

PROTECTED SPECIES MITIGATION AND MONITORING REPORT

Marine Geophysical 2D Seismic Survey, Ross Sea (Cruise ID No. NBP2301)

Ross Sea Survey, RVIB *Nathaniel B. Palmer* (Callsign: WBP3210)
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Report Author

Name	Draft Submission Date
Cassandra Frey	22 February 2023

Report Reviewer

Name	Date of Review
Katherine Gideon	01 March 2023
Stephanie Milne	07 Mar 2023

Final Report Approval

Name	Stephanie Milne
Title	Team Leader – Senior Environmental Manager
Signature	
Date	May 5, 2023

Prepared by:**RPS**

Stephanie Milne
Team Leader – Senior Environmental Manager

575 N. Dairy Ashford
Suite 700
Houston, Texas 77079

T +1 281 589 7257
E stephanie.milne@rpsgroup.com

Prepared for:**The National Science Foundation****For Submission to:****National Marine Fisheries Service
Office of Protected Resources**

1315 East-West Hwy, Silver Spring, MD
20910-3282

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Acronyms and Abbreviations

ADCP – Acoustic Doppler Current Profiler
BiOp – Biological Opinion (US)
BOEM – Bureau of Ocean Energy Management
BSS – Beaufort Sea State
BZ – Buffer Zones
DAQ – Data acquisition
dB - decibels
DSLR – Digital Single Lens Reflex
EA – Environmental Assessment (US)
EPU – Electronic Processing Unit
ESA – Endangered Species Act (US)
EEZ – Economic Exclusion Zone
EZ – Exclusion Zone
GPS – Global Positioning System
HF – High Frequency
HZ – Hertz
IHA – Incidental Harassment Authorization (US)
ITS – Incidental Take Statement (US)
LDEO – Lamont-Doherty Earth Observatory (US)
LF – Low Frequency
MBES – Multibeam Echosounder
MMPA – Marine Mammal Protection Act (US)
NBP – RVIB Nathaniel B Palmer
NMFS – National Marine Fisheries Service (US)
NRP – Navigation Reference Point
NSF – National Science Foundation (US)
PI – Principal Investigator
PTS – Permanent threshold shift
PSO – Protected Species Observer
RME – PAM sound card manufacturer company name (not an acronym)
RMS – Root mean square
RPS – PSO Provider company name (not an acronym)
RVIB – Research vessel with ice-breaking capability
SBP – Sub-bottom Profiler
TOAD – Time of Arrival Distance
TTS – Temporary Threshold Shift
TVG – Transverse Gradiometer
US – United States
UTC – Coordinated Universal Time
VSA – Vessel Strike Avoidance

1 EXECUTIVE SUMMARY

The *RVIB Nathaniel B. Palmer* (NBP) is owned by Offshore Vessel Services Limited Liability Company (LLC) and is operated by the Galliano Marine Service LLC. The vessel is chartered by the National Science Foundation (NSF) to support the U.S. Antarctic Program. A low energy 2D seismic and coring survey was conducted in the Ross Sea, from December 2022 through January 2023 (referred to herein as “survey”). The operational activities were conducted in support of research proposed by Principal Investigator (PI) Dr. P.J. Bart (Louisiana State University).

The purpose of the survey was to collect low energy 2D seismic reflection data, along with oceanographic and sediment samples to understand if, how, when, and why the Ross Ice Shelf unpinned from the Ross Bank in the recent geologic past. Data collected will also be used to assess the degree that an event caused a re-organization of ice sheet and ice shelf flow towards its current configuration.

This report was prepared to meet the reporting requirements for the survey required under the Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA). On 14 July 2020, NSF 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 during the seismic survey. The survey was deferred, however, due to logistical challenges associated with managing coronavirus. On 26 May 2022, the IHA application was resubmitted to NMFS with updates, including additional research activities. On 13 December 2022, NMFS released the Biological Opinion (BiOp) and IHA on 14 December 2022 for the survey.

Mitigation measures were implemented to minimize potential impacts to marine mammals and protected species. These measures included, but were not limited to, the use of NMFS approved Protected Species Observers (PSOs) for visual monitoring, the designation of buffer zones (BZ) and exclusion zones (EZ) (where the presence of a protected species would require a mitigation action), and the implementation of ramp-up procedures, mitigation actions (including delayed operations and shutdowns), and Vessel Strike Avoidance (VSA) maneuvers. Continuous protected species observation coverage during the survey was provided by RPS, the PSO provider contracted for the survey. 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.

Five PSOs, one of which was designated as the Lead, were present on board the *NBP* throughout the survey to conduct visual monitoring. Throughout the survey, PSOs conducted visual monitoring for a total of 440 hours 45 minutes.

The acoustic source was active for a total of 153 hours 54 minutes. In accordance with the IHA, source activity was conducted during daylight hours only and with constant visual monitoring during that activity.

There was a total of 73 visual detections of protected species during the survey. Visual detections included 40 detections of whales (33 sightings of Antarctic minke whales, two sightings of humpback whales, and five sightings of unidentified whales), six detections of dolphins (three sightings of killer whales, two sightings of long-finned pilot whales, one sighting of Hector’s dolphins, and one sighting of Southern right-whale dolphins), and 26 detections of pinnipeds (13 sightings of crabeater seals, three sightings of New Zealand fur seals, two sightings of leopard seals, four sightings of Weddell seals, and four sightings of unidentified seals). Three of the 73 visual detections were sightings of two different species within the same detection event.

Protected species detections resulted in the implementation of one mitigation action during the survey, consisting of one shutdown for a total of two minutes. There were five Vessel Strike Avoidance (VSA) maneuvers implemented for large whales, which required the vessel to reduce speed and/or alter course.

NMFS issued an IHA, and ITS authorizing 20,491 Level B takes for 17 species of marine mammals, including four species that are 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.

During the survey program, 29 marine mammals consisting of 25 Antarctic minke whales, one humpback whale, two killer whales, and one crabeater seal, were observed within the predicted 160 decibel radius

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(where there is a potential for a behavioral response and temporary threshold shift (TTS)) while the acoustic source was active or showed a behavioral change during ice breaking activities, constituting potential Level B takes. 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 coring survey on board the *Nathaniel B. Palmer (NBP)* in the Southern Ocean, within the Ross Sea, off the coast of Antarctica from 26 December 2022 to 15 January 2023.

This document serves to meet the reporting requirements dictated in the IHA issued to NSF by NMFS on 13 and 14 December 2022, respectively. The IHA authorized takes of specific protected species incidental to the survey. NMFS has stated that seismic source received sound levels equal to or greater than 160 dB re 1 μ Pa 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 (HF) 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.

NMFS requires that measures such as buffer zones (BZs), exclusion zones (EZs), 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 require 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 require the implementation of a shutdown 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, 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.

In accordance with the IHA, the PSO team conducted an onboard environmental management briefing with the vessel personnel prior to the start of source operations. The lead PSO covered the mitigation and monitoring protocols, communication procedures, roles and responsibilities of the monitoring team and any additional operational procedures for this survey.

The IHA is attached as Appendix A.

2.1 Project Overview and Location

The research activities involved a 2D low-energy seismic survey and oceanographic and sediment sampling. The research activities took place within the Antarctic Treaty area in the Ross Sea, off the coast of Antarctica, in water depths of approximately 150 to 1100 meters (Figure 1).

The purpose of the research was to collect 2D seismic reflection data, along with oceanographic and sediment samples to understand if, how, when, and why the Ross Ice Shelf unpinned from the Ross Bank in the recent geologic past and to assess to what degree that event caused a re-organization of ice sheet and ice shelf flow towards its current configuration. Geophysical data collection was needed to determine the extent of the previously existing Ross Ice Shelf ice rise/rumple, the extent of any moraine features associated with the maximum extent of a paleo-ice-rise and the thickness and distribution of post-pinning sediment on Ross Bank. Also, a regional grid of seismic data with companion multi-beam echosounder and sub-bottom profiler data were needed to place the existing and new observations within a regional stratigraphic framework. The sediment sampling via coring effort was used to track sedimentary changes and to provide a detailed record of the time-transgressive environmental changes associated with ice

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shelf unpinning from Ross Bank. In addition, from the sedimentary boundaries in these cores, targeted sampling can be designed to generate a radiocarbon chronology of environmental changes at Ross Bank.

All operations for the survey were conducted solely by *NBP*. The vessel is 94 meters (308.4 feet) in length and has a beam of 18 meters (59.1 feet) and a maximum draft of 6.8 meters (22.3 feet). The *NBP* is specially made for polar operations and ice breaking activities. The vessel's cruising speed was approximately 10 knots, during transits and varied between three and five knots during the seismic survey. During coring operations, the vessel remained stationary. The vessel speed varied while transiting through ice and ice breaking.

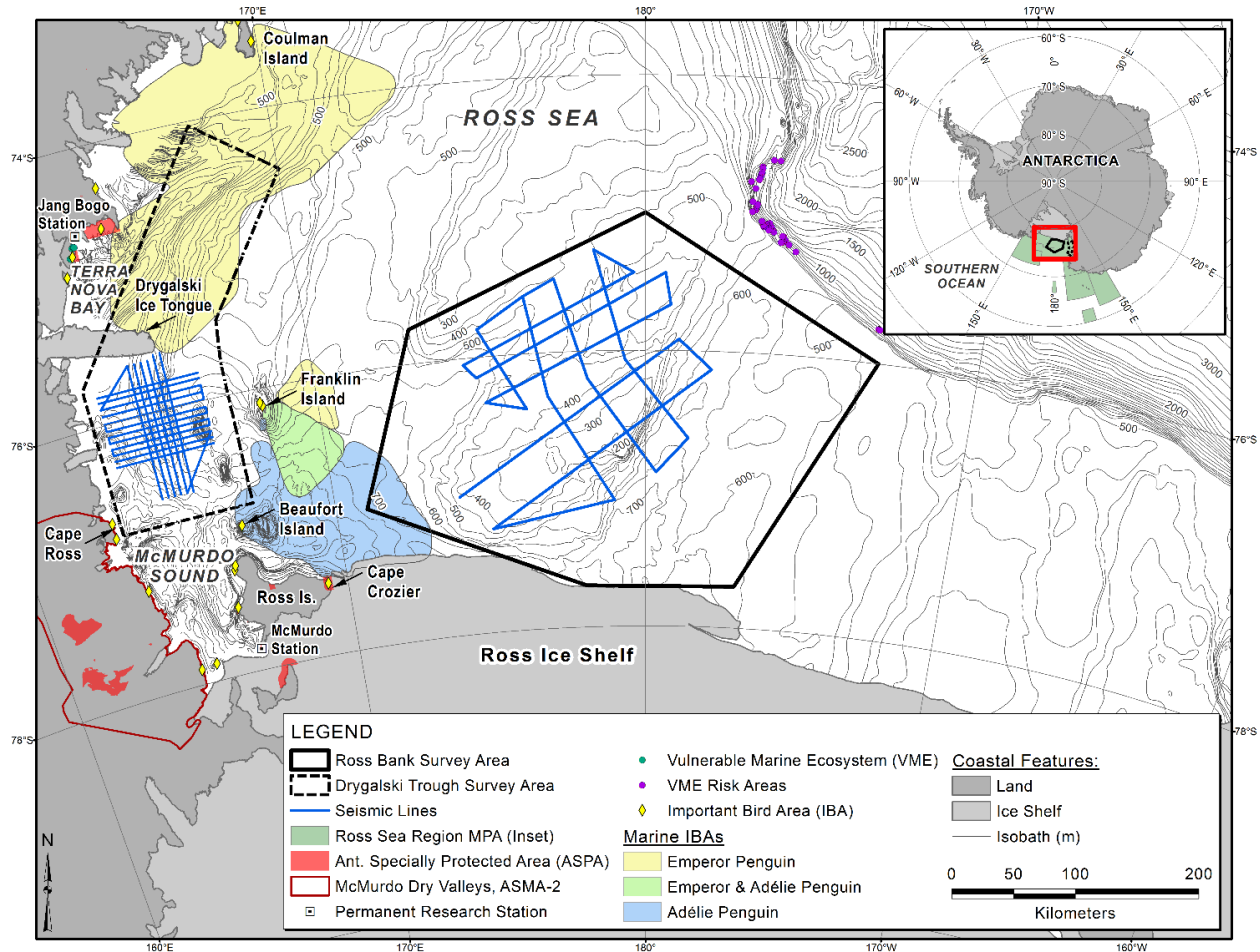


Figure 1: Location and survey points of the marine geophysical survey.

Due to logistical challenges, activities only occurred within the Ross Bank Survey Area and activities within the Drygalski Trough Survey Area were deferred. Seismic Operations were conducted between 05 and 12 January 2023. Coring operations were conducted at three different sites, one on 05 January and two on 13 January.

There was a total of 17 survey line sequences acquired. At the first two coring sites, operations included a Conductivity, Temperature, Depth (CTD) cast, a box core, replicate sediment samples with a multi-corer, and a Kasten core. The third coring site only conducted a Kasten core.

2.1.1 Energy Source and Receiving Systems

The energy source utilized during the survey consisted of one Generator Injector (GI) sound source on one source array deployed just aft of the vessel on the starboard stern. The source element had a volume of 45 cubic inches for the survey. A second GI sound source was deployed along the same array as a spare and was kept “hot” in case of mechanical issues with the main sound source. On occasion, both sound sources (for a total of 90 cubic inches) were used for equipment testing. The operating pressure was 2000 pounds per square inch and the dominant frequency components ranged from zero to 188 Hertz (Hz). The shot point interval was 11.6 to 30 meters (five to 13 seconds respectively) dependent on vessel speed which ranged from 3 to 5 knots during acquisition. During acquisition, the source elements emitted a brief (approximately 0.1 second) pulse of sound. The source elements were towed at a depth of three meters. The center of the source was 100.5 meters from the Navigation Reference Point (NRP), which was located 50 meters from the stern of the vessel. This positioned the elements on the array 50.5 meters from the starboard stern of the vessel.

The receiving system for the seismic survey consisted of one streamer at a time during operations, however two unique streamers were used over the course of acquisition for separate periods of time. The streamer in use received the returning acoustic signals and transferred the data to the onboard processing system. The first streamer, provided by the vessel, was 185.56 meters in length with 24 channels and was in use from 05 January until 08 January, for the first four survey lines. The second streamer, provided by Scripps, was 990 meters in length with 120 channels and was in use from 08 January until 12 January for the remaining 13 survey lines.

The oceanographic and sediment sampling included conductivity, temperature, and depth (CTD) measurements, megacore, kasten core, plankton netting, and McLane pump water collection. Two main oceanographic samplings took place utilizing all oceanographic and sediment sampling methods, a third oceanographic sampling took place with only the kasten core, oceanographic and sediment sampling took place within the seismic survey area. For sediments, six to nine sub-samples were collected at each location. The CTD profiles were collected at discreet depth intervals decided through down-cast observation of CTD data. All oceanographic sampling use standard research techniques and methodologies. The CTD, box core, and multi-core equipment deployed over the stern of the vessel. Pingers were used on the CTD and coring equipment.

CTD measurements were made using an instrument attached to a wire line and equipped with a series of water samplers (e.g., Niskin bottles) that were activated individually at desired depths. Box Coring and Multi-Coring Core samples are open cylindrical or box-shaped devices that were inserted or driven into the seafloor to sample sediment or benthic organisms. The depth a sampler penetrates the sediment is a function of the bottom type, the type of sampler, and its configuration (e.g., ballast weight). Depending on the seafloor composition, standard three or six meter (9.8 or 19.7 feet) long core barrels (approximately 15.2 centimeters [6 inches] in diameter) may be interconnected to collect a continuous core up to approximately 15 meters (49.2 feet) long. A box corer consists of a stainless-steel box and weighted drive mechanism that can collect a sediment sample (50 by 50 by 75 centimeters [19.7 by 19.7 by 29.5 inches]) with negligible disturbance to the sampled material. Though limited by the size of the box, the depth that the corer penetrates the seafloor may be controlled by the speed, at which the unit is lowered to the seafloor or the height above the seafloor at which the sampler is allowed to free fall. Replicate sediment samples may be collected with a multi-corer, which allows researchers to collect multiple samples. The individual multiple core samples are collected in polycarbonate tubes which also capture the supernatant liquid to preserve sediment/water interface.

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. 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 μ Pa (root mean square [rms]). The hull-mounted SBP beam was transmitted as a 27-degree cone, which was directed

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downward by a 3.5 kilohertz transducer. The nominal power output was 10 kilowatts; however, the actual maximum radiated power was three kilowatts or 222 dB re: 1 μ Pa m (rms). The ping duration was 64 seconds, and the interval was one second. The hull-mounted ADCP operated at a frequency of 75 kilohertz and a maximum source level of 224 dB re: 1 μ Pa 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 *NBP* was established to meet the standards set forth in the IHA and BiOp requirements. Survey mitigation measures were designed to minimize potential impacts of the *NBP*'s seismic and ice breaking activities on marine mammals 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.

3.1 Mitigation Methodology

Mitigation actions were implemented for visual detections of protected species, including marine mammals, as outlined in the IHA and BiOp. These actions included the establishment of buffer zones (BZs) and exclusion zones (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, two PSOs conducted a 30-minute clearance period 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 activation 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 or pinnipeds, this time was 15 minutes following last sighting. For detections of mysticetes and other large odontocetes (including sperm whales or beaked whales), 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 shutdown of active source.
An aggregation of six or more large whales observed at any distance from the vessel.	Delayed operation of inactive source and shutdown of active source.
Any marine mammal species not authorized for take observed approaching, entering, or within the 160-decibel radius.	Delayed operation of inactive source and shutdown of active source.
Any marine mammal species for which the total authorized takes has been met observed approaching, entering, or within the 160-decibel radius.	Delayed operation of inactive source and shutdown of active source.

Table 2: Separation distances, buffer and exclusion zones 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)
Large whale/calf, 6+ large whales	100	500	500	30
Beaked whale	100	500	500	30
Mysticetes and large odontocetes	100	200	100	30
All other small dolphins and porpoises	50	200	100	15
Pinnipeds	50	200	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 require a shutdown of the seismic source, depending on the species present. For marine mammals, the detection of one approaching, entering, or within their designated zone would require a shutdown of the source.

Upon the implementation of a shutdown 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 submerger/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 or pinnipeds, this time was 15 minutes following last sighting. For detections of mysticetes and other large odontocetes (including sperm whales or beaked whales) this time was 30 minutes following last sighting.

The IHA also outlined additional mitigation actions for specific protected species while the acoustic source was active as outlined in Table 1.

Specific acoustic source operation procedures outlined in the IHA 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 (if required for testing). 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., BSS 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 shutdown, both a pre-start clearance watches and a ramp-up were required.

Table 3 describes the predicted 160 decibel radius (Level B harassment zone for marine mammals) where the maximum predicted distance for the source was used. However, the vessel used the smaller source levels during operations.

Table 3: Predicted 160 decibel zones* implemented during the survey.

Source	Volume (in ³)	Water Depth (m)	160 dB radius – Level B harassment zone for marine mammals
1 element	45	> 1000	726
1 element	45	100-1000	1089
Ice breaking			6456

**Distances are from any single element on the array*

3.2 Visual Monitoring Survey Methodology

There were five experienced PSOs on board the *NBP* during the seismic survey to conduct monitoring for protected species, record and report detections, and request mitigation actions in accordance with the IHA and BiOp. The PSOs on board were NMFS approved and held certifications from a recognized Bureau of Ocean Energy Management (BOEM) PSO course. The PSOs that were onboard the *NBP* are listed in Appendix B. Visual monitoring was primarily carried out from the wings of the observation ice tower (Figure 2) and from inside the tower (Figure 3), located 24.4 meters above the surface of the water. Both locations allowed a 360-degree viewpoint around the vessel and acoustic source.



Figure 2: Protected Species Observer stern view of observation tower.



Figure 3: Inside view from the observation tower.

The PSOs were equipped with reticle Bushnell 7x50, Hooway 7x50 binoculars, and SLR cameras. In addition, Fujinon 25x150 Big-Eye binoculars were mounted on the starboard bridge wing (Figure 4), located 16.5 meters above the surface of the water. Inside the ice tower, PSOs were provided two radios to communicate to the bridge, two radios to communicate with the survey lab, and a display screen with pertinent information about the vessel including position; speed; heading; water depth; sea temperature, wind speed and direction, and air temperature. The display also included source activity information. 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 wings; however, during severe weather monitoring would be conducted from inside of the tower.



Figure 4: Big Eye binoculars mounted on starboard bridge wing of the vessel.

Visual monitoring methods were implemented in accordance with the survey requirements outlined in the IHA. A minimum of one PSO was required to be on duty and always conducting monitoring during daylight hours, from when the vessel departed port to when the vessel returned to port. Visual monitoring during the transits between ports and survey area were conducted for VSA and to gather baseline data on the presence and abundance of protected species in the areas during periods of acoustic source silence. Scheduled watches were a maximum of four hours followed by at least one hour of scheduled

break time. For most of the transit time, during the entire seismic and ice breaking operations, two PSOs were required to maintain watch, to the maximum extent possible. To accomplish this, there were individuals from the vessel or science crew that were trained to monitor, that shared watch with one of the experienced PSOs. See compilation of additional monitoring individuals in Appendix C.

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 or the ice, 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, range sticks 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.

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As required by the IHA (section 5(d)(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 IHA 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 SLR cameras ranging from 18 to 400-millimeter lenses. Marine mammal identification manuals (*Whales, Dolphins and Other Marine Mammals of the World*; *Guide to Marine Mammals of the world*; *Antarctica Wildlife Guide, Birds, Whales, Dolphins and Seals*; *Seabirds of the World*; *Sibley Guide to Birds*) were consulted, and photos were examined to confirm identifications 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 Ross Sea seismic survey began on 26 December 2022, when the *NBP* departed port in Lyttleton, New Zealand. Seismic data acquisition operations were conducted between 05 and 12 January. The survey concluded on 15 January 2023, when the vessel arrived back at port in McMurdo, Antarctica (Table 4).

Table 4: Survey parameters.

Survey Parameter	Date	Time (UTC)	Location
Mobilization	26 December 2022	03:11	Lyttleton, New Zealand
First seismic source activity	05 January 2023	14:16	Ross Sea
Start of acquisition	05 January 2023	14:47	Ross Sea
End of acquisition	12 January 2023	12:31	Ross Sea
Transit to McMurdo	12 January 2023	15:00	Ross Sea
Arrive in McMurdo	15 January 2023	02:45	McMurdo, Antarctica

During the seismic survey, data was acquired continuously according to the survey plan, with source operations only suspended when there were mechanical or technical issues. On 07 January 2023, source operations were suspended when the streamer was swapped, as outlined in Table 5.

Table 5: Suspension of source operations during the survey.

Date	Time Source Silenced	Date	Time Source Re-activated	Reason for Interruption to Acquisition
05 January 2023	16:30	05 January 2023	17:17	Stop acquisition for mechanical issues
05 January 2023	19:27	05 January 2023	19:33	Stop acquisition for mechanical issues
05 January 2023	21:52	05 January 2023	22:09	Stop acquisition for mechanical issues
07 January 2023	23:41	08 January 2023	06:54	Pause acquisition to swap streamer and source
08 January 2023	14:08	08 January 2023	14:10	Stop acquisition for technical issues
09 January 2023	03:23	09 January 2023	06:43	Stop acquisition for mechanical issues

4.1.2 MBES, SBP, and ADCP Operations

The multi-beam echosounder (MBES), sub-bottom profiler (SBP), and the Acoustic Doppler current profiler (ADCP) systems were active throughout the survey for a total of 472 hours 56 minutes. The SBP was active for the first time on 26 December 2022 at 03:30 UTC. The ADCP was active for the first time on 29 December at 23:34 UTC. The MBES was active for the first time on 29 December at 22:38 UTC. All the sound sources were active during transit and throughout the survey. The ADCP was disabled on 13 January 2023 at 17:03 UTC. The SBP was disabled on 14 January at 20:15 UTC. The MBES was disabled on 14 January at 20:26 UTC. All three sound sources were disabled and re-enabled multiple times throughout the survey, mainly for technical issues.

4.1.3 Acoustic Source Operations

The acoustic source was active for a total of 153 hours 54 minutes throughout the survey. This total included: 14 minutes of ramp-up, 148 hours 33 minutes of operations on a survey line (all at full volume), four hours 31 minutes of operations not on a survey line (all at full volume), and 36 minutes of source testing.

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Table 6 summarizes the acoustic source operations over the course of the seismic survey.

The acoustic source was ramped up twice during the survey to commence testing. All ramp-ups were cleared by visual monitoring. One totaled eight minutes and one ramp-up totaled six minutes in duration.

There were three occasions of source testing. They consisted of two 90 cubic inch volume, multi-source tests after source maintenance: one after a ramp-up and the other resumed four minutes after the completion of the previous test. The other test was a 23-minute multi-source, 90 cubic inch, volume test after a ramp-up and preceding the first survey line.

Table 6: Total acoustic source operations during the survey.

Acoustic Source Operation	Number	Duration (hh:mm)
Source Tests	3	00:36
Ramp-up	2	00:14
Day-time ramp-ups	2	00:14
Night-time ramp-ups	N/A	N/A
Full (45 in³)/Reduced Volume on a Survey Line		148:33
Full (45 in³)/Reduced Volume not on a Survey Line		04:31
Total Time Acoustic Source Was Active		153:54

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

The monitoring effort, source operations and protected species detections for this survey are provided as an excel dataset in Appendix D and the basic data summary form found in Appendix E.

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 *NBP*'s towed gear/equipment, and the *NBP* 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 *NBP* had such an interaction with another vessel during the survey.

4.2 Visual Monitoring Survey Summary

Visual monitoring was conducted by one or 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 7). On 02 January 2023, 24-hour daylight hours began as the vessel transited South, thus visual monitoring was continuous until the vessel was docked at the end of the program. During transit most observations were undertaken by two PSOs, to the maximum extent possible, for VSA and visual monitoring during times with no source operations was conducted to collect baseline data about protected species abundance in the survey areas. However, when it was not possible during transit or non-seismic/ice breaking operations, one PSO conducted visual monitoring for brief periods of time. During all seismic operations and ice breaking activities there were always two observers present. To accomplish this, there were individuals from the vessel or science crew, that shared watch with one of the NMFS approved PSOs.

Table 7: Initiation and termination of visual monitoring during the survey.

Visual Monitoring	Date	Time (UTC)
Initiation for the survey	26 December 2022	03:11
Termination for the survey	15 January 2023	20:30

Visual monitoring on the *NBP* was conducted over a period of 21 days for a total of 440 hours 45 minutes. Of the overall total visual monitoring effort, 35% (153 hours 54 minutes) was undertaken while the acoustic source was active, and 65% (286 hours 51 minutes) was undertaken while the acoustic source was silent. Visual monitoring while the acoustic source was silent was mainly conducted during the transits and coring measurement operations. Additionally, while the source was silent, the vessel conducted 14 hours five minutes of ice breaking activities, which accounted for three percent of overall effort. Table 8 details visual monitoring with acoustic source operations on the *NBP* throughout the seismic survey.

Table 8: Total visual monitoring effort during the survey.

Visual Monitoring Effort	Duration (hh:mm)	% of Overall Effort
Total monitoring while acoustic source active	153:54	35%
Total monitoring while acoustic source silent	286:51	65%
Total monitoring while vessel was ice breaking	14:05	3%
Total monitoring effort	440:45	-

Visual observations on the *NBP* were conducted entirely from the PSO tower, which provided a 360-degree view of the water around the vessel and the acoustic source.

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 ‘very good’.

Visibility was classified as ‘excellent’ if it extended greater than 10 kilometers and ‘very good’ if it was between seven and 10 kilometers. 56% and 5% of monitoring effort on the *NBP* was undertaken at ‘excellent’ and ‘very good’ visibility levels, respectively (Table 9). These conditions are only during the day since operations was conducted daytime only. Only 1% of the visual monitoring effort was in reduced visibility of 0.5 km or less and this was attributed to periods of snow and the one instance during transit sunrise / sunset monitoring occurred prior to arriving to the survey area. When the vessel initially left port at the beginning of the program, monitoring was suspended at 08:46 UTC due to the sunset at 08:16 UTC and it recommenced at 16:20 UTC for sunrise at 16:50 UTC. As the vessel continued to transit south, towards the Ross Sea survey area, the time between the sunset and the sunrise shortened until there was no longer any nighttime hours and visual monitoring became continuous. Therefore, survey activities occurred during daylight hours.

Table 9: Visibility during the survey (in 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	00:00	00:00	05:24	24:28	24:14	80:47	34:48	21:55	249:09

Reduced visibility was mainly attributed to periods of snow, and the brief periods of reduced lighting before sunrise and after sunset. Precipitation was recorded during visual monitoring on the *NBP* for a total of 157 hours 18 minutes. Most of the precipitation recorded was haze (17%) or snow (11%) (Table 10).

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Table 10: Precipitation during the survey.

Total	None	Heavy Rain	Moderate Rain	Light Rain	Heavy Fog	Moderate Fog	Thin Fog	Haze	Sleet	Snow
Duration (hh:mm)	283:27	00:00	00:40	01:49	00:00	07:30	21:45	74:20	01:00	50:14

The Beaufort Sea State recorded during visual monitoring ranged from level one to level eight. Most visual observations on the *NBP* were undertaken in conditions where the BSS was level two (34%) or level three (25%), which were considered ‘very good’ conditions for the detection of protected species (Table 11).

Table 11: Beaufort Sea State during the survey.

Total	B0	B1	B2	B3	B4	B5	B6	B7	B8	B9
Duration (hh:mm)	15:45	10:21	149:17	110:19	45:58	19:10	42:30	24:10	23:15	00:00

Wind speeds recorded visual monitoring ranged between one and 51 knots. Most of the visual monitoring on the *NBP* occurred during recorded wind speeds less than 10 knots (31%) and from 10 to 15 knots (26%) (Table 12).

Table 12: Wind speed during the survey.

Total	<10	10-15	16-20	21-25	26-30	>31
Duration (hh:mm)	137:04	113:38	42:17	41:16	35:52	70:38

Swell heights during visual observations were generally low, with swells of less than two meters recorded for visual observations (76%) (Table 13).

Table 13: Swell height during the survey.

Total	<2m	2-4m	>4m
Duration (hh:mm)	336:55	65:25	38:25

Visual monitoring was conducted when no glare (46%) was present (Table 14). During times of moderate to severe glare, it is possible that the detection of protected species was hindered.

Table 14: Glare during the survey.

Total	None	Mild	Moderate	Severe
Duration (hh:mm)	202:23	57:15	48:38	132:29

5 MONITORING AND DETECTION RESULTS

5.1 Visual Detections

Visual monitoring efforts during the survey program resulted in a total of 73 visual detections events of protected species totaling 349 individuals (summarized in Appendix F). This total included 40 detections of whales, six detections of dolphins, one detection of porpoises, and 26 detections of pinnipeds.

Table 15 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 G.

Maps of the detections of the protected species are shown in Figure 5 and Figure 6.

Table 15: Number of visual detection records collected for each protected species during the survey.

Species	Total Number of Detection Records	Total Number of Animals
Antarctic minke whale	33	89
Humpback whale	2	9
Unidentified whale	5	7
Whales	40	105
Orca	3	6
Long-finned pilot whale	2	34
Southern right whale dolphin	1	8
Dolphins	6	48
Hector's dolphin	1	3
Porpoises	1	3
Crabeater seal	13	29
New Zealand fur seal	3	5
Leopard seal	2	2
Weddell seal	4	4
Unidentified seal	4	153
Pinnipeds	26	193
Total	73*	349

*There were three mixed species detections, consisting of two different species each (VD#08; Long-finned pilot whale and Southern right whale dolphin, VD#52; Crabeater seal and Weddell seal, and VD#69: Crabeater seal and Unidentifiable seal).

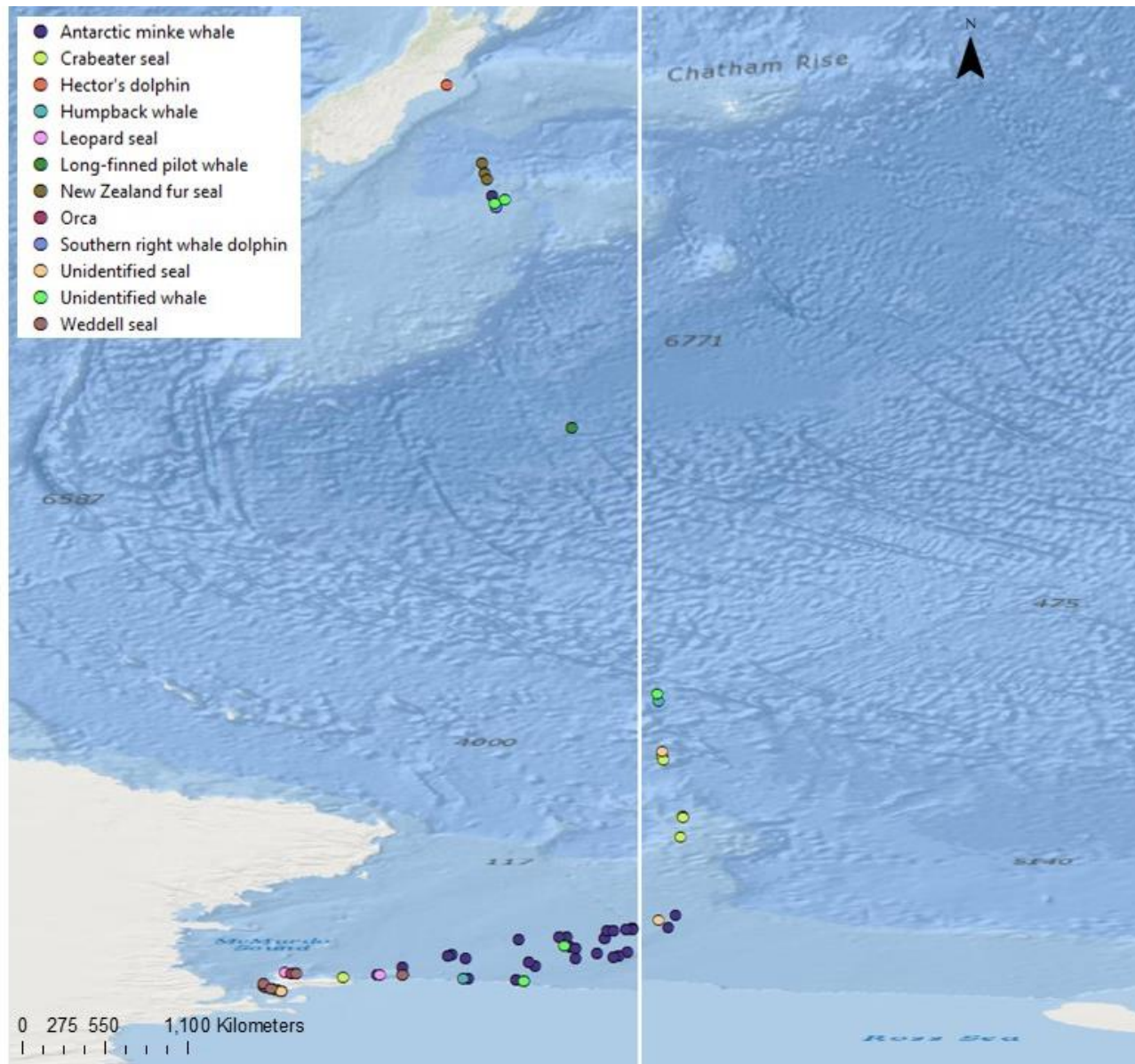


Figure 5: All protected species detections by common name during the survey.

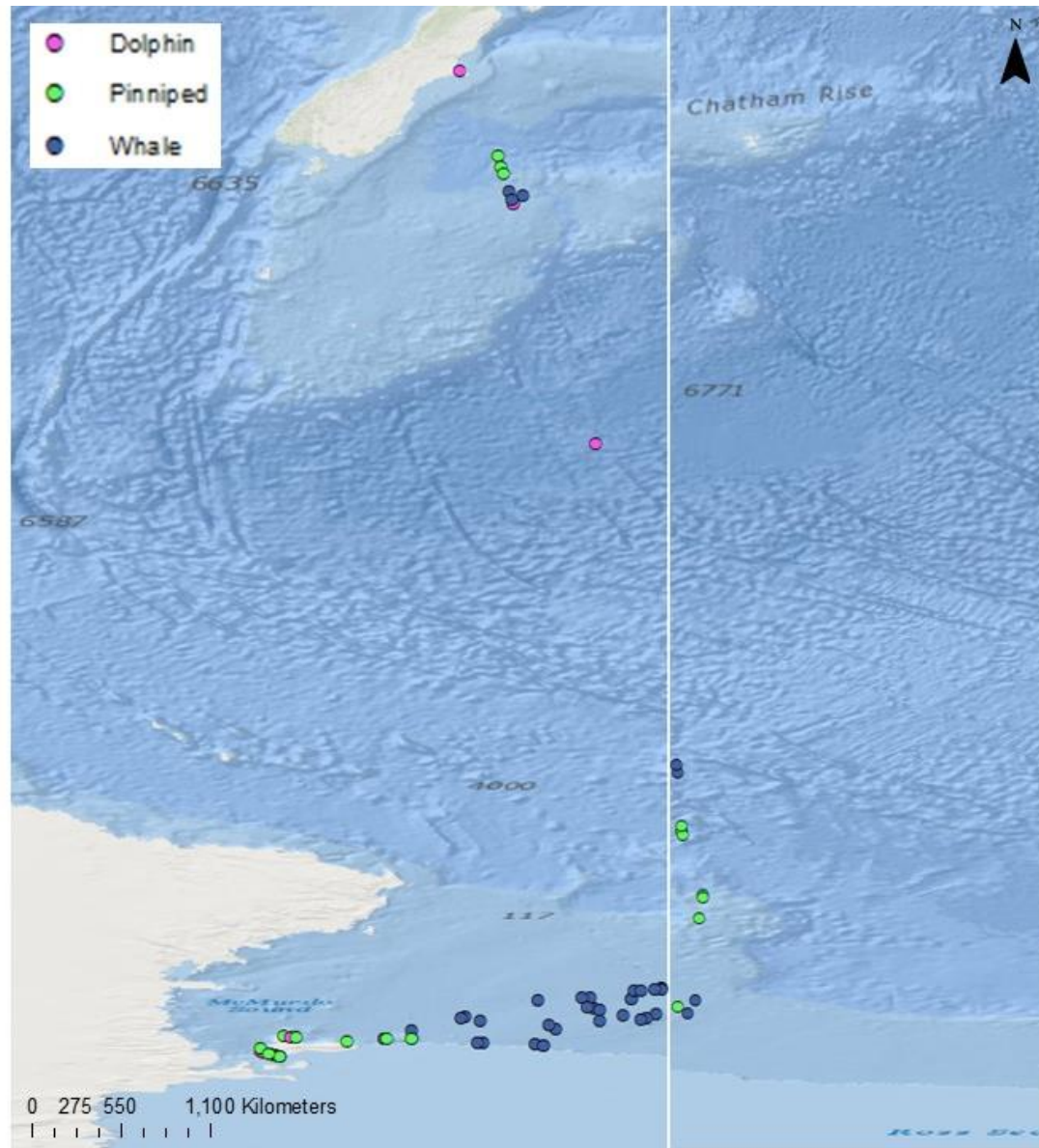


Figure 6: All protected species detections by group during the survey.

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Of the 73 visual detections, 22 detections occurred while the acoustic source was deployed and active and four detections occurred while the acoustic source was deployed and inactive. Additionally, during ice breaking activities, 13 detections of marine mammals occurred. Table 16 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. The closest distance to the source was not recorded while the source was not deployed for the remaining 34 detections of the 73. Detections occurred in water depths ranging between 289 and 735 meters.

Table 16: Average closest approach of protected species to the acoustic source during the survey.

Species Detected	Regulated Source Active		Regulated Source Inactive		Ice breaking	
	Number of detections	Mean closest observed approach to source (meters)	Number of detections	Mean closest observed approach to source (meters)	Number of detections	Mean closest observed approach to the vessel (meters)
Antarctic minke whale	19	1231	3	1002	3	223
Crabeater Seal	-	-	-	-	4	725
Humpback whale	1	422	-	-	-	-
Orca	-	-	-	-	2	350
Unidentifiable Seal	-	-	-	-	2	2000
Unidentifiable Whale	2	2412	1	2049	-	-
Weddell Seal	-	-	-	-	2	225

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 spy hopping while traveling at moderate or sedate paces away from the vessel. Pinnipeds detected during the survey program were mainly observed stationary resting on top of ice floes.

5.1.1 Other Wildlife

Observations of other wildlife included 19 species of birds and one species of fish. 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 H. No adverse impacts to any other wildlife species as a result of research activities were observed.

6 MITIGATION ACTION SUMMARY

There was one mitigation action implemented, a shutdown of the active source due to an Antarctic minke whale being observed after it surfaced at 50 meters, which was inside its EZ. At the time of detection, the source was at full volume on a survey line. The individual was observed surfacing and swimming at a sedate pace from port to starboard, ahead of the vessel. As the individual was observed entering the 100-meter exclusion zone, a shutdown of the active source was requested and immediately implemented. The closest distance to the active source was 50 meters, whilst the closest distance to the silent source was 100 meters. The whale was actively observed leaving the Exclusion Zone and clearance was given to ramp-up two minutes after the mitigation shutdown. In this instance, only the smallest volume single source was being used as the full volume source, therefore after clearance, the source was ramped up and switched back on simultaneously and data acquisition recommenced. This detection was also associated with a VSA measure.

6.1 Vessel Strike Avoidance (VSA) Maneuvers

There were five VSA measures implemented for protected species consisting of humpback whale and Antarctic minke whale detections. During transit, a pod of eight humpback whales, including one juvenile, were observed and the pod was observed milling, blowing, and occasionally diving with flukes. During this detection event, two VSA maneuvers were requested and implemented; a course alteration and a speed reduction, each of which were implemented for different animals over the course of the detection. First, as the vessel approached the stationary whales, a course alteration was implemented at 4000 meters to animals. One of the whales was sighted away from the pod, 250 meters in front the vessel and a reduction of speed was implemented.

Three VSA maneuvers were implemented for Antarctic minke whales; two of which were during transit and one of which during seismic operations. During transit to a coring site, one VSA maneuver of reduction of speed, was implemented for a detection of a pod containing 28 Antarctic minke whales. The whales were first observed 2600 meters from the vessel, and the closest point of approach being 120 meters from the vessel. In another instance, a VSA of an alteration of course was implemented for three whales observed 300 meters off the bow, porpoising, and swimming vigorously towards the vessel. The closest approach of the individuals was 200 meters from the vessel, with the whales changing direction away from the vessel. In the third instance, whilst the source was active in data acquisition, one VSA was implemented for an Antarctic minke whale observed 2600 meters ahead of the vessel. The whale was seen surfacing, blowing, and swimming at a sedate pace from port to starboard. A VSA of an alteration of course was implemented when the whale surfaced 130 meters from the port bow. In this instance, the whale entered the 100-meter separation distance with the closest distance of 50 meters to the vessel stern. This detection was also associated with a mitigation measure of a source shutdown.

6.2 Protected Species Known to Have Been Exposed to 160 Decibels or Greater of Received Sound Levels

Numerous protected species are known to occur within the survey area, including four species listed as endangered or threatened under the ESA. These species included: blue whale, fin whale, sei whale and sperm whale.

NMFS granted an IHA, which included an ITS, for the marine seismic survey authorizing a total of 20,491 individuals from 17 species or species groups, including nine species of whales, three delphinid species, and five species of pinnipeds. Four species of whales are 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 μ Pa rms) where there is a potential for behavioral changes), including 956 takes for endangered/threatened species.

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During acoustic source operations, 22 marine mammals, correlating to 21 Antarctic minke whales, and one Humpback whale, were observed within the predicted 160 decibel radius (where there is a potential for a behavioral response) while the acoustic source was active, constituting potential Level B takes. 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.

During ice breaking operations, seven marine mammals were observed within the predicted 160 decibel radius and displaying behavioral changes, while the vessel was actively breaking ice, constituting potential Level B takes. Consideration was also given to the species' location, whether in the water or on the ice. If the animals were observed in the water, inside the 6456-meter radius, they were potential Level B takes. With regards to seals, if the individuals were observed on the ice, with no behavioral change, these animals were not considered to be potential Level B takes; however, if the animals were noted to change their behavior whilst on the ice, or consequently were observed in the water, these animals were determined to be potential Level B takes. The seven species considered to be potential Level B takes during ice breaking activities consisted of: four Antarctic minke whales, two orcas and one crabeater seal.

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 (Table 17).

Table 17: Number of authorized and potential Level A and B harassment takes / exposures during the survey.

Species	IHA Authorized Level B Takes/ Exposures	Total Potential Takes/ Exposures During Seismic operations	Total Potential Takes/ Exposures During Ice Breaking	Total Potential Takes/Exposures for Entire Survey
Humpback whale	594	1	-	1
Blue whale	121	-	-	-
Fin whale	567	-	-	-
Sei whale	85	-	-	-
Antarctic Minke whale	1564	21	4	25
Sperm whale	183	-	-	-
Southern bottlenose whale	218	-	-	-
Arnoux's beaked whale	249	-	-	-
Strap-toothed beaked whale	83	-	-	-
Hourglass dolphin	351	-	-	-
Orca	386	-	2	2
Long-finned pilot whale	739	-	-	-
Crabeater seal	12,575	-	1	1
Leopard seal	493	-	-	-
Weddell seal	1973	-	-	-
Ross seal	308	-	-	-
Southern elephant seal	2	-	-	-

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Table 18 describes the behavior of all animals, including unidentified species, which were visually observed within the predicted Level B harassment zones. There were no highly distinctive behavioral reactions observed in relation to the vessel or acoustic source during the seismic survey. During Ice breaking activities, distinct behavioral reactions were taken into consideration when determining the species exposure to sound pressures of 160 dB or greater.

Table 18: Behavior of species visually observed to be exposed to sound pressure levels of 160 dB or greater during the survey.

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
Antarctic minke whale	VD25	1	931m	45	Blowing/ Surfacing	Crossing astern of vessel	Blowing/ Swimming	Crossing astern of vessel
Humpback whale	VD26	1	422m	45	Blowing/ Swimming	Away from vessel	Blowing/Diving	Away from vessel
Antarctic minke whale	VD27	1	599m	45	Blowing/ Swimming	Parallel in same direction as vessel	Blowing/ Swimming	Parallel in same direction as vessel
Antarctic minke whale	VD28	2	652m	45	Blowing/ Swimming	Parallel in opposite direction as vessel	Blowing/ Swimming	Parallel in opposite direction as vessel
Antarctic minke whale	VD29	1	50m	45	Blowing/ Swimming	Crossing ahead of vessel	Blowing/ Swimming	Crossing astern of vessel
Antarctic minke whale	VD32	1	195	45	Blowing/ Surfacing	Towards vessel	Surfacing/ Swimming	Away from vessel
Antarctic minke whale	VD33	2	711	45	Blowing/ Swimming	Parallel in opposite direction as vessel	Blowing/ Swimming	Parallel in opposite direction as vessel
Antarctic minke whale	VD37	2	899	45	Surfacing/ Swimming	Parallel in opposite direction as vessel	Swimming/ Blowing	Away from vessel

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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
Antarctic minke whale	VD38	3	986	45	Blowing/ Surfacing	Crossing ahead of vessel	Porpoising	Away from vessel
Antarctic minke whale	VD39	2	393	45	Blowing/ Surfacing	Parallel in opposite direction as vessel	Surfacing/ Feeding	Away from vessel
Antarctic minke whale	VD40	2	926	45	Blowing/ Surfacing	Crossing ahead of vessel	Surfacing/ Swimming	Away from vessel
Antarctic minke whale	VD41	4	593	45	Surfacing	Crossing ahead of vessel	Swimming	Away from vessel
Orca	VD61	2	n/a	n/a	Spy hopping	Parallel in opposite direction as vessel	Surfacing	Away from vessel
Antarctic minke whale	VD65	1	n/a	n/a	Spy hopping	Stationary	Spy hopping/ Blowing	Stationary
Antarctic minke whale	VD68	2	n/a	n/a	Swimming/ Blowing	Towards vessel	Swimming/ Blowing	Parallel in opposite direction as vessel
Crabeater seal	VD69	1	n/a	n/a	Stationary	Stationary	Diving	Crossing ahead of vessel
Antarctic minke whale	VD70	1	n/a	n/a	Blowing/ Swimming	Away from vessel	Swimming	Away from vessel

6.3 Implementation and Effectiveness of the Biological Opinion and IHA

To minimize the potential impacts to marine mammals during the seismic survey, NSF 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 and BiOp. There was one mitigation action implemented for protected species consisting of a shut-down of the sound source for an Antarctic minke whale. The confirmation of the implementation of each term and condition of the project permit documents are described in this report.

If 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.

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 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 were five instances during the survey where avoidance maneuvers were required to be implemented for protected species detections consisting of course alterations and/or speed reductions for individuals/groups of humpback whales and Antarctic minke whales.

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.

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 appear to have been an effective means to protect the marine species encountered during survey operations.

Appendix A: Incidental Harassment Authorization

Appendix B: Protected Species Observers Onboard the *NBP*

RPS PSOs onboard the <i>NBP</i>	
Name	Initials
Cassandra Frey	CF
Grace De Leon	GD
Henry Lewis	HL
Lyndon Lai Tan	LL
Edgar Brunett	EB

Appendix C: Additional Trained Watchstanders onboard the *NBP*

Additional Watchstanders for the <i>NBP</i>		
Affiliation	Name	Initials
GHG / HSC	Kody Leonard	KL
UWF	Rachel Weisend	RW
UWF	Alyssa Cotton	AC
LSU	Sam Schwippert	SS
LSU	Ben Lindsey	BL
Six Mile	Travis Groh	TG
TAMUCC	Hannah Organ	HO
LSU	Jaren Bradford	JB
LSU	Martina Tenti	MT
LSU	Ana Sivils	AS
University of South Alabama	Caleb Boyd	CB
NSF	Rachel Mayne	RM
LSU	Emily Kaiser	EM

Appendix D: Complete Survey Raw Datasheets (Provided in Attached File in Excel Format)

Appendix E: Basic Data Summary Form

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BASIC DATA FORM			
NSF Project Number	NBP2301		
Seismic Contractor	NSF		
Area Surveyed During Reporting Period	Ross Sea, Antarctic coast		
Survey Type	2D seismic, sediment & water sampling		
Vessel and/or Rig Name	<i>Nathaniel B. Palmer</i>		
Permit Number	BiOp issued on 2022/12/13, IHA issued on 2022/12/14		
Location / Distance of Source Deployment	50.5 meters astern		
Water Depth in survey area	100-1100 meters		
Dates of project	26 December 2022	Through	15 January 2023
Total time source operating – all power levels:	153:54		
Time source operating on survey lines:	148:33		
Time source operating not on a survey line:	04:31		
Amount of time single 40 in ³ element operations:	N/A		
Amount of time in ramp-up:	00:14		
Number daytime ramp-ups:	2		
Number of nighttime ramp-ups:	0		
Number of ramp-ups from mitigation source:	N/A		
Amount of time conducted in source testing:	00:30		
Duration of visual observations:	440:45		
Duration of observations while source active:	153:54		
Duration of observation during source silence:	286:51		
Lead Protected Species Observer:	Cassandra Frey		
Protected Species Observers on the Langseth:	Edgar Brunett, Grace De Leon, Lyndon Lai Tan, Henry Lewis		
Number of Marine Mammal Visual Detections:	70		
Total Number of Protected Species Detections:	70		
List Mitigation Actions	One shutdown for an Antarctic minke whale		
Duration of Mitigation Actions:	00:02		

Appendix F: Summary of Visual Detections of Protected Species During the Survey

REPORT

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	2022-12-26	3:36	Hector's dolphin	3	43.60983°S/ 172.75191°E	Not deployed	TV PV/OD	OB/SS/DI	N/A	None	No VSA due to voluntary approach
2	2022-12-26	22:57	New Zealand Fur Seal	3	46.59607°S/ 174.11027°E	Not deployed	AV TV	FT/PO	N/A	None	
3	2022-12-27	1:03	New Zealand Fur Seal	1	46.95783°S/ 174.21900°E	Not deployed	PV/SD PV/OD	PO/DI	N/A	None	
4	2022-12-27	2:18	New Zealand Fur Seal	1	47.17710°S/ 174.28597°E	Not deployed	AV AV	PO/DI	N/A	None	
5	2022-12-27	6:15	Antarctic minke whale	1	47.82667°S/ 174.48273°E	Not deployed	PV/SD AV	BV/OB	N/A	None	
6	2022-12-27	7:12	Unidentified Whale	1	47.98030°S/ 174.98030°E	Not deployed	PV/OD AV	BV/OB	N/A	None	
7	2022-12-27	7:49	Unidentified Whale	2	48.08017°S/ 174.56232°E	Not deployed	UN AV	BV	N/A	None	
8	2022-12-27	8:49	Long-finned pilot whale	27	48.24100°S/ 174.61107°E	Not deployed	PV/SD AV	NS	N/A	None	Mixed species detection
8	2022-12-27	8:52	Southern right whale dolphin	8	48.24100°S/ 174.61107°E	Not deployed	PV/SD PV/SD	PO/FT	N/A	None	Mixed species detection
9	2022-12-30	15:41	Long-finned pilot whale	7	56.55405°S/ 177.50750°E	Not deployed	TV AV	NS	N/A	none	
10	2023-01-02	10:23	Unidentified whale	2	66.70242°S/ 179.36692°W	Not deployed	PV/OD	BV	N/A	none	

REPORT

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/ Source Activity	Mitigation Action	Comments
11	2023-01-02	12:17	Humpback whale	8	66.99380°S/ 179.33508°W	Not deployed	MI	BV/MI/DF	N/A	none	VSA
12	2023-01-03	0:39	Unidentified Seal	1	68.94627°S/ 179.19318°W	Not deployed	SA	OB	N/A	none	
13	2023-01-03	1:39	Crabeater Seal	1	69.09687°S/ 179.20362°W	Not deployed	SA	OB	N/A	none	
14	2023-01-03	1:50	Crabeater Seal	3	69.11939°S/ 179.19519°W	Not deployed	SA	OB	N/A	none	
15	2023-01-03	1:55	Crabeater Seal	1	69.13193°S/ 179.19188°W	Not deployed	SA	OB	N/A	none	
16	2023-01-03	2:48	Crabeater Seal	1	69.26338°S/ 179.14933°W	Not deployed	SA/AV	OB	N/A	none	
17	2023-01-03	19:39	Crabeater Seal	1	71.46245°S/ 178.39608°W	Not deployed	SA	OB	N/A	none	
18	2023-01-03	20:09	Crabeater Seal	2	71.53305°S/ 178.39102°W	Not deployed	SA	OB	N/A	none	
19	2023-01-04	1:16	Crabeater Seal	2	72.29077°S/ 178.50222°W	Not deployed	SA AV	OB	N/A	none	
20	2023-01-04	22:17	Unidentified Seal	1	75.52805°S/ 179.33315°W	Not deployed	PV/OD	FT	N/A	none	
21	2023-01-05	17:07	Antarctic Minke Whale	2	75.79353°S/ 178.95097°W	Source silent	AV	BV/NS	2603m / active	none	
22	2023-01-06	2:20	Antarctic minke whale	5	76.38467°S/ 179.59792°E	Full volume	PV/ OD UN	BV/NS	1106m / active	none	
23	2023-01-06	4:23	Antarctic minke whale	2	76.50775°S/ 179.23448°E	Full volume	AV	BV	1409m / active	none	
24	2023-01-06	5:23	Antarctic minke whale	2	76.57390°S/ 179.04163°E	Full volume	PE (AH)AV	BV/NS	1844m /active	none	
25	2023-01-06	15:09	Antarctic minke whale	1	76.87575°S/ 176.11973°E	Full volume	PE (BH)	BV/OB/NS	931m /active	none	
26	2023-01-07	2:47	Humpback whale	1	77.36470°S/ 173.38438°E	Full volume	AV	BV/DI	422m /active	none	
27	2023-01-07	3:17	Antarctic minke whale	1	77.37382°S/ 173.56668°E	Full volume	PV/OD	BV/NS	599m /active	none	

REPORT

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/ Source Activity	Mitigation Action	Comments
28	2023-01-07	8:41	Antarctic minke whale	2	77.43805°S/ 175.39014°E	Full volume	PV/OD	BV/NS	485m /active	none	
29	2023-01-07	9:31	Antarctic minke whale	1	77.45071°S/ 175.68320°E	Full volume	PE (AH) PE (BH)	BV/NS	50m/active 100m/inactive	shutdown of source	
30	2023-01-07	9:35	Unidentified whale	1	77.45071°S/ 175.68320°E	Full volume	PE (AH) PV/OD	BV/NS	2104m/active 2049m/inactive	none	
31	2023-01-08	6:30	Antarctic minke whale	1	76.62885°S/ 173.50893°E	Source silent	V AV	BV/OB/NS	1250m /inactive	none	
32	2023-01-08	15:01	Antarctic minke whale	1	76.72853°S/ 175.85723°E	Full volume	TV AV	BV/OB/NS	195m /active	none	
33	2023-01-09	16:15	Antarctic minke whale	2	76.61480°S/ 177.64360°E	Full volume	PV/OD	BV/NS	711m /active	none	
34	2023-01-09	23:30	Unidentified whale	1	76.11083°S/ 177.21595°E	Full volume	AV	BV	2721m /active	none	
35	2023-01-10	0:24	Antarctic minke whale	3	76.16635°S/ 177.44030°E	Full volume	AV	BV/OB/MI	3013m /active	none	
36	2023-01-10	1:09	Antarctic minke whale	3	76.21210°S/ 177.62835°E	Full volume	PE (AH) PV/SD	BV/OB/NS	1962m /active	none	
37	2023-01-10	4:16	Antarctic minke whale	2	76.41268°S/ 178.45340°E	Full volume	PV/OD AV	OB/NS/BV	899m /active	none	
38	2023-01-11	4:23	Antarctic minke whale	3	75.84345°S/ 178.71713°E	Full volume	PE (AH) AV	BV/OB/PO	986m /active	none	
39	2023-01-11	4:34	Antarctic minke whale	2	75.82692°S/ 178.70497°E	Full volume	PV/OD AV	BV/OB/FF	393m /active	none	
40	2023-01-11	11:08	Antarctic minke whale	2	75.46517°S/ 179.76485°E	Full volume	PE (AH) AV	BV/OB/NS	926m /active	none	
41	2023-01-11	16:52	Antarctic minke whale	4	75.31780°S/ 178.68472°W	Full volume	PE (AH) AV	OB/NS/BV	593m /active	none	
42	2023-01-12	5:56	Antarctic minke whale	1	75.78710°S/ 177.30247°E	Full volume	UN AV	BV/NS	1804m /active	none	
43	2023-01-12	6:40	Antarctic minke whale	1	75.81383°S/ 177.01327°E	Full volume	UN	BV	2721m /active	none	
44	2023-01-12	21:19	Antarctic minke whale	28	75.55727°S /178.82867°E	Not deployed	PV/OD	BV/NS/SA/ OB	N/A	none	VSA

REPORT

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/ Source Activity	Mitigation Action	Comments
45	2023-01-13	8:12	Antarctic minke whale	2	75.49270°S/ 179.79278°E	Not deployed	PE (AH) AV	OB/PO/BV	N/A	none	VSA
46	2023-01-13	8:33	Antarctic minke whale	3	75.51187°S/ 179.55552°E	Not deployed	PV/SD AV	OB/PO/BV	N/A	none	
47	2023-01-13	10:39	Antarctic minke whale	1	75.55158°S/ 179.06082°E	Not deployed	TV PE (BH)	OB/NS/BV	N/A	none	
48	2023-01-13	16:05	Antarctic minke whale	3	75.87012°S/1 75.47537°E	Not deployed	PV/SD	OB/NS/BV	N/A	none	
49	2023-01-13	21:06	Antarctic minke whale	1	76.48102°S/ 172.98687°E	Not deployed	PV/SD	BV	N/A	none	
50	2023-01-13	21:34	Antarctic minke whale	3	76.51955°S/ 172.82227°E	Not deployed	AV	BV	N/A	none	
51	2023-01-14	1:04	Antarctic minke whale	1	76.95885°S/ 171.09577°E	Not deployed	TV PE (BH)	OB/SS	N/A	none	
52	2023-01-14	3:02	Crabeater Seal	4	77.20282°S/ 171.12430°E	Not deployed	SA		N/A	none	Multi-species detection
52	2023-01-14	3:13	Weddell Seal	1	77.20282°S/ 171.12430°E	Not deployed	SA		N/A	none	Multi-species detection
53	2023-01-14	4:16	Leopard Seal	1	77.20873°S/ 170.2587°E	Not deployed	SA		N/A	none	
54	2023-01-14	4:34	Antarctic minke whale	1	77.21900°S/ 170.17533°E	Not deployed	AV	BV/OB	N/A	none	
55	2023-01-14	6:21	Crabeater Seal	1	77.33088°S/ 168.86877°E	Not deployed	SA		N/A	none	
56	2023-01-14	10:10	Weddell Seal	1	77.19318°S/ 167.11322°E	Not deployed	SA		N/A	none	
57	2023-01-14	10:28	Killer whale	2	77.16050°S/ 166.92088°E	Not deployed	PV/OD AV	OB/NS	N/A	none	
58	2023-01-14	10:50	Leopard Seal	1	77.15335°S/ 166.69537°E	Not deployed	SA		N/A	none	
59	2023-01-14	16:14	Weddell Seal	1	77.54428°S/ 165.86892°E	Not deployed	SA		N/A	none	Vessel ice breaking
60	2023-01-14	18:03	Killer whale	2	77.66763°S/ 165.88450°E	Not deployed	PE (AH) AV	BV/OB/OB	N/A	none	Vessel ice breaking

REPORT

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/ Source Activity	Mitigation Action	Comments
61	2023-01-14	18:30	Killer whale	2	77.70250°S/ 165.98683°E	Not deployed	PV/OD AV	OB/OB	N/A	none	Vessel ice breaking
62	2023-01-14	18:42	Crabeater Seal	1	77.71367°S/ 165.98533°E	Not deployed	SA		N/A	none	Vessel ice breaking
63	2023-01-14	18:49	Weddell Seal	1	77.73148°S/ 166.13681°E	Not deployed	SA		N/A	none	Vessel ice breaking
64	2023-01-14	18:55	Unidentified seal	72	77.74373°S/ 166.18600°E	Not deployed	SA		N/A	none	Vessel ice breaking
65	2023-01-14	19:26	Antarctic minke whale	1	77.79152°S/ 166.37328°E	Not deployed	SA	OB/BV	N/A	none	Vessel ice breaking
66	2023-01-14	19:32	Crabeater Seal	8	77.80043°S/ 166.40878°E	Not deployed	V SA		N/A	none	Vessel ice breaking
67	2023-01-14	19:49	Crabeater Seal	1	77.82718°S/ 166.51683°E	Not deployed	SA		N/A	none	Vessel ice breaking
68	2023-01-14	19:56	Antarctic minke whale	2	77.82908°S/ 166.51965°E	Not deployed	TV PV/OD	NS/BV/SS	N/A	none	Vessel ice breaking
69	2023-01-14	20:00	Crabeater Seal	3	77.83885°S/ 166.56256°E	Not deployed	SA PE (AH)		N/A	none	Vessel ice breaking; multi-species detection
69	2023-01-14	20:00	Unidentified Seal	79	77.83885°S/ 166.56256°E	Not deployed	SA		N/A	none	Vessel ice breaking; multi-species detection
70	2023-01-14	20:00	Antarctic minke whale	1	77.83885°S/ 166.56256°E	Not deployed	AV	BV/NS	N/A	none	Vessel ice breaking

Appendix G: Photographs of Protected Species Visually Detected During the Survey



Picture 1: Visual Detection 01 - 26 December 2022 - Hector's dolphin



Picture 2: Visual Detection 02 - 26 December 2022 - New Zealand fur seal



Picture 3: Visual Detection 02 - 26 December 2022 - New Zealand fur seal



Picture 4: Visual Detection 04 - 27 December 2022 - New Zealand fur seal



Picture 5: Visual Detection 05 - 27 December 2022 - Antarctic minke whale



Picture 6: Visual Detection 08 - 27 December 2022 - Long-finned pilot whales (multi-species detection)



Picture 7: Visual Detection 08 - 27 December 2022 - Southern right whale dolphins (multi-species detection)



Picture 8: Visual Detection 11 - 02 January 2023 - Humpback whale



Picture 9: Visual Detection 13 - 03 January 2023 - Crabeater seal



Picture 10: Visual Detection 14 - 03 January 2023 - Crabeater seals



Picture 11: Visual Detection 15 - 03 January 2023 - Crabeater seal



Picture 12: Visual Detection 16 - 03 January 2023 - Crabeater seal



Picture 13: Visual Detection 17 - 03 January 2023 - Crabeater seal



Picture 14: Visual Detection 18 - 03 January 2023 - Crabeater seal



Picture 15: Visual Detection 19 - 04 January 2023 - Crabeater seal



Picture 16: Visual Detection 21 - 05 January 2023 - Antarctic minke whales



Picture 17: Visual Detection 22 - 06 January 2023 - Antarctic minke whale



Picture 18: Visual Detection 24 - 06 January 2023 - Antarctic minke whales



Picture 19: Visual Detection 27 - 07 January 2023 - Antarctic minke whale



Picture 20: Visual Detection 28 - 07 January 2023 - Antarctic minke whale



Picture 21: Visual Detection 29 - 07 January 2023 - Antarctic minke whale



Picture 22: Visual Detection 31 - 08 January 2023 - Antarctic minke whale



Picture 23: Visual Detection 35 - 10 January 2023 - Antarctic minke whale



Picture 24: Visual Detection 36 - 10 January 2023 - Antarctic minke whale



Picture 25: Visual Detection 37 - 10 January 2023 - Antarctic minke whale



Picture 26: Visual Detection 38 - 11 January 2023 - Antarctic minke whale



Picture 27: Visual Detection 39 - 11 January 2023 - Antarctic minke whale



Picture 28: Visual Detection 40 - 11 January 2023 - Antarctic minke whale



Picture 29: Visual Detection 41 - 11 January 2023 - Antarctic minke whales



Picture 30: Visual Detection 44 - 12 January 2023 - Antarctic minke whales



Picture 31: Visual Detection 45 - 13 January 2023 - Antarctic minke whale



Picture 32: Visual Detection 46 - 13 January 2023 - Antarctic minke whale



Picture 33: Visual Detection 49 - 13 January 2023 - Antarctic minke whale



Picture 34: Visual Detection 51 - 14 January 2023 - Antarctic minke whale



Picture 35: Visual Detection 52 - 14 January 2023 - Crabeater seal (multi species detection)



Picture 36: Visual Detection 52 - 14 January 2023 - Weddell seal (multi species detection)



Picture 37: Visual Detection 53 - 14 January 2023 - Leopard seal



Picture 38: Visual Detection 54 - 14 January 2023 - Antarctic minke whale



Picture 39: Visual Detection 55 - 14 January 2023 - Crabeater seal



Picture 40: Visual Detection 57 - 14 January 2023 - Killer whale



Picture 41: Visual Detection 58 - 14 January 2023 - Crabeater seal



Picture 42: Visual Detection 59 - 14 January 2023 - Weddell seal



Picture 43: Visual Detection 60 - 14 January 2023 - Killer whale



Picture 44: Visual Detection 61 - 14 January 2023 - Killer whale



Picture 45: Visual Detection 62 - 14 January 2023 - Crabeater seal



Picture 46: Visual Detection 63 - 14 January 2023 - Weddell seal



Picture 47: Visual Detection 64 - 14 January 2023 - Unidentified seal



Picture 48: Visual Detection 65 - 14 January 2023 - Antarctic minke whale



Picture 49: Visual Detection 66 - 14 January 2023 - Crabeater seal



Picture 50: Visual Detection 67 - 14 January 2023 - Unidentified seals



Picture 51: Visual Detection 68 - 14 January 2023 - Antarctic minke whale



Picture 52: Visual Detection 69 - 14 January 2023 - Unidentified seals



Picture 53: Visual Detection 70 - 14 January 2023 - Antarctic minke whale

Appendix H: Birds and Other Wildlife Observed

Birds: Common Name	Taxonomic Identification	Approximate Number Individuals Observed	Approximate Number of Days Species Was Observed
Adelie penguin	<i>Pygoscelis adeliae</i>	1730	7
Antarctic petrel	<i>Thalassarche antarctica</i>	1611	11
Black-billed gull	<i>Larus bulleri</i>	58	1
Black-browed albatross	<i>Thalassarche melanophrys</i>	27	4
Blue Petrel	<i>Halobaena caerulea</i>	3	1
Cape petrel	<i>Daption capense</i>	18	4
Emperor Penguin	<i>Aptenodytes forsteri</i>	14	3
Gray headed albatross	<i>Thalassarche chrysostoma</i>	28	2
Parkinsons petrel	<i>Procellaria parkinsoni</i>	25	2
Salvin's albatross	<i>Thalassarche salvini</i>	7	1
Slender-billed prion	<i>Pachyptila belcheri</i>	87	2
Snowy petrel	<i>Pagodroma nivea</i>	46	7
Sooty shearwater	<i>Puffinus griseus</i>	5	2
South polar skua	<i>Catharacta maccormicki</i>	30	6
Southern giant-petrel	<i>Macronectes giganteus</i>	9	3
Southern fulmar	<i>Fulmarus glacialisoides</i>	42	1
Southern royal albatross	<i>Diomedea epomophora</i>	104	7
Wandering albatross	<i>Diomedea exulans</i>	3	1
White-chinned petrel	<i>Procellaria aequinoctialis</i>	11	1
White-fronted tern	<i>Sterna striata</i>	26	1

Fish: Common Name	Taxonomic Identification	Approximate Number Individuals Observed	Approximate Number of Days Species Was Observed
Oceanic sunfish	<i>Mola mola</i>	1	1