan de Fuca plate as it enters the Cascadia subduction zone. The data collection was planned across several distinct structures that have not been previously studied, including a pseudo fault, complex buried seamounts, and small outcrops that represent the summit of much larger buried seamounts. The seismic reflection data is required to contain basement depth and other structural features that affect the heat flow measured near the seafloor and are critical for accurately modeling the heat flow observations.

All operations for the survey were conducted solely by the *Langseth*. The vessel is 72 meters (235 feet) in length and has a beam of 17 meters (56 feet) and a maximum draft of 5.9 meters (19.4 feet). The *Langseth* utilizes a particularly quiet propulsion system to avoid interference with the seismic signals. The vessel's cruising speed was approximately 10 to 11 knots during transits and varied between three and five knots during the seismic survey and between 0.5 and 1.5 knots during movements between heat flow measurement sites with the probe deployed.



1. Margin site. 2. Nubbin site. 3. Pseudofault site. 4. Diebold site. 5. Coast site (not surveyed at this time).

Figure 1. Location and survey points of the marine geophysical survey.

Operations were conducted between 05 and 18 August 2022, altering between seismic survey acquisition and heat flow measurement operations at the different sites within the survey location (named Margin, Nubbin, Pseudofault, and Diebold). Heat flow measurements only were collected at the Margin and Diebold sites, seismic survey data only was only collected at the Pseudofault site, and both heat flow measurement and seismic survey data was collected at the Nubbin site. Additional data collection was planned for these sites, as well as two other sites that were unable to be completed during the survey program due to time constraints and issues with the heat probe and the vessel's engines, which caused the project to end early. The PIs will attempt to return to complete the data collection at a later date.

There was a total of 19 survey line sequences acquired totaling 732.45 kilometers. This included six survey lines at the Nubbin site and 13 survey lines at the Pseudofault site. There were 16 heat flow

measurement sites collected at the Margin site, 27 collected at the Nubbin site, and 25 collected at the Diebold site.

2.1.1. Energy Source and Receiving Systems

The energy source utilized during the survey consisted of two Generator Injector sound sources on one source array deployed just aft of the vessel. Each element had a volume of 45 cubic inches, giving a maximum source volume of 90 cubic inches for the survey. The operating pressure was 1,950 pounds per square inch, the dominant frequency components ranged from zero to 188 Hertz (Hz), and nominal source levels ranged from 231 dB re: 1 µPa (zero to peak) to 237 dB re: 1 µPa (peak-to-peak). The shot point interval was 25 meters (12.5 seconds). During acquisition the source elements emitted a brief (approximately 0.1 second) pulse of sound. During the intervening periods of operations, the source elements were silent. The source elements were towed at a depth of three meters. The center of the source was situated 300 meters from the Navigation Reference Point , which was located on the PSO observation tower. This positioned the elements on the array 271 meters from the stern of the vessel.

The receiving system for the seismic survey consisted of one 900-meter streamer, which received the returning acoustic signals and transferred the data to the onboard processing system.

The heat flow probe was a passive system that took temperature measurements of the sediments (Figure 2). The probe was lowered into the water off the starboard side of the vessel utilizing the A-frame and suspended in the water column. When the vessel was at the desired measurement location, the probe was lowered into the seabed, penetrating up to six meters (19.7 feet) into the sediment. The data was stored in the probe until it was retrieved to the vessel and collected, mainly when the probe battery needed to be changed, or if there was a longer transit distance between measurement sites.

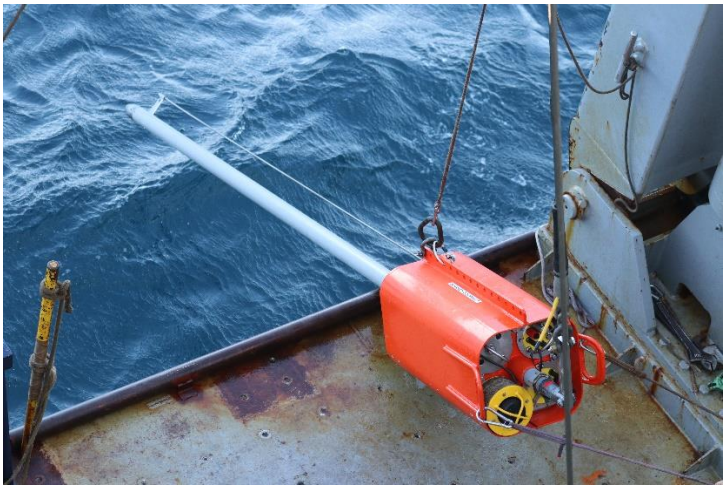


Figure 2: Heat probe.

Additional sound sources used in support of research efforts 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 (kHz). Each ping consisted of eight (in water depths greater than 1,000 meters) or four (in water depths less than 1,000 meters) successive fan-shaped transmissions. The transmitting beam width was one or two degrees fore-aft and 150 degrees perpendicular to the ship's line of travel. The maximum source level was 242 dB re: 1 µPa (rms). The hull-mounted SBP beam was transmitted as a 27-degree cone, which was directed downward by a 3.5 kHz transducer. The nominal power output was 10 kilowatts; however, the actual maximum radiated power was three kilowatts or 222 dB re: 1 µPa m (rms). The ping duration was 64 seconds, and the interval was one second. The hull-mounted ADCP operated at a frequency of 75 kHz 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 seafloor sedimentary features and to map the topography of the ocean floor. The ADCP was used to measure water current velocities

3. MITIGATION AND MONITORING METHODS

The PSO monitoring program on the *Langseth* was established to meet the standards set forth in the PEIS, EA, IHA, ITS, and BiOp requirements. 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 necessary.
- Effects of marine species 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 project permit documents, PSOs collected and analyzed necessary data mandated by the IHA and ITS (Appendix C).

3.1. MITIGATION METHODOLOGY

Mitigation actions were implemented for visual detections of protected species, including marine mammals, sea turtles, and protected sea birds, as outlined in the EA, IHA, ITS, and BiOp. These actions included the establishment of BZs and EZs, and the implementation of delayed operations and shutdowns (where the seismic source was fully silenced) for protected species detected approaching, entering, or within their designated BZ and EZ (Table 1).

Before the acoustic source could be activated from silence (day and night), two PSOs conducted a 30-minute clearance survey of the BZs and EZs. In the event of a detection of protected species within their designated zones (Table 2) or as outlined in Table 1, a delay of source operations would be implemented. Source operations would not be cleared to begin until the protected species were observed exiting their designated zones. If the protected species were not observed exiting their designated zones (i.e., if they dove/submerged 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 and other large odontocetes (including sperm whales, pygmy sperm whales, dwarf sperm whales, beaked whales, pilot whales, killer whales, and Risso's dolphins) this time was 30 minutes following last sighting.

Table 1: Specific detections of protected species and their required mitigation actions.

Detection of:	Mitigation Action Required
A large whale (defined as a sperm whale or any mysticete species) with a calf (defined as an animal less than two-thirds the body size of an adult and observed in close association with an adult) observed at any distance from the vessel.	Delayed operation of inactive source and shut-down of active source.
An aggregation of six or more large whales observed at any distance from the vessel.	Delayed operation of inactive source and shut-down of active source.
A North Pacific right whale observed at any distance from the vessel.	Delayed operation of inactive source and shut-down of active source.
Any marine mammal species not authorized for take observed approaching, entering, or within the 160-dB radius.	Delayed operation of inactive source and shut-down of active source.
Any marine mammal species for which the total	Delayed operation of inactive source and shut-

Detection of:	Mitigation Action Required
authorized takes has been met observed approaching, entering, or within the 160-dB radius.	down of active source.
Any other protected species detected approaching, entering, or within their designated buffer zones.	Delayed operation of inactive source and a warning call that a mitigation action may soon be required for an active source.
Any other protected species detected approaching, entering, or within their designated exclusion zones.	Delayed operation of inactive source and shut-down of active source.
Any dolphin species with a shut-down exemption detected approaching, entering, or within their designated exclusion zones.	None.

Table 2: Separation distances, and buffer and exclusion zone sizes for each species/species group expected to occur in the survey area.

Species/Species Groups	Separation Distance (meters)	Buffer Zones (meters)	Exclusion Zones (meters)	Delay Duration (minutes)
North Pacific right whale, large whale/calf, 6+ large whales	500	Any distance	Any distance	30
Beaked whale, pygmy & dwarf sperm whale, killer whale	50	500	500	30
Mysticetes and sperm whale	100	200	200	30
Pilot whale and Risso's dolphin	50	200	100	30
All other small dolphins and porpoises	50	200	100	15
Pinnipeds	50	200	100	15
Sea Turtles	50	175 dB radius	100	15
Esa-listed sea birds	N/A	100	100	15

Once the acoustic source was active, the BZ from any element on the acoustic source arrays were established as areas 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 would keep in frequent contact with each other and the seismic team, relaying information on the location and movement of the protected species, and the implementation of any needed mitigation actions.

The EZs from any active source element were established as areas in which the detection of a protected species would trigger a shut-down of the seismic source, depending on the species present. For marine mammals and sea turtles, the detection of one approaching, entering, or within their designated zone would trigger a shutdown of the source. For protected sea birds, the detection of one foraging or diving within their exclusion zone would trigger a shut-down of the source.

Upon the implementation of a shut-down for a detection of protected species, a ramp-up was required to resume source activity once the protected species were confirmed to have exited their respective exclusion zones. If the protected species could not be confirmed to have exited their respective exclusion zones (i.e., if they submerged/dove within the zone and were not re-sighted), clearance for ramp-up would not be given until a specific time following the last sighting of the individuals within the zones. For detections of small odontocetes, pinnipeds, sea turtles, or sea birds, this time was 15 minutes following last sighting. For detections of mysticetes and other large odontocetes (including sperm whales, pygmy sperm whales, dwarf sperm whales, beaked whales, pilot whales, killer whales, and Risso's dolphins) this time was 30 minutes following last sighting.

The IHAs and ITSs also outlined additional mitigation actions for specific protected species while the acoustic source was active as outlined in Table 1. The shutdown requirement was waived for small dolphins in the genera *Delphinus, Stenella, and Lissodelphis*. If PSOs could identify the dolphins sighted

as one of these species, no mitigation action was required if they were observed approaching, entering, or within the exclusion zone. If there was any uncertainty regarding the species identification, visual PSOs were to use their best professional judgment in making the decision to call for a shutdown.

Specific acoustic source operation procedures outlined in the IHAs and ITSs that were relevant to this specific survey included:

1. Ramp-ups had to begin with one 45 cubic inch element, with the second 45 cubic inch element added after five minutes. The time between ramp-up completion and start of data acquisition had to be minimized.
2. Testing of individual elements or strings required a 30-minute clearance search period but no ramp-up. Testing of more than one element or string required both a 30-minute clearance search period and a ramp-up to the maximum volume being tested.
3. Brief periods (less than 30 minutes) of operational silence for reasons other than a protected species shut-down did not require a ramp-up to resume full volume source operations provided that: (1) PSOs maintained constant visual observation, and (2) no detections of protected species occurred within the applicable exclusion zone during that silent period. For any brief period of silence at night or in periods of poor visibility (e.g., Beaufort sea state of four or greater), a ramp-up was required, but if constant observation was maintained, a pre-start clearance watch was not required. For any longer shut-down, both a pre-start clearance watches and a ramp-up were required.

Table 3 describes the predicted 160 dB radius (Level B harassment zone for marine mammals) and the predicted 175 dB radius (Level B harassment zone for sea turtles). Table 4 describes the predicted Level A harassment zones for each protected species hearing group per the NMFS guidelines, and the species that could occur in the survey area assigned to each group; as noted previously however, shutdowns would occur at each species designated EZs (e.g., 500m, 1500m, etc.).

Table 3: Predicted 160/175 dB Zones* Implemented during the survey.

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
2 elements	90	> 1,000	553	98

*Distances are from any single element on the array

Table 4: Predicted Level A Harassment Zones* for each Marine Mammal Hearing Group Implemented during the survey.

Source	Volume (in^3)	Low Frequency Cetaceans (m)	Mid Frequency Cetaceans (m)	High Frequency Cetaceans (m)	Phocid Pinnipeds (m)	Otariid Pinnipeds/ Sea Otters (m)	Sea Turtles (m)
2 elements	90	28.6	1.1	N/A	N/A	0.4	0.3
Distances are from any single element on the array The dolphin species in blue are the shut-down exemption species		• Humpback whale • Blue whale • Fin whale • Sei whale • Minke whale	• Sperm whale • Baird's beaked whale • Small beaked whale (includes Blainville's, Stejneger's, Cuvier's, and Hubb's beaked whales) • Striped dolphin • Short-beaked common dolphin • Pacific white-sided dolphin • Northern right-whale dolphin • Risso's dolphin • Killer whale	• Pygmy sperm whale • Dwarf sperm whale • Dall's porpoise	• Northern elephant seal	• Guadalupe fur seal • Northern fur seal • California sea lion • Steller sea lion	• Leatherback sea turtles • Loggerhead sea turtles • Green sea turtles • Olive ridley sea turtles • Hawksbill sea turtles

3.2. VISUAL MONITORING SURVEY METHODOLOGY

There were six experienced PSOs on board the *Langseth* during the seismic survey to conduct monitoring for protected species, record and report detections, and request mitigation actions in accordance with the PEIS, EA, IHA, ITS, and BiOp. The PSOs on board were NMFS approved and held certifications from a recognized Bureau of Ocean Energy Management (BOEM) course. Visual monitoring was primarily carried out from an observation tower (Figure 3) located 18.9 meters above the surface of the water, which allowed a 360-degree viewpoint around the vessel and acoustic source.

Figure 3. Protected Species Observer stern view of observation tower with mounted Big-Eye binoculars.

The PSO tower was equipped with Fujinon 7x50 and Steiner Marine 7x50 binoculars, as well as two mounted 25x150 Big-Eye binoculars for visual monitoring. A D-300-2MS Night Optics USA, Inc. monocular and two Butler Creek PVS-7-night vision devices were also available for visual monitoring during reduced/restricted lighting conditions if needed. Inside the tarpaulin tent the PSOs were provided a laptop, bridge, and main lab, and a monitor that displayed pertinent information about the vessel including position; speed; heading; water depth; sea temperature, wind speed and direction, and air temperature. The monitor also displayed source activity information including survey line number, total number of active elements and volume. Environmental conditions along with vessel and acoustic source activity were recorded at least once an hour, and every time there was a change in one or more of the above variables. Most visual monitoring was held from the tower; however, during severe weather or when the ships exhaust was blowing on the tower, monitoring would be conducted from the bridge (approximately 12.8 meters above sea level) or the catwalk (approximately 12.3 meters above sea level).

Visual monitoring methods were implemented in accordance with the survey requirements outlined in the IHA and ITS. Two PSOs visually monitored for protected species during daylight hours throughout the survey program, from the moment the vessel departed port to the moment the vessel returned to port. Visual monitoring during the transits between the ports and the survey area were conducted for vessel strike avoidance and to gather baseline data on the presence and abundance of protected species in the areas during periods of acoustic source silence. Throughout the survey program, visual 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 12:44 to 04:16 Coordinated Universal Time (UTC) (05:44 to 21:16 local time). Scheduled watches were a maximum of 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, divided between the two PSOs on watch. 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 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 float. PSOs would also identify to species, if possible, upon initial detection to ensure that the proper mitigation measures were implemented, should any be required.

As required by the IHA (section 5(e)(iii)), 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, and acoustic source activity (e.g., volume and number of active elements).

II. Species, detection cue, group size (including number of adults, juveniles, and calves), 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, closest, and final distance to the vessel and the source, time when entering and exiting the exclusion zones, type of mitigation action implemented, total time of the mitigation action, 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 IHAs and ITSs in a detection datasheet. Each sighting event was linked to an entry on an effort datasheet where specific environmental conditions (e.g., Beaufort Sea state, wind force, swell height, visibility, and glare) and vessel activity were logged.

Species identifications were made whenever the distance from the observer, length of the sighting, and visual observation conditions allowed. Whenever possible during detections, photographs were taken with Canon EOS 80D DSLR cameras that had 300-millimeter lenses. Marine mammal identification manuals (*Whales, Dolphins and Other Marine Mammal of the World; Guide to Marine Mammals of the world; Readers Digest Whales, Dolphins, and Porpoises; Seabirds of the world; Sibley Guide to Birds*) were consulted, and photos were examined to confirm identifications.

4. MONITORING EFFORT SUMMARY

4.1. SURVEY OPERATIONS SUMMARY

4.1.1. General survey parameters

The heat flow seismic survey began on 04 August 2022 when the *Langseth* departed port in Newport, Oregon. Seismic data acquisition and heat flow measurement operations were conducted between 05 August 2022 and 18 August 2022, with a brief break in operations on 09 August 2022 when the vessel transited back to Newport for a crew change. The survey concluded on 19 August 2022 when the vessel arrived back at port in Newport, Oregon. (Table 5).

Table 5: Survey parameters

Survey Parameter	Date	Time (UTC)	Location
Mobilization	04 August 2022	13:36	Newport, Oregon
First seismic source activity	05 August 2022	06:35	Nubin site
Start of acquisition	05 August 2022	07:16	Nubin site
End of acquisition	05 August 2022	23:33	Nubin site
Start of heat flow operations	06 August 2022	09:47	Margin site
End heat flow operations	09 August 2022	07:12	Margin site
Transit to Newport for crew change	09 August 2022	07:36	Newport, Oregon
Transit back to survey area	09 August 2022	21:00	Newport, Oregon
Start of heat flow operations	10 August 2022	07:04	Nubin site
End heat flow operations	13 August 2022	08:55	Nubin site
Resume seismic source activity	13 August 2022	15:19	Pseudofault site
Start of acquisition	13 August 2022	16:00	Pseudofault site
End of acquisition	15 August 2022	17:12	Pseudofault site
Start of heat flow operations	15 August 2022	21:12	Diebold site
End heat flow operations	17 August 2022	16:51	Diebold site
Resume seismic source activity	17 August 2022	22:42	Pseudofault site
Start of acquisition	17 August 2022	22:49	Pseudofault site
End of acquisition	18 August 2022	23:32	Pseudofault site
Transit to Newport	19 August 2022	01:00	Survey area
Arrive in Newport,end of project	19 August 2022	20:30	Newport, Oregon

During the seismic survey, data was acquired continuously according to the survey plan, with source operations only suspended when operationally necessary, as outlined in Table 6.

Table 6: Suspension of source operations during the survey.

Date	Time Source Silenced	Date	Time Source Re-activated	Reason for Interruption in Acquisition
05 August 2022	23:33	13 August 2022	15:19	Heat flow measurement operations and crew change
15 August 2022	17:12	17 August 2022	22:42	Heat flow measurement operations

4.1.2. MBES, SBP, and ADCP operations

The MBES, SBP, and the (ADCP) systems were active throughout the majority of the survey for a total of 310 hours and three minutes. The sound sources were active for the first time on 04 August 2022 at 15:13 UTC while the vessel was in transit to the first survey site, and they disabled for the last time on 19 August 2022 at 18:10 UTC while the vessel was in transit back to port. All three sound sources were disabled and re-enabled multiple times throughout the survey, mainly for heat flow measurement operations.

4.1.3. Acoustic source operations

The acoustic source was active for a total of 87 hours 47 minutes throughout the survey. This total included: 36 minutes of ramp-up, 80 hours 58 minutes of operations on a survey line (all at full volume), five hours and one minute of operations not on a survey line (all at full volume), and one hour and 12 minutes of source testing.

Table 7 summarizes the acoustic source operations over the course of the seismic survey.

The acoustic source was ramped up seven times during the survey, all to commence source operations from a period of operations silence. Six ramp-ups were conducted during daylight hours and one ramp-up was conducted during hours of darkness. All ramp-ups were cleared by visual monitoring, and each ramp-up had a minimum five minute duration.

There were two occasions of source testing, consisting of two 36-minute full volume tests after a ramp-up preceding a survey line, after source maintenance and an extended period of no source activity, respectively.

Table 7. Total acoustic source operations during the seismic survey.

Acoustic Source Operation	Number	Duration
Source Tests	**2**	**01:12**
Ramp-up	**7**	**00:36**
Day-time ramp-ups	6	00:31
Night-time ramp-ups	1	00:05
Full (6600 in^3)/Reduced Volume on a Survey Line[1]		**80:58**
Full (6600 in^3)/Reduced Volume not on a Survey Line[2]		**05:01**
Total Time Acoustic Source Was Active		**87:47**

1. **On a Survey Line:** 80:58 (full volume), 00:00 (reduced volume)
2. **Not on a Survey Line:** 05:01 (full volume), 00:00 (reduced volume)

The geospatial data for source operations are provided as a shapefile attachment to this report (Appendix G).

4.1.4. Interactions with Other Vessels

In addition to visually monitoring for protected species, PSOs also observed and documented interactions with other marine vessel traffic. Such interactions included but were not limited to another vessel or another vessels' towed gear/equipment interacting with the *Langseth's* towed gear/equipment, and the *Langseth* having to deviate from planned survey operations (i.e., diverge from the survey line, increase/decrease speed) because of another vessel.

There were no instances where the *Langseth* had such an interaction with another vessel during the survey.

4.2. VISUAL MONITORING SURVEY SUMMARY

Visual monitoring was conducted by two PSOs during all daylight hours, beginning 30 minutes before sunrise and ending 30 minutes after sunset each day, initiating when the vessel left dock at the beginning of the program and terminating upon the vessels return to dock at the end of the program (Table 8). This included times when the vessel was in transit, conducting seismic survey and heat flow operations, and deploying and retrieving equipment. Visual monitoring during transit was conducted for vessel strike avoidance, and 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.

Visual Monitoring	Date	Time (UTC)
Initiation for the survey	04 August 2022	13:36
Termination for the survey	19 August 2022	20:30

Visual monitoring on the *Langseth* was conducted over a period of 16 days for a total of 259 hours 36 minutes. Of the overall total visual monitoring effort, 21% (54 hours 43 minutes) was undertaken while the acoustic source was active, and 79% (204 hours 53 minutes) was undertaken while the acoustic source was silent. Visual monitoring while the acoustic source was silent was mainly conducted during the transits and heat flow measurement operations. Table 9 details visual monitoring with acoustic source operations on the *Langseth* throughout the seismic survey.

Table 9. Total visual monitoring effort during the survey.

Visual Monitoring Effort	Duration (hh:mm)	% of Overall Effort
Total monitoring while acoustic source active	54:43	21%
Total monitoring while acoustic source silent	204:53	79%
Total monitoring effort	259:36	-

Visual observations on the *Langseth* were preferentially conducted from the PSO tower, which provided a 360-degree view of the water around the vessel and the acoustic source. Visual watches were conducted from other locations, including the bridge and bridge wings if monitoring conditions could not be undertaken from the tower, such as during rough weather and sea conditions which made the tower unsafe, or when the vessel was heading into the wind, blowing the engine exhaust onto the tower. PSOs conducted visual monitoring from the bridge (48%) more often than any other location (Table 10) during the survey.

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

Observation Location During Visual Effort	Duration (hh:mm)	% of Overall Effort
Tower	85:14	33%
Bridge	124:18	48%
Bridge wings	50:04	19%

4.3. ENVIRONMENTAL CONDITIONS

Environmental conditions can have an impact on the probability of detecting protected species. The environmental conditions present during visual observations undertaken during the survey program were generally considered to be good.

Visibility was classified as ‘excellent’ if it extended greater than 10 kilometers and ’very good’ if it was between seven and 10 kilometers. 1.48% and 52.44% of monitoring effort on the *Langseth* was undertaken at ‘excellent’ and ‘very good’ visibility levels respectively (Table 11). There were multiple occasions where the predicted harassment zone, BZs, and EZs were not visible due to precipitation, reduced lighting (before sunrise and just after sunset), and night-time visual monitoring times. Those times are accounted for in the tables below.

Table 11: Visibility during the survey (kilometers).

Total	<0.05	0.05-0.1	0.1-0.3	0.3-0.5	0.5-1	1-2	2-5	5-7	7-10	>10
Duration (hh:mm)	00:00	00:25	01:12	06:15	08:47	37:36	21:49	43:34	136:08	03:50

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 visual monitoring on the *Langseth* for a total of 81 hours 12 minutes. The majority of the precipitation recorded was fog (22.82%) (Table 12).

Table 12. Precipitation during the survey.

Total	None	Heavy Rain	Moderate Rain	Light Rain	Heavy Fog	Moderate Fog	Thin Fog	Haze
Duration (hh:mm)	178:24	10:25	10:37	00:56	00:00	32:52	20:47	05:35

The Beaufort sea state recorded during visual monitoring ranged from level one to level six. The majority of visual observations on the *Langseth* were undertaken in conditions where the Beaufort sea state was level three (30.03%) or level two (23.42%), which were considered good conditions for the detection of protected species (Table 13).

Table 13. Beaufort Sea State during the survey.

Total	B0	B1	B2	B3	B4	B5	B6	B7	B8	B9
Duration (hh:mm)	00:00	19:28	60:48	77:58	37:37	52:00	11:45	00:00	00:00	00:00

Wind speeds recorded visual monitoring ranged between one and 30 knots. Visual monitoring on the *Langseth* occurred during recorded wind speeds between 10 and 15 knots (34.60%) and less than 10 knots (33.46%) (Table 14).

Table 14. Wind speed during the survey.

Total	<10	10-15	16-20	21-25	26-30	>31
Duration (hh:mm)	86:52	89:49	45:12	32:53	04:20	00:30

Swell heights during visual observations were generally low, with swells of less than two meters recorded for visual observations (92.55%) (Table 15).

Table 15. Swell Height during the survey.

Total	<2m	2-4m	>4m
Duration (hh:mm)	240:16	19:20	00:00

Visual monitoring effort on both vessels was conducted while no glare (42.71%) was present (Table 16). During times of moderate to severe glare, it is possible that the detections of protected species was hindered.

Table 16. Glare during the survey.

Total	None	Mild	Moderate	Severe
Duration (hh:mm)	110:52	45:37	44:44	58:23

5. MONITORING AND DETECTION RESULTS

5.1. VISUAL DETECTIONS

Visual monitoring efforts during the survey program resulted in a total of 28 visual detections of protected species totaling 256 individuals (summarized in Appendix D). This total included 20 detections of whales, two detections of dolphins, one detections of porpoises, and five detections of pinnipeds.

Table 17 lists the total number of detections and total number of animals recorded for each protected species observed during the survey. Photographs taken of visual detections can be found in Appendix E.

Maps of the detections of the protected species are shown in Figure 4 and Figure 5.

Table 17. Number of visual detection records collected for each protected species during the survey.

Species	Total Number of Detection Records	Total Number of Animals
Baird's beaked whale	1	1
Fin whale	4*	8
Humpback whale	7*	11
Minke whale	1	2
Sei whale	2	4
Unidentified whale	6	6
Whales	**20***	**32**
Northern right-whale dolphin	1	200
Pacific white-sided dolphin	1	2
Dolphins	**2**	**202**
Dall's porpoise	1	2
Porpoises	**1**	**2**
California sea lion	3	18
Steller sea lion	1	1
Unidentified fur seal	1	1
Pinnipeds	**5**	**20**
Total	**28**	**256**

*There was one detection consisting of both a fin whale and a humpback whale sighted together, which only counted as one sighted for the overall total number of detections.

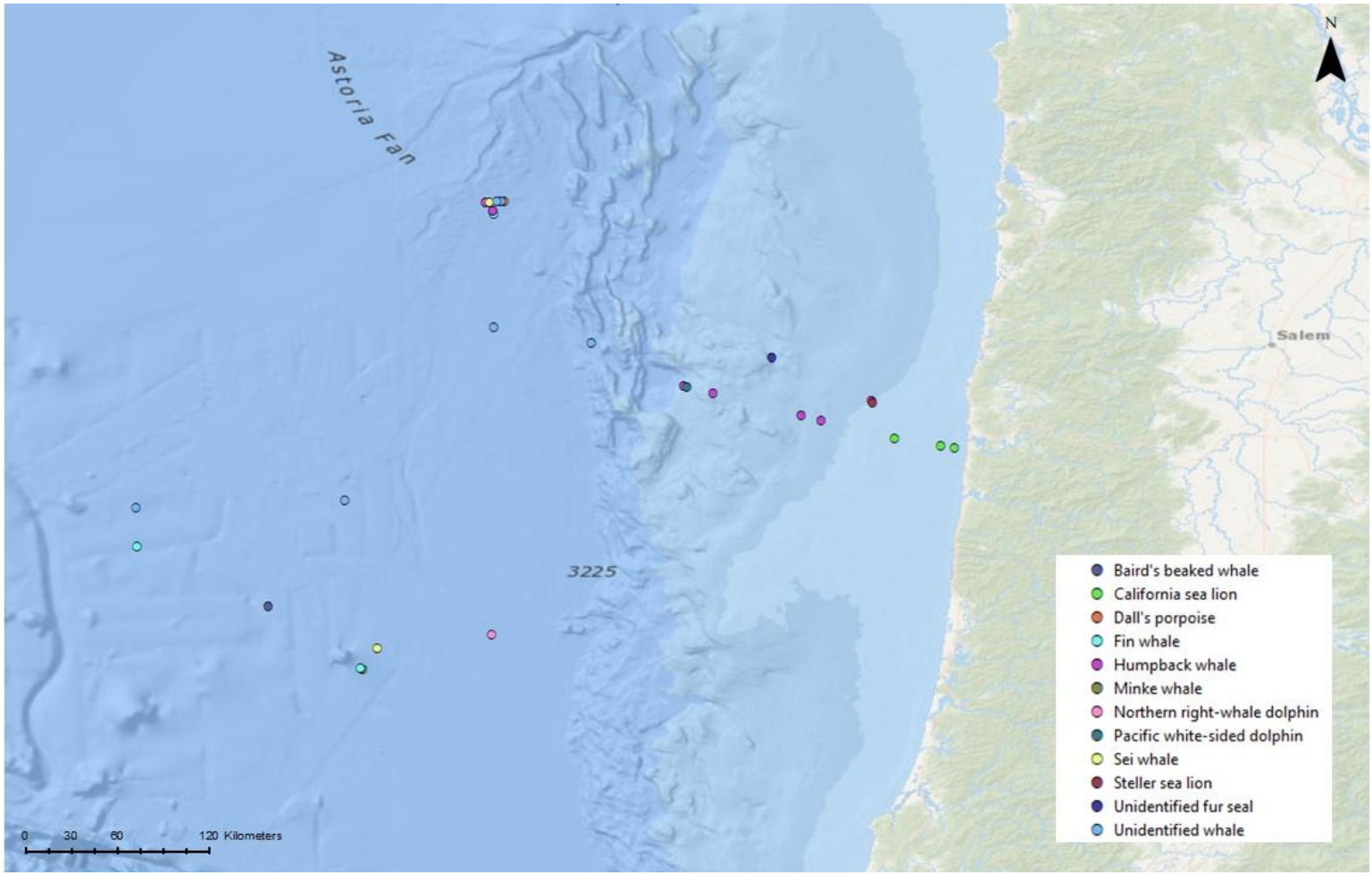


Figure 4: All protected species detections during the survey.

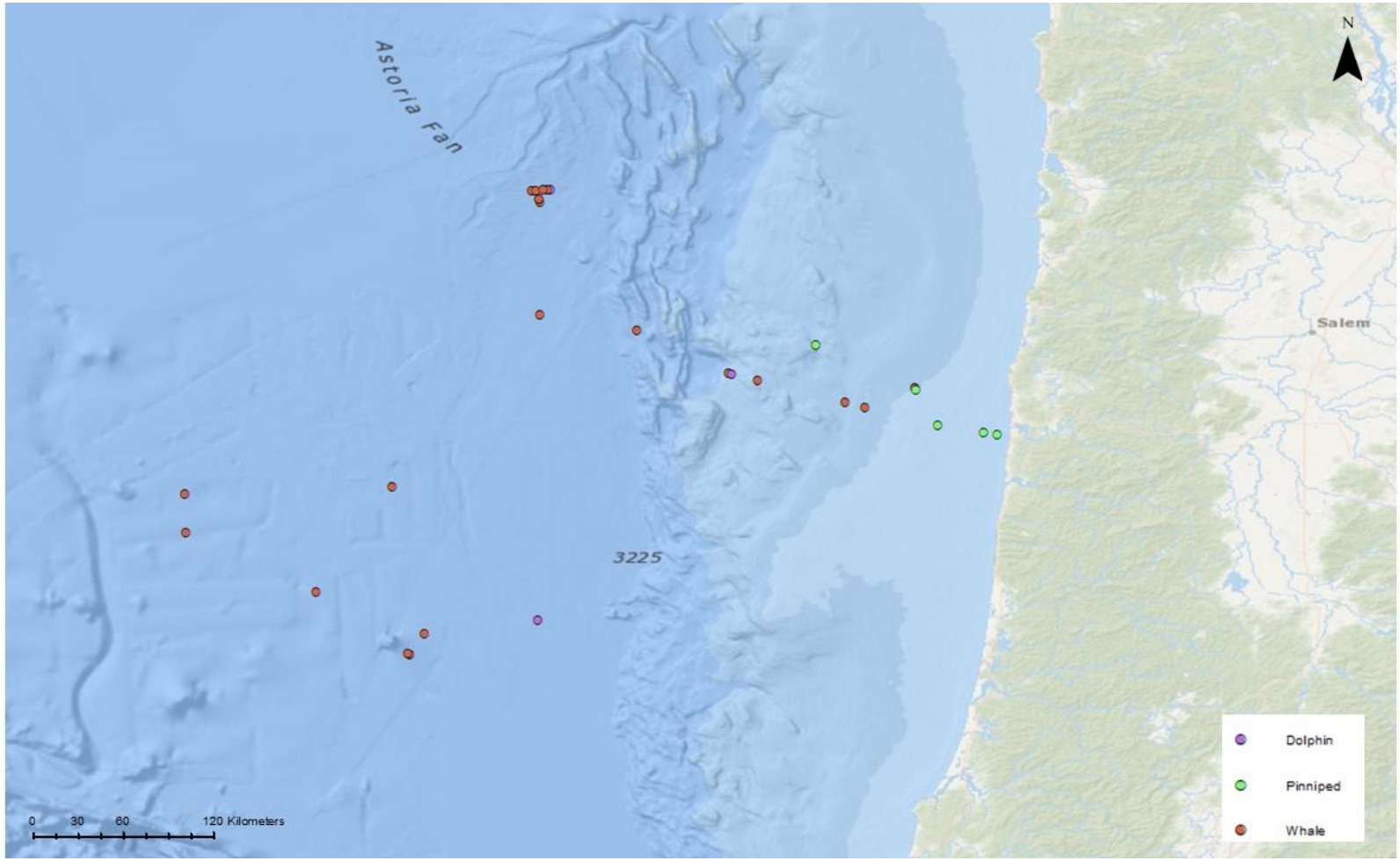


Figure 5: All protected species observed during the survey by species group.

Of the 28 visual detections, three detections occurred while the acoustic source was deployed and active and 25 detections occurred while the acoustic source was not deployed. Table 18 lists the number of each species detected during each different source activity described above as well as the species average closest approach to the source during those times. Detections occurred in water depths ranging between 53 and 3,035 meters. Detections outside of the survey area in water depths less than 1,600 meters included all pinniped sightings and one dolphin sighting (which occurred while the vessel was in transit to/from Newport, Oregon and closer to shore.

Detections that occurred while the source was active included one sighting of a Baird's beaked whale, one sighting of two fin whales (including a juvenile), and one sighting of an unidentifiable whale. The seismic source was active at full volume for all three detections. The Baird's beaked whale had the closest observed distance to the active source at 532 meters, the fin whales had the closest observed distance of 1,932 meters, and the unidentifiable whale had the closest observed distance of 7,773 meters.

Detections while the source was not deployed (i.e., during transits and heat flow measurement operations) included two sightings of fin whales, six sightings of humpback whales, one sighting of a fin whale and a humpback whales, one sighting of minke whales, two sightings of sei whales, five sightings of unidentifiable whales, one sighting of northern right-whale dolphins, one sighting of Pacific white-sided dolphins, one sighting of Dall's porpoise, three sightings of California sea lions, one sighting of a Steller sea lion, and one sighting of an unidentifiable fur seal. As the seismic source was secured onboard the vessel during these detections, no distances to the elements were recorded.

While the source was not deployed, the Pacific white-sided dolphins had the closest observed distance to the vessel at 20 meters followed by a sighting of a fin whale with a closest observed distance of 80 meters. This dolphin detection occurred while the vessel was in transit while the fin whale sighting occurred while the vessel was stationary retrieving the heat probe. The protected species in the other detections while the source was not deployed had closest observed distances to the vessel ranging between 100 meters (California sea lions on a buoy sighted near port during a transit) and 4,619 meters (northern right whale dolphins sighted during heat flow measurement operations).

Table 18. Average closest approach of protected species to the acoustic source at during the

survey.

Species Detected	Regulated Source Active		Regulated Source Inactive	
	Number of detections	Mean closest observed approach to source (meters)	Number of detections	Mean closest observed approach to source (meters)
Barid's beaked whale	1	532	-	-
California sea lions	-	-	3	578
Dall's porpoise	-	-	1	500
Fin whale	1	1932	-	-
Humpback whale	-	-	7	1867
Minke whale	-	-	1	250
Northern right whale dolphin	-	-	1	6000
Pacific white-sided dolphin	-	-	1	100
Sei whale	-	-	2	2093
Stellar sea lion	-	-	1	1035
Unidentifiable fur seal	-	-	1	1089
Unidentifiable whale	1	7773	5	1781

In general, whales detected during the survey program were mainly observed surfacing and blowing while traveling at sedate or moderate paces away from or in the opposite direction as the vessel. Dolphins and porpoises detected during the survey program were mainly observed surfacing and porpoising while traveling at moderate or vigorous paces away from the vessel. Pinnipeds detected during the survey program were mainly observed stationary resting on top of the channel marker buoys near port.

5.1.1. Other Wildlife

Observations of other wildlife included 25 species of birds, two species of fish, and two species of marine invertebrates. There were no sightings of ESA-listed seabirds during the survey program. 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 F. No impacts to any other wildlife species as a result of research activities.

6. MITIGATION ACTION SUMMARY

There were no mitigation actions implemented due to visual protected species being observed approaching, entering, or within their designated exclusion zones.

There was one vessel strike avoidance implemented for a fin whale the briefly entered the 100-meter separation zone for the species. At the time of the detection, the vessel was stationary while retrieving the heat probe, and the vessel remained stationary while the whale briefly entered and then exited the separation zone while it was traveling at a vigorous pace in the opposite direction as the vessel.

6.1. PROTECTED SPECIES KNOWN TO HAVE BEEN EXPOSED TO 160 DB 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 ESA. These species included: humpback whale, blue whale, fin whale, sei whale, sperm whale, and Guadalupe fur seal.

NMFS granted an IHA and ITS for the marine seismic survey authorizing a total of 766 individuals from 24 species or species groups, including five species of whales and one species of pinnipeds listed as endangered or threatened. No individuals were authorized for Level A harassment takes (exposure to sound pressure levels where there is a potential for auditory injury based upon each species hearing range). All individuals were authorized for Level B harassment takes only (exposure to sound pressure levels equal to or greater than 160 dB re: 1 µPa (rms) where there is a potential for behavioral changes), including 66 takes for endangered/threatened species. While no specific number of takes were issued for sea turtle species, behavioral harassment was expected to occur in the 175-dB zone.

During acoustic source operations, one marine mammal, one Baird's beaked whale, was observed within the predicted 160 dB radius (where there is a potential for a behavioral response) while the acoustic source was active, constituting potential Level B takes. There were no sea turtles observed within the predicted 175-dB radius (where there is a potential for a behavioral response) while the source was active, constituting potential Level B exposures. There were no protected species observed within the predicted radius at which there is a 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/exposures. Table 19 details the authorized and potential Level A and Level B takes/exposures.

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 individuals not being visually sighted or having moved away before they were observed.

Additionally, weather conditions have a large impact on the ability to visually detect protected species, particularly smaller or unobtrusive species such as sea otters, sea turtles, and beaked whales. Visual monitoring was conducted for 54 hours 43 minutes while the acoustic source was active. Of this time, 12% (six hours 36 minutes) was undertaken while swell heights were between two and four meters, and 43% (23 hours 39 minutes) was undertaken while the Beaufort sea state was a level four or greater, which were considered moderate to poor conditions for visually sighting protected species. In addition, there were several occasions were the entire predicted radii and zones were not entirely visible, mainly due to reduced lighting in the dawn/dusk hours and precipitation. Thirty-six percent of visual monitoring efforts (19 hours 39 minutes) while the source was active were undertaken during recorded precipitation, mainly fog and haze. The source was active 38% of the total source activity time at night and 62% of the total activity took place during daylight hours.

Table 19. Number of authorized and potential Level A and B Harassment Takes/Exposures during the survey.

Species	IHA Authorized Level A Takes/ Exposures	Potential Level A Takes/ Exposures/ PTS During the Program	IHA Authorized Level B Takes/ Exposures	Potential Level B Takes/ Exposures/ TTS During the Program	Total IHA Authorized Takes/ Exposures	Total Potential Takes/ Exposures During the Program
Humpback whale	-	-	2	-	2	-
Blue whale	-	-	2	-	2	-
Fin whale	-	-	4	-	4	-
Sei whale	-	-	2	-	2	-
Minke whale	-	-	2	-	2	-
Sperm whale	-	-	7	-	7	-
Kogia (dwarf/pygmy sperm whales)	-	-	3	-	3	-
Baird's beaked whale	-	-	9	1	9	1
Blainville's beaked whale	-	-	1	-	1	-
Stejneger's beaked whale	-	-	1	-	1	-
Cuvier's beaked whale	-	-	1	-	1	-
Hubb's beaked whale	-	-	1	-	1	-
Striped dolphin	-	-	46	-	46	-
Short-beaked common dolphin	-	-	179	-	179	-
Pacific white-sided dolphin	-	-	99	-	99	-
Northern right-whale dolphin	-	-	82	-	82	-
Risso's dolphin	-	-	22	-	22	-
Killer whale	-	-	7	-	7	-
Dall’s porpoise	-	-	155	-	155	-
Northern fur seal	-	-	17	-	17	-
Guadalupe fur seal	-	-	49	-	49	-
California sea lion	-	-	9	-	9	-
Steller sea lion	-	-	4	-	4	-
Northern elephant seal	-	-	62	-	62	-

Table 20 describes the behavior of all animals, including unidentified species, which were visually observed within the predicted Level A and Level B harassment zones. While there were no highly distinctive behavioral reactions observed in relation to the vessel or acoustic source during the seismic survey.

Table 20: Behavior of species visually observed to be exposed to sound pressure levels of 160 dB or greater.

Species	Detection No.	No. Of Animals	CPA Active Source (meters)	Source Volume (in^3) at CPA	Initial Behavior	Initial Direction in Relation to Vessel	Subsequent and Final Behaviors	Final Direction in Relation to Vessel
Baird's beaked whale	27	1	532	90	breaching / jumping / acrobatic behaviour	parallel in opposite direction as vessel	blowing, fast travel	parallel in opposite direction as vessel

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

To minimize the potential impacts to marine mammals, sea turtles, and protected sea birds during the seismic survey, LDEO and PSOs were prepared to implement mitigation measures whenever these protected species were detected approaching, entering, or within their designated exclusion zones as outlined in the IHA, ITS, BiOp and Final EA. There were no mitigation actions implemented for protected species. The confirmation of the implementation of each term and condition of the project permit documents are described in this report.

As noted in Section 3.1, there were several additional mitigation measures for certain detections of protected species as well as mitigation exemption for dolphins in the genera *Delphinus, Stenella,* and *Lissodelphis*. There were no instances during the survey where these extra mitigation measures or exemptions were implemented.

In the event that an injured or dead protected species was discovered, the incident was to be reported to the NMFS Office of Protected Resources (OPR), NMFS, and the NMFS West Coast Regional Stranding Coordinator as soon as possible. The report would include a detailed description of the incident (time, date, location, species identification, description of the animal, condition of the animal/carcass, observed behaviors if the animal was alive, and general circumstances under which the animal was discovered), including pictures when possible. There were no sightings of dead or injured protected species during the seismic survey.

In order to prevent the occurrence of the vessel striking a marine mammal during transits, PSOs and vessel crew members maintained a vigilant watch for marine mammals, and the vessel was prepared to slow down, stop, or alter course as appropriate to avoid striking a protected species. The vessel speed had to be reduced to 10 knots or less when mother/calf pairs, pods, or large assemblages of cetaceans were observed near the vessel. The vessel had to maintain the minimum separation distances as described in Table 2 in Section 3. If a whale was sighted and could not be confirmed as a species other than a North Pacific right whale, the vessel operator must assume that it is a North Pacific right whale and take appropriate action. If a marine mammal was sighted during transits, the vessel was to act as necessary to avoid violating the relevant separation distances (e.g., attempt to remain parallel to the animal's course, avoid excessive speed or abrupt changes in direction until the animal left the area). If marine mammals were sighted within the relevant separation distances, the vessel was required to reduce speed, shift the engines to neutral, and not engage the engines until the animals were clear of the area. If a whale entered the separation zone while the vessel was stationary, the vessel would not engage the engines until the whale has exited the zone. These requirements did not apply in any case where compliance would create an imminent and serious threat to a person or vessel, or if the vessel was restricted in maneuverability due to towed equipment. There was one instance during the survey where avoidance maneuvers were required to be implemented for protected species detections. On 17 August 2022, a fin whale entered the 100-meter separation zone for the species while the vessel was stationary retrieving the heat probe. The vessel remained stationary while the whale briefly entered and then exited the zone.

In the event of a ship strike of a marine mammal, the incident was to be reported to NMFS OPR, and to the West Coast Regional Stranding Coordinator as soon as feasible. The report would include a detailed description of the incident (date, time, location, species identification, description of the animal(s) involved, vessel speed leading up to the incident, vessel's course/heading and what operations were being conducted, status of all sound sources in use, description of avoidance measures taken if any, environmental conditions, description of the animals behavior preceding and following the strike, and estimated fate of the animal), including pictures when possible. There were no instances of the vessel striking a protected species during the survey.

In the event of a sighting of a species of concern – Northern Pacific right whales and Southern resident killer whales – the detection was to be reported to OPR and NMFS as soon as possible. The report would

include a detailed description of the sighting (date, time, location, description of the animal(s) sighted, behaviors observed, direction of the vessel's travel and the animal(s) travel in relation to the vessel, and vessel activity), including pictures when possible. There were no detections of species of concern during the survey.

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

7. LITERATURE CITED

NOAA, 2020. 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.

Crone, T.J., M. Tolstoy, and H. Carton. 2017. Utilizing the R/V Marcus G. Langseth's streamer to measure the acoustic radiation of its seismic source in the shallow waters of New Jersey's continental shelf. PloS ONE 12(8): e0183096. http://doi.org/10.1371/journal.pone.018

Appendix A

Incidental Harassment Authorization

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1315 East-West Highway
Silver Spring, Maryland 20910

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 incidentally harass marine mammals, under the following conditions:

(1) This incidental harassment authorization (IHA) is valid for one year from the date of issuance.

(2) This IHA is valid only for geophysical survey activity as specified in L-DEO's 2022 IHA application and for use of an airgun array aboard the R/V *Langseth* with characteristics specified in the IHA application, in the Northeast Pacific Ocean at the Cascadia Subduction Zone and Juan de Fuca Plate.

(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 and/or stocks authorized for taking are listed in Table 1. Authorized take, by Level B harassment only, is limited to the species and numbers listed in Table 1.

c. The taking by Level A harassment, serious injury, or death of any of the species listed in Table 1 or any taking of any other species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this IHA. Any taking exceeding the authorized amounts listed in Table 1 is prohibited and may result in the modification, suspension, or revocation of this IHA.

d. During use of the acoustic source, if any marine mammal species that are not listed in Table 1 appear within or enter the Level B harassment zone (Table 2) the acoustic source must be shut down.

e. L-DEO must ensure that relevant vessel personnel and the PSO team participate in a joint onboard briefing led by the vessel operator and lead PSO to ensure that responsibilities, communication procedures, protected species monitoring protocols, operational procedures, and IHA requirements are clearly understood.

(4) Mitigation Requirements

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

a. L-DEO must use independent, dedicated, trained visual PSOs, meaning that the PSOs must be employed by a third-party observer provider, must not have tasks other than to conduct observational effort, 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 must have successfully completed an approved PSO training course.

a. At least one visual PSO must have a minimum of 90 days at-sea experience working in that role during a shallow penetration or low energy survey, with no more than 18 months elapsed since the conclusion of the at-sea experience.

b. 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 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).

ii. Visual monitoring of the exclusion and buffer zones must begin no less than 30 minutes prior to ramp-up, including for nighttime ramp-ups, and must continue until one hour after use of the acoustic source ceases or until 30 minutes past sunset.

iii. 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. The estimated harassment zone is provided in Table 2 for reference.

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.

c. Exclusion zones and buffer zones

i. Except as provided below in 4(d)(ii), the PSOs must establish and monitor exclusion zones and additional buffer zones. During all survey effort, the exclusion zone shall be 100 m with an additional 100 m buffer zone (total 200

m). The 200-m zone shall serve to focus observational effort but not limit such effort; observations of marine mammals beyond these distances shall also be recorded as described in 5(d) below and/or trigger shutdown as described in 4(g)(iv) below, as appropriate. The exclusion zone encompasses the area at and below the sea surface out to the defined distance from the edges of the airgun array (rather than being based on the center of the array or around the vessel itself). The buffer zone encompasses the area at and below the sea surface from the edge of the exclusion zone, out to the defined distance from the edges of the airgun array. During use of the acoustic source, occurrence of marine mammals within the buffer zone (but outside the exclusion zone) must be communicated to the operator to prepare for the potential shutdown of the acoustic source. PSOs must monitor the exclusion zone and buffer zone for a minimum of 30 minutes prior to ramp-up (i.e., pre-start clearance).

ii. An extended 500-m exclusion zone must be established for Beaked whales (*Ziphiidae* spp.), Dwarf and pygmy sperm whales (*Kogia* spp.), killer whale (*Orcinus orca*), a large whale[1] with a calf, and groups of 6 or more large whales during all survey effort. No buffer zone is required.

[1] Large whale defined as sperm whale or any baleen whale; calf is defined as an animal less than two-thirds the body size of an adult observed to be in close association with an adult.

d. Pre-start 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(e)(v). Ramp-up must begin with activation of on 45 in^3 airgun, with the second 45 in^3 airgun added after 5 minutes.

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-start 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 all other odontocetes, including sperm whales, pygmy sperm whales, dwarf sperm whales, beaked whales, pilot whales, killer whales, Risso's dolphin).

iii. PSOs must monitor the exclusion and buffer zones during ramp-up, and rampup must cease and the source must be shut down upon visual 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, but such observation must be communicated to the operator to prepare for the potential shutdown.

iv. If the acoustic source is shut down for brief periods (i.e., less than 30 minutes) for reasons other than that described for shutdown (e.g., mechanical difficulty), it may be activated again without ramp-up if PSOs have

maintained constant observation and no detections of marine mammals have occurred within the applicable exclusion zone. For any longer shutdown, prestart 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-start clearance watch is not required.

v. Testing of the acoustic source involving all elements requires ramp-up. Testing limited to individual source elements or strings does not require rampup but does require pre-start clearance watch.

e. Shutdown requirements

i. Any PSO on duty has the authority to delay the start of survey operations or to call for shutdown of the acoustic source.

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 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 a marine mammal appears within or enters 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 dispute regarding a PSO shutdown must be resolved after deactivation.

iv. The shutdown requirements described in 4(f)(iii) shall be waived for small dolphins of the following genera: *Delphinus, Stenella, and Lissodelphis.*

1. If a small delphinid (individual of the Family Delphinidae, which includes the aforementioned dolphin genera), is visually detected and localized within the exclusion zone, no shutdown is required unless the PSO confirms the individual to be of a genera other than those listed above, in which case a shutdown is required.

2. If there is uncertainty regarding identification, visual PSOs may use best professional judgement in making the decision to call for a shutdown.

v. 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 all other odontocetes, including sperm whales, beaked whales, pilot whales, killer whales, and Risso's dolphin) with no further observation of the marine mammal(s).

vi. Shutdown of the array is required upon observation of a species for which authorization has not been granted, or a species for which authorization has been granted but the authorized number of takes has been met, approaching or observed with in any harassment zone (Table 2).

f. Vessel strike avoidance

i. Vessel operators and crews must maintain a vigilant watch for all protected species and slow down, stop their vessel, or alter course, as appropriate and regardless of vessel size, to avoid striking any protected species. A visual observer aboard the vessel must monitor a vessel strike avoidance zone around the vessel (distances stated below). Visual observers monitoring the vessel strike avoidance zone may be third-party observers (i.e., PSOs) or crew members, but crew members responsible for these duties must be provided sufficient training to 1) distinguish protected species from other phenomena and 2) broadly to identify a marine mammal to taxonomic group (i.e., as a large whale or other marine mammal).

ii. Vessel speeds must also be reduced to 10 knots or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near a vessel.

iii. The vessel must maintain a minimum separation distance of 500 m from North Pacific right whales. If a whale is observed but cannot be confirmed as a species other than a right whale, the vessel operator must assume that it is a right whale and take appropriate action.

iv. All vessels must maintain a minimum separation distance of 100 m from sperm whales and all other baleen whales.

v. All vessels must, to the maximum extent practicable, attempt to maintain a minimum separation distance of 50 m from all other marine mammals, with an understanding that at times this may not be possible (e.g., for animals that approach the vessel).

vi. When protected species are sighted while a vessel is underway, the vessel shall take action as necessary to avoid violating the relevant separation distance (e.g., attempt to remain parallel to the animal's course, avoid excessive speed or abrupt changes in direction until the animal has left the area). If protected species 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 does not apply to any vessel towing gear or any vessel that is navigationally constrained.

vii. These requirements do not apply in any case where compliance would create an imminent and serious threat to a person or vessel or to the extent that a vessel is restricted in its ability to maneuver and, because of the restriction, cannot comply.

1. (5) MONITORING REQUIREMENTS

The holder of this Authorization is required to conduct marine mammal monitoring during survey activity. Monitoring must be conducted in accordance with the following requirements:

a. The operator must provide a night-vision device suited for the marine environment for use during nighttime ramp-up pre-clearance, at the discretion of the PSOs. At minimum, the device should feature automatic brightness and gain control, bright light protection, infrared illumination, and optics suited for low-light situations.

b. 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 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.

c. 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. Reticle binoculars (e.g., 7 x 50) of appropriate quality (at least one per PSO, plus backups).

ii. Global Positioning Unit (GPS) (plus backup).

iii. Digital single-lens reflex cameras of appropriate quality that capture photographs and video (plus backup).

iv. Compass (plus backup)

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

vi. Any other tools necessary to adequately perform necessary PSO tasks.

d. Protected Species Observers Qualifications

i. PSOs must have successfully completed an approved PSO training course. ii. NMFS must review and approve PSO resumes.

iii. 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.

iv. One PSO with experience as shown in 4(b) shall be designated as the lead for the PSO team. The lead must coordinate duty schedules and roles for the PSO team and serve as primary point of contact for the vessel operator. (Note that the responsibility of coordinating duty schedules and roles may instead be assigned to a shore-based, third-party monitoring coordinator.) 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.

v. 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.

vi. 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.

vii. 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.

e. 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:

1. Vessel name and call sign;
2. PSO names and affiliations;
3. Date and participants of PSO briefings (as discussed in General Requirement);
4. Dates of departure and return to port with port name;
5. Dates and times (Greenwich Mean Time) of survey effort and times corresponding with PSO effort;
6. Vessel location (latitude/longitude) when survey effort began and ended and vessel location at beginning and end of visual PSO duty shifts;
7. Vessel heading and speed at beginning and end of visual PSO duty shifts and upon any line change;
8. 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;
9. 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
10. 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-start 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:

1. Watch status (sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform);
2. PSO who sighted the animal;
3. Time of sighting;
4. Vessel location at time of sighting;
5. Water depth;
6. Direction of vessel’s travel (compass direction);
7. Direction of animal’s travel relative to the vessel;
8. Pace of the animal;

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

10. 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;

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

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

13. 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);

14. 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);

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

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

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

2. (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. A final report must be submitted within 30 days following resolution of any comments on the draft report. The draft report must include the following:

i. Summary of all activities conducted and sightings of protected species near the activities; ii. Summary of all data required to be collected (see 5(d));

iii. Full documentation of methods, results, and interpretation pertaining to all monitoring;

iv. Summary of dates and locations of survey operations (including (1) the number of days on which the airgun array was active, including which array was being used and (2) the percentage of time and total time the array was active during daylight vs. nighttime hours (including dawn and dusk)) and all marine mammal sightings (dates, times, locations, activities, associated survey activities);

v. 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);

vi. 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; vii. Raw observational data.

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 to the NMFS West Coast regional Stranding Coordinator (866-767-6114). The report must include the following information:

1. Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);
2. Species identification (if known) or description of the animal(s) involved;
3. Condition of the animal(s) (including carcass condition if the animal is dead);
4. Observed behaviors of the animal(s), if alive;
5. If available, photographs or video footage of the animal(s); and
6. 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, the IHA-holder shall report the incident to OPR, NMFS and to the West Coast Regional Stranding Coordinator as soon as feasible. The report must include the following information:

1. Time, date, and location (latitude/longitude) of the incident;
2. Species identification (if known) or description of the animal(s) involved;
3. Vessel's speed during and leading up to the incident;
4. Vessel's course/heading and what operations were being conducted (if applicable);
5. Status of all sound sources in use;
6. 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;
7. Environmental conditions (*e.g.*, wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike;
8. Estimated size and length of animal that was struck;
9. Description of the behavior of the marine mammal immediately preceding and following the strike;
10. If available, description of the presence and behavior of any other marine mammals immediately preceding the strike;
11. 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
12. To the extent practicable, photographs or video footage of the animal(s).

c. Reporting Species of Concern – L-DEO must immediately report all observations of Southern Resident killer whales and North Pacific Right Whales to OPR, NMFS (301-427-8401). The report must include the following information:

i. Time, date, and location (latitude/longitude, water depth) of the observation;

ii. Description of the animal(s) seen, including number of animals, estimated age and sex classes observed, and distinguishing features;

iii. Behavior observations (e.g., number of blows/breaths, number of surfaces, breaching, spyhopping, diving, feeding, traveling; as explicit and detailed as possible);

iv. Direction of vessel's travel (compass direction) and direction of animal's travel relative to the vessel; and

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

(7) This Authorization may be modified, suspended or revoked if the holder fails to abide by the conditions prescribed herein (including, but not limited to, failure to comply

with monitoring or reporting requirements), or if NMFS determines: (1) the authorized taking is likely to have or is having more than a negligible impact on the species or stocks of affected marine mammals, or (2) the prescribed measures are likely not or are not effecting the least practicable adverse impact on the affected species or stocks and their habitat.

3. (8) RENEWALS

a. On a case-by-case basis, NMFS may issue a one-time, one-year Renewal IHA following notice to the public providing an additional 15 days for public comments when (1) up to another year of identical, or nearly identical, activities are planned or (2) the specified activities would not be completed by the time this IHA expires and a Renewal would allow for completion of the activities, provided all of the following conditions are met:

i. A request for renewal is received no later than 60 days prior to the needed Renewal IHA effective date (the Renewal IHA expiration date cannot extend beyond one year from expiration of this IHA).

ii. The request for renewal must include the following:

1. An explanation that the activities to be conducted under the requested Renewal IHA are identical to the activities analyzed for this IHA, are a subset of the activities, or include changes so minor (e.g., reduction in pile size) that the changes do not affect the previous analyses, mitigation and monitoring requirements, or take estimates (with the exception of reducing the type or amount of take).

2. 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.

iii. 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 will remain the same and appropriate, and the findings made in support of this IHA remain valid.

Table 1. Numbers of Incidental Take of Marine Mammals Authorized.

Species	MMPA Stock	Authorized Take by Level B Harassment
Humpback whale (*Megaptera novaeangliae*)	California/Oregon/Washington	2
Blue whale (*Balaenoptera musculus)*	Eastern North Pacific	2
Fin whale (*Balaenoptera physalus*)	California/Oregon/Washington	4
Sei whale (*Valaenoptera borealis*)	Eastern North Pacific	2
Minke whale (*Balaenoptera acutorostrata*)	California/Oregon/Washington	2
Sperm whale (*Physeter macroccephalus*)	California/Oregon/Washington	7
Baird's beaked whale (*Berardius Bairdii*)	California/Oregon/Washington	9
Small beaked whale (*Mesoplodon* spp.)	California/Oregon/Washington	41
Striped dolphin (*Stenella coeruleoalba*)	California/Oregon/Washington	46
Short-beaked common dolphin (*Delphinus delphis*)	California/Oregon/Washington	179
Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)	California/Oregon/Washington	99
Northern right whale dolphin (*Lissodelphis borealis*)	California/Oregon/Washington	82
Risso's dolphin (*Grampus griseus*)	California/Oregon/Washington	22
Killer whale (*Orcinus orca)*	West Coast Transient	7
	North Pacific Offshore	
Pygmy/dwarf sperm whale (*Kogia* spp.*)*	California/Oregon/Washington	3
Dall's porpoise (*Phocoenoides dalli)*	California/Oregon/Washington	155
Northern fur seal (*Callorhinus ursinus)*	Eastern Pacific	17
	California	
Guadalupe fur seal (*Arctocephalus townsendi)*	Mexico	49
California sea lion (*Zalophus californianus)*	United States	9
Steller sea lion (*Eumetopias jubatus*)	Eastern	4
Northern elephant seal (*Mirounga angustirostris*)	California Breeding	62

[1]Includes one take of each: Balinville's beaked whale, Stejneger's beaked whale, Cuvier's beaked whale, and Hubbs' beaked whale.

Table 2. Level B Harassment Zones

Airgun Configuration	Water Depth (m)	Level B harassment zone (m)
Two 45 in^3 GI guns	>1,000	553

Appendix B
Incidental Take Statement

14 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of threatened and endangered species, respectively, without a special exemption. “Take” is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct (16 U.S.C. §1532(19)). “Harm” is further defined by regulation to include significant habitat modification or degradation that results in death or injury to ESAlisted species by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 C.F.R. §222.102). NMFS has not yet defined “harass” under the ESA in regulation. On December 21, 2016, NMFS issued interim guidance on the term “harass,” defining it as to “create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering,” For purposes of this consultation, we relied on NMFS’ interim definition of harassment to evaluate when the proposed seismic survey activities are likely to harass ESA-listed marine mammals (cetaceans and pinnipeds).

Section 9 take prohibitions do not apply to threatened species. This incidental take statement, however, includes limits on taking of threatened species since those numbers were analyzed in the jeopardy analysis and to provide guidance to the action agency on its requirement to reinitiate consultation if the take limit for any species covered by this opinion is exceeded. The ESA does not prohibit the take of threatened species unless special regulations have been promulgated, pursuant to section 4(d), to promote the conservation of the species. ESA section 4(d) rules have been promulgated for Mexico DPS of humpback whales and Guadalupe fur seals; therefore, section 9 take prohibitions do apply to these two species. This incidental take statement includes numeric limits on the take of these species because specific amounts of take were analyzed in our jeopardy analysis. These numeric limits provide guidance to the action agency on its requirements to reinitiate consultation if the amount of take estimated in the jeopardy analysis of this opinion is exceeded. This incidental take statement includes reasonable and prudent measures and terms and conditions designed to minimize and monitor take of these threatened species.

Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement.

ESA section 7(b)(4) states that take of ESA-listed marine mammals (cetaceans and pinnipeds) must be authorized under MMPA section 101(a)(5) before the Secretary can issue an incidental take statement for ESA-listed marine mammals. NMFS’ implementing regulations for MMPA section 101(a)(5)(D) specify that an IHA is required to conduct activities pursuant to any incidental take authorization for a specific activity that will “take” marine mammals. Once NMFS has authorized the incidental take of marine mammals under an IHA for the tentative period of July 2022 through July 2023 (valid for a period of one year from the date of issuance), under the MMPA, the incidental take of ESA-listed marine mammals is exempt from the ESA take prohibitions as stated in this incidental take statement pursuant to section 7(b)(4) and 7(o)(2).

3.1.1. 14.1 Amount or Extent of Take

Section 7 regulations require NMFS to specify the impact of any incidental take of threatened or endangered species; that is, the amount or extent, of such incidental taking on the species (50 C.F.R. §402.14(i)(1)(i)). The amount of take represents the number of individuals that are expected to be taken by actions while the extent of take specifies the impact, i.e., the amount or extent, of such incidental taking on the species and may be used if we cannot assign numerical limits of animals that could be incidentally taken during the course of an action (see 80 FR 26832).

If the amount or location of tracklines during the low-energy seismic survey changes, or the number of seismic survey days is increased, then incidental take for marine mammals may be exceeded. As such, if more tracklines are conducted during the low-energy seismic survey, an increase in the number of days beyond the 25 percent contingency, greater estimates of sound propagation, and/or increases in the airgun array source levels occur, reinitiation of consultation will be necessary.

The NMFS ESA Interagency Cooperation Division and NMFS Permits Division anticipate the proposed

low-energy seismic survey in the Northeast Pacific Ocean is likely to result in the incidental take of ESA-listed marine mammals by harassment (Table 26). Behavioral harassment is expected to occur at received levels at or above 160 dB re: 1 µPa (rms) for airgun array operations for ESA-listed marine mammals. For all species of ESA-listed marine mammals, this incidental take will result from exposure to acoustic energy during airgun array operations and will be in the form of ESA harassment, and is not expected to result in the death or injury of any individuals that will be exposed. It is believed that no ESA harm or PTS will be incurred in these marine mammals as a result of the proposed seismic survey activities, because of the constant movement of both the R/V *Marcus G. Langseth* and of the marine mammals in the action area, the fact that the research vessel is not expected to remain in any one area in which individual marine mammals will be expected to concentrate for an extended period of time (i.e., since the duration of exposure to loud sounds will be relatively short), and the implementation of monitoring and mitigation measures. Also, as described above, we expect that marine mammals will be likely to move away from a sound source that represents an aversive stimulus, especially at levels that will be expected to result in PTS, given sufficient notice of the R/V *Marcus G. Langseth*'s approach due to the research vessel's relatively slow speed when conducting seismic survey activities.

Table 26. Estimated amount of incidental take of Endangered Species Act-listed marine mammals anticipated as a result of the proposed actions in the Northeast Pacific Ocean.

Species	Anticipated Incidental Take by Harassment (Potential Temporary Threshold Shift and Behavioral) by Seismic Survey Activities
Marine Mammals – Cetaceans	
Blue Whale	2
Fin Whale	4
Humpback Whale – Central America DPS	1
Humpback Whale – Mexico DPS	1
Sei Whale	2
Sperm Whale	7
Marine Mammals – Pinnipeds	
Guadalupe Fur Seal	46

DPS=distinct population segment

14.2 Reasonable and Prudent Measures

"Reasonable and prudent measures" are measures that are necessary or appropriate to minimize the amount or extent of incidental take (50 C.F.R. §402.02). The measures described below must be undertaken by the NSF, L-DEO, and the NMFS Permits Division so that they become binding conditions for the exemption in section 7(o)(2) to apply. Section 7(b)(4) of the ESA requires that when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA and the proposed action may incidentally take individuals of ESA-listed species, we will issue a statement that specifies the impact of any incidental taking of threatened or endangered species. To minimize such impacts, reasonable and prudent measures, and term and conditions to implement the measures, must be provided. Only incidental take resulting from the agency actions and any specified reasonable and prudent measures and terms and conditions identified in the incidental take statement are exempt from the taking prohibition of section 9(a), pursuant to section 7(o) of the ESA.

We believe the reasonable and prudent measures described below are necessary and appropriate to

minimize the impacts of incidental take on threatened and endangered species:

- The NMFS Permits Division must ensure that the NSF and L-DEO implements a program to mitigate and report the potential effects of seismic survey activities as well as the effectiveness of mitigation measures incorporated as part of the proposed IHA and possible renewal for the incidental taking of blue whales, fin whales, Central America DPS of humpback whales, Mexico DPS of humpback whales, sei whales, sperm whales, and Guadalupe fur seals pursuant to section 101(a)(5)(D) of the MMPA. In addition, the NMFS Permits Division must ensure that the provisions of the IHA and possible renewal are carried out, and must inform us if take is exceeded.

14.3 Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA and regulations issued pursuant to section 4(d), the Federal action agency (i.e., NSF and NMFS Permits Division) must comply (or must ensure that any applicant complies) with the following terms and conditions. These include the take minimization, monitoring and reporting measures required by the section 7 regulations (50 C.F.R. §402.14(i)).

The terms and conditions detailed below for each of the Reasonable and Prudent Measures include monitoring and minimization measures where needed:

1. The NSF must provide a copy of the draft comprehensive report on all seismic survey activities and monitoring results must be provided to the ESA Interagency Cooperation Division within 90 days of the completion of the seismic survey, or expiration of the IHA, whichever comes sooner.
2. Any reports of injured or dead ESA-listed species must be provided by the NSF to the ESA Interagency Cooperation Division immediately to Lisamarie Carrubba, Acting Chief, ESA Interagency Cooperation Division by e-mail at lisamarie.carrubba@noaa.gov.

Appendix C
Basic Data Summary Form

BASIC DATA FORM			
LDEO Project Number	MGL2208		
Seismic Contractor	LDEO		
Area Surveyed During Reporting Period	Northeast Pacific Ocean, Oregon coast		
Survey Type	2D seismic and heat flow measurement survey		
Vessel and/or Rig Name	*Marcus G. Langseth*		
Permit Number	IHA and BiOp issued on 01 August 2022		
Location / Distance of Source Deployment	300 meters astern from NRP in PSO tower		
Water Depth in survey area	Greater than 1,600 meters		
Dates of project	04 August 2022	Through	19 August 2022
Total time source operating – all power levels:	87:47		
Time source operating on survey lines:	80:58		
Time source operating not on a survey line:	05:01		
Amount of time single 40 in³ element operations:	00:00		
Amount of time in ramp-up:	00:36		
Number daytime ramp-ups:	6		
Number of nighttime ramp-ups:	1		
Number of ramp-ups from mitigation source:	0		
Amount of time conducted in source testing:	01:12		
Duration of visual observations:	259:36		
Duration of observations while source active:	54:43		
Duration of observation during source silence:	204:53		
Duration of acoustic monitoring:	98:44		
Duration of acoustic monitoring while source active:	87:47		
Duration of acoustic monitoring during source silence:	10:57		
Duration of simultaneous acoustic and visual monitoring:	63:51		
Lead Protected Species Observer:	Amanda Dubuque		
Protected Species Observers on the Langseth:	Cassandra Frey, Ana Lira, Jimena Ortega, Maritza Martines, Michelle Klein		
Number of Marine Mammal Visual Detections:	27		
Number of Marine Mammal Acoustic Detections:	1		
Number of Simultaneous Visual and Acoustic Detections:	0		
Number of Sea Turtle Detections:	0		
Total Number of Protected Species Detections:	28		
List Mitigation Actions	1 VSA for a large whale consisting of the vessel remaining stationary while retrieving gear		
Duration of Mitigation Actions:	00:00		

Appendix D

Summary of Visual Detections of Protected Species

APPENDIX D: Summary of Visual Detections of Protected Species during the 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

Behavioral 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 behavior; **MT**: mating behavior; **BV**: blow visible (whale); **SV**: only splashes visible (dolphins); **DV**: dorsal fin visible; **OB**: other behavior

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/ Source Activity	Mitigation Action	Comments
1	2022-08-04	15:43	Humpback whale	3	44.75556°N 124.39732°W	Not deployed	V	BV, MI, DF	N/A	None	Vessel in transit to survey site.
2	2022-08-04	17:21	Unidentified fur seal	1	44.90119°N 124.73445°W	Not deployed	SA	BA	N/A	None	Vessel in transit to survey site.
3	2022-08-04	19:50	Unidentified whale	1	44.95306°N 125.35060°W	Not deployed	PV/OD	BV	N/A	None	Vessel in transit to survey site.
4	2022-08-04	22:25	Unidentified whale	1	45.00698°N 125.68101°W	Not deployed	PV/SD, AV	BV	N/A	None	Vessel in transit to survey site.
5	2022-08-06	22:05	Humpback whale	1	45.43060°N 125.70898°W	Not deployed	TV, AV	BV, DF	N/A	None	Vessel conducting heat flow measurements.
6	2022-08-07	23:11	Dall's porpoise	2	45.43482°N 125.64541°W	Not deployed	TV, AV	FT, PO	N/A	None	Vessel conducting heat flow measurements.
7	2022-08-07	23:48	Unidentifiable whale	1	45.43414°N 125.65515°W	Not deployed	UN	BV	N/A	None	Vessel conducting heat flow measurements.
8	2022-08-08	01:25	Unidentifiable whale	1	45.43314°N 125.67090°W	Not deployed	UN, AV	BV, ST	N/A	None	Vessel conducting heat flow measurements.
9	2022-08-08	02:20	Sei whale	1	45.43152°N 125.69627°W	Not deployed	PE(AH), AV	BV, ST	N/A	None	Vessel conducting heat flow measurements.
10	2022-08-08	14:03	Fin whale	3	45.38961°N 125.68142°W	Not deployed	V, UN	BF, SA	N/A	None	Vessel conducting heat flow measurements.
11	2022-08-08	15:36	Fin whale and Humpback whale	2 (1 FW and 1 HW)	45.40341°N 125.68571°W	Not deployed	UN, AV, PV/OD	BV, ST, NS	N/A	None	Vessel conducting heat flow measurements.
12	2022-08-09	15:19	Steller sea lion	1	44.74886°N 124.39226°W	Not deployed	PV/OD, AV	NS, SS, ST	N/A	None	Vessel in transit to Newport.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/ Source Activity	Mitigation Action	Comments
13	2022-08-09	20:43	California sea lion	1	44.60261°N 124.16067°W	Not deployed	PV/OD	NS, DI	N/A	None	Vessel on standby near Newport channel.
14	2022-08-09	21:35	California sea lion	5	44.62900°N 124.31731°W	Not deployed	SA	OB	N/A	None	Vessel in transit to survey site. Sea lions were on top of channel marker buoy.
15	2022-08-09	22:50	Humpback whale	2	44.68874°N 124.56685°W	Not deployed	PV/OD	BV, SA, DF	N/A	None	Vessel in transit to survey site. Adult and juvenile pair.
16	2022-08-09	23:12	Humpback whale	1	44.70461°N 124.63572°W	Not deployed	AV	BV, DI, DF	N/A	None	Vessel in transit to survey site.
17	2022-08-10	00:43	Humpback whale	2	44.78040°N 124.93665°W	Not deployed	PV/OD	BV, NS, DF	N/A	None	Vessel in transit to survey site.
18	2022-08-10	01:08	Pacific white-sided dolphin	2	44.80396°N 125.02279°W	Not deployed	PE(AH), AV	ST, NS, DI	N/A	None	Vessel in transit to survey site.
19	2022-08-10	01:11	Humpback whale	1	44.80737°N 125.03593°W	Not deployed	PV/OD, AV	BV, NS, DI	N/A	None	Vessel in transit to survey site.
20	2022-08-13	13:11	Unidentifiable whale	1	44.41749°N 126.18663°W	Not deployed	PV/OD	BV, DI	N/A	None	Vessel in transit to survey site.
21	2022-08-13	22:49	Unidentifiable whale	1	44.39298°N 126.89646°W	Full volume	UN	BV	7773m/full volume	None	Seismic source active acquiring a survey line.
22	2022-08-14	00:40	Fin whale	2	44.25863°N 126.89418°W	Full volume	AV, PV/OD	BV, DI, SS	1932m/full volume	None	Seismic source active acquiring a survey line in the Pseudofault site.
23	2022-08-16	00:30	Northern right-whale dolphin	200	43.95824°N 125.68820°W	Not deployed	AV	SA, PO, FF, DI	N/A	None	Vessel conducting heat flow measurement operations.
24	2022-08-17	00:45	Sei whale	3	43.91433°N 126.07598°W	Not deployed	AV	BV, DI, NS	N/A	None	Vessel conducting heat flow measurement operations.
25	2022-08-17	14:18	Minke whale	2	43.84148°N 126.12781°W	Not deployed	PV/OD, AV	BV, SA, FT, DI	N/A	None	Vessel conducting heat flow measurement operations.
26	2022-08-17	16:28	Fin whale	2	43.84738°N 126,13539°W	Not deployed	TV, AV	BV, FT	N/A	None	Vessel retrieving heat flow probe. One whale briefly entered the 100-meter separation zone for vessel strike avoidance, and the vessel remained stationary during that time.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/ Source Activity	Mitigation Action	Comments
27	2022-08-18	20:49	Baird's beaked whale	1	44.05463°N 126.44718°W	Ful volume	PV/OD	SA, BV, FT	532m/full volume	None	Seismic source active acquiring a survey line in the Pseudofault site. Potential level B take.
28	2022-08-19	19:33	California sea lions	12	44.59422°N 124.11373°W	Not deployed	SA, V	BA, PO, DI	N/A	None	Vessel in transit into port. Included two juveniles. All but one individual was on top of the channel marker buoys.

Appendix E

Photographs of Protected Species Visually Detected

Figure 1: Humpback whales, 04 August 2022 (VD01).

Figure 2: Unidentified fur seal, 04 August 2022 (VD02).

Figure 3: Unidentified whale, 04 August 2022 (VD04).

Figure 4: Humpback whale, 06 August 2022 (VD05).

Figure 5: Dall's porpoise, 07 August 2022 (VD06).

Figure 6: Sei whale, 08 August 2022 (VD09).

Figure 7: Fin whales, 08 August 2022 (VD10).

Figure 8: Humpback and fin whales, 08 August 2022 (VD11).

Figure 9: Steller sea lion, 09 August 2022 (VD12).

Figure 10: California sea lion, 09 August 2022 (VD#13).

Figure 11: California sea lions, 09 August 2022 (VD14).

Figure 12: Humpback whales, 09 August 2022 (VD15).

Figure 13: Humpback whale, 09 August 2022 (VD16).

Figure 14: Humpback whales, 10 August 2022 (VD17).

Figure 15: Pacific white-sided dolphins, 10 August 2022 (VD18).

Figure 16: Humpback whale, 10 August 2022 (VD19).

Figure 17: Fin whales, adult and juvenile, 14 August 2022 (VD 22).

Figure 18: Minke whales, 17 August 2022 (VD 25).

Figure 19: Fin whale 17 August 2022 (VD 26).

Figure 20 Baird's beaked whale 18 August (VD 27).

Figure 21: California sea lions, 19 August 2022 (VD 28).

Appendix F
Birds and Other Wildlife Observed

Birds: Common Name	Taxonomic Identification	Approximate Number Individuals Observed	Approximate Number of Days Species Was Observed
Ancient murrelet	*Synthliboramphus*	15	1
Artic tern	*Sterna paradisaea*	1	1
Black-footed albatross	*Diomedea nigripes*	21	7
Brandt's cormorant	*Phalacrocorax penicillatus*	52	3
Brown-headed cowbird	*Molothrus ater*	3	2
Buller's Shearwater	*Puffinus bulleri*	64	6
California gull	*Larus californicus*	1	1
Cassin's auklet	*Ptychoramphus aleuticus*	40	1
Common murre	*Uria aalge*	118	3
Common tern	*Sterna hirundo*	9	6
Herring gull	*Larus argentatus*	53	4
Laughing gull	*Larus atricilla*	3	1
Leach's Storm-petrel	*Oceanodroma leucorhoa*	4	3
Least sandpiper	*Calidris minutilla*	1	1
Long-tailed skua	*Stercorarius longicaudus*	7	3
Masked booby	*Sula dactylatra*	2	2
Northern fulmar	*Fulmarus g. rodgersii*	5	3
Pigeon guillemot	*Cepphus columba*	2	1
Red-necked phalarope	*Phalaropus lobatus*	10	3
Rhinoceros Auklet	*Cerorhinca monocerata*	6	2
Short-tailed shearwater	*Puffinus tenuirostris*	2	1
Sooty shearwater	*Puffinus griseus*	1	1
Stejneger's petrel	*Pterodroma longirostris*	4	2
Surfbird	*Calidris virgata*	9	1
Western gull	*Larus occidentalis*	120	3

Fish: Common Name	Taxonomic Identification	Approximate Number Individuals Observed	Approximate Number of Days Species Was Observed
Oceanic sunfish	*Mola mola*	1	1
Blue shark	*Prionace glauca*	12	3

Invertebrates: Common Name	Taxonomic Identification	Approximate Number Individuals Observed	Approximate Number of Days Species Was Observed
Pacific sea nettle	*Chrysaora fuscescens*	2	1
Moon jellyfish	*Aurelia aurita*	6	2

Appendix G
Geospatial Shapefile for Source Operations