



PROTECTED SPECIES MITIGATION AND MONITORING REPORT

Marine Geophysical 2D Seismic Survey, Drygalski Trough (Cruise ID No. *NBP24-02*)

Drygalski Trough Survey, RVIB *Nathaniel B. Palmer* (Callsign: WBP3210)

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Report Author

Name	Draft Submission Date
Amanda Dubuque Michelle Klein Edgar Alvarado Jimena Ortega Heber Huizar Leonardo De La Rosa	28 February 2024

Report Reviewer

Name	Date of Review
Anna Turano	March 1, 2024
Benjamin Finkes	March 12, 2024

Final Report Approval

Name	Stephanie Milne
Title	Team Leader – Senior Environmental Manager
Signature	<small>DocuSigned by:</small> <i>Stephanie Milne</i> <small>ATEB551BB603441</small>
Date	Apr 30, 2024

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
BSS – Beaufort Sea State
BiOp – Biological Opinion (US)
BZ – Buffer Zones
BOEM – Bureau of Ocean Energy Management
dB - Decibels
DSLR – Digital Single Lens Reflex
DP – Dynamic Positioning
ESA – Endangered Species Act (US)
EZ – Exclusion Zone
Hz – Hertz
HF – High-Frequency
IEE – Initial Environmental Evaluation
in³ – Inches Cubed
IHA – Incidental Harassment Authorization (US)
ITS – Incidental Take Statement (US)
kHz – Kilohertz
LF – Low-Frequency
MF – Mid-Frequency
mm – Millimeter
ms – Millisecond
MBES – Multibeam Echosounder
MCS - Multi-channel Seismic
MMPA – Marine Mammal Protection Act (US)
NBP – Nathaniel B. Palmer
NMFS – National Marine Fisheries Service (US)
NSF – National Science Foundation (US)
NRP – Navigation Reference Point
OBS – Ocean Bottom Seismometer
PTS – Permanent Threshold Shift
PI – Principal Investigator
PSO – Protected Species Observer
RPS – PSO Provider company name (not an acronym)
rms – Root-Mean-Square
RVIB – Research vessel with ice-breaking capability
SBES – Single-Beam Echosounder
SBP – Sub-Bottom Profiler
TTS – Temporary Threshold Shift
US – United States
µPa – Micropascal
USAP – United States Antarctic Program
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 United States Antarctic Program (USAP). A low energy (high-resolution) two-dimensional (2D) seismic survey was conducted in the Drygalski Trough, from 03 to 22 February 2024 (referred to herein as “survey”). The operational activities were conducted in support of research proposed by Principal Investigator (PI) Dr. R. Coffin (Texas A&M University), and co-PIs Dr. N. Bangs (University of Texas at Austin), Dr. I. Pecher (Texas A&M University), Dr. W. Jeffreys (University of West Florida), and Dr. B. Reese (Dauphin Island Sea Lab).

The purpose of the Drygalski Trough survey was to collect low energy 2D seismic reflection and refraction data to examine the gas hydrate contribution to the Ross Sea carbon budget as well as the warming and carbon cycling of the ephemeral reservoir of carbon at the extensive bottom ocean layer-sediment interface of the Ross Sea.

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. NMFS released the Biological Opinion (BiOp) on 13 December 2022 and the IHA on 14 December 2022. NSF issued the Initial Environmental Evaluation (IEE) on 05 January 2023 for the surveys. As only the Ross Sea portion of the survey was completed in 2022/2023, NSF requested and NMFS issued on 15 November 2023 a renewal of the IHA to complete the Drygalski Trough portion of the survey in 2024.

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.

Six PSOs, one of which was designated as the Lead PSO and one of which was designated as the co-Lead PSO, were present onboard the *NBP* throughout the survey to conduct visual monitoring. Visual monitoring effort for the survey totaled 421 hours and 10 minutes.

The seismic source was active for 94 hours and 54 minutes, all of which occurred with constant visual monitoring during daylight hours.

There were 83 visual detections of protected species during the survey, including 38 detections of whales (30 sightings of Antarctic minke whales (*Balaenoptera bonaerensis*), two sightings of humpback whales (*Megaptera novaeangliae*), one sighting of fin whales (*Balaenoptera physalus*), one sighting of sei whales (*Balaenoptera borealis*), two sightings of unidentified whales (*Cetacea*), and two sightings of unidentified baleen whales (Mysticeti)), four detections of dolphins (one sighting each of dusky dolphins (*Lagenorhynchus obscurus*), Hector’s dolphins (*Cephalorhynchus hectori*), hourglass dolphins (*Lagenorhynchus cruciger*), and long-finned pilot whales (*Globicephala melas*), 34 detections of pinnipeds (one sighting of crabeater seals (*Lobodon carcinophaga*), one sighting of a leopard seal (*Hydrurga leptonyx*), seven sightings of New Zealand fur seals (*Arctocephalus forsteri*), 16 sightings of Weddell seals (*Leptonychotes weddellii*), two sightings of unidentified pinnipeds (*Obobenidae*), two sightings of unidentified otariid pinnipeds (*Otariidae*), one sighting of an unidentified phocid pinniped (*Phocidae*), and

four sightings of unidentified seals), and seven sightings of ESA-listed seabirds (all consisting of emperor penguins (*Aptenodytes forsteri*)).

Protected species detections resulted in the implementation of four mitigation shutdown actions during the survey totaling 30 minutes, including one shutdown for a whale totaling three minutes, and three shutdowns for Weddell seals totaling 27 minutes. There were 18 VSA maneuvers implemented, including three times where the vessel reduced speed and shifted the engine to neutral for whales, one time when the vessel altered course for a whale, two times where the vessel remained stationary on dynamic positioning (DP) for a whale and a seal, and 12 times when the vessel maintained course and speed for whales, dolphins, and seals.

NMFS issued an IHA and ITS authorizing 14,650 Level B takes/exposures for 17 species of marine mammals, including four species listed as endangered (blue whale, fin whale, sei whale, and sperm whale (*Physeter macrocephalus*)) for seismic source and vessel icebreaking activities. There were no Level A takes authorized for any marine mammal or bird 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, 19 marine mammals, including 11 Antarctic minke whales, five Weddell seals, two unidentified whales, and one unidentified phocid pinniped were observed within the predicted 160-decibel radius (where there is a potential for a behavioral response and temporary threshold shift (TTS)) while the seismic source was active. 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. There were no vessel icebreaking activities during the survey.

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 survey on board the *Nathaniel B. Palmer (NBP)* in the Southern Ocean, within the Drygalski Trough, off the coast of Antarctica from 3 to 22 February 2024.

This document serves to meet the reporting requirements dictated in the IHA issued to NSF by NMFS on 15 November 2023. The IHA authorizes 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 (160 dB) could potentially disturb marine mammals, temporarily disrupting behavior, such that they could be considered non-lethal 'takes' (Level B harassment). In 2018, NMFS updated technical guidance issued in 2016 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 (LF), mid-frequency cetaceans (MF), 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 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, an individual detected approaching, entering, or within their designated EZ would require 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 on 03 February 2024 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 ocean bottom seismometer (OBSs) and multi-channel seismic (MCS) survey, that took place in the Ross Sea, off the coast of Antarctica in the Drygalski Trough, in water depths of approximately 150 to 1,100 meters (Figure 1).

The purpose of the research was to conduct low-energy seismic surveys along the Drygalski Trough to examine the gas hydrate contribution to the Ross Sea carbon budget. The Drygalski Trough survey would examine the warming and carbon cycling of the ephemeral reservoir of carbon at the extensive bottom ocean layer–sediment interface of the Ross Sea. This large carbon reserve appears to be sealed in the form of gas hydrate and is a thermogenic carbon source and carbon storage in deep sediment hydrates. The warming and ice melting coupled with high thermogenic gas hydrate loadings suggest the Ross Sea is an essential environment to determine contributions of current day and potential future methane, petroleum, and glacial carbon to shallow sediment and water column carbon cycles. The Drygalski Trough survey would also use OBSs to acquire long offset reflection and refraction data to improve the assessment of methane hydrate.

All operations for the survey were conducted solely by the *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. The vessel's speed varied while transiting through the ice pack ice and no ice-breaking was required.

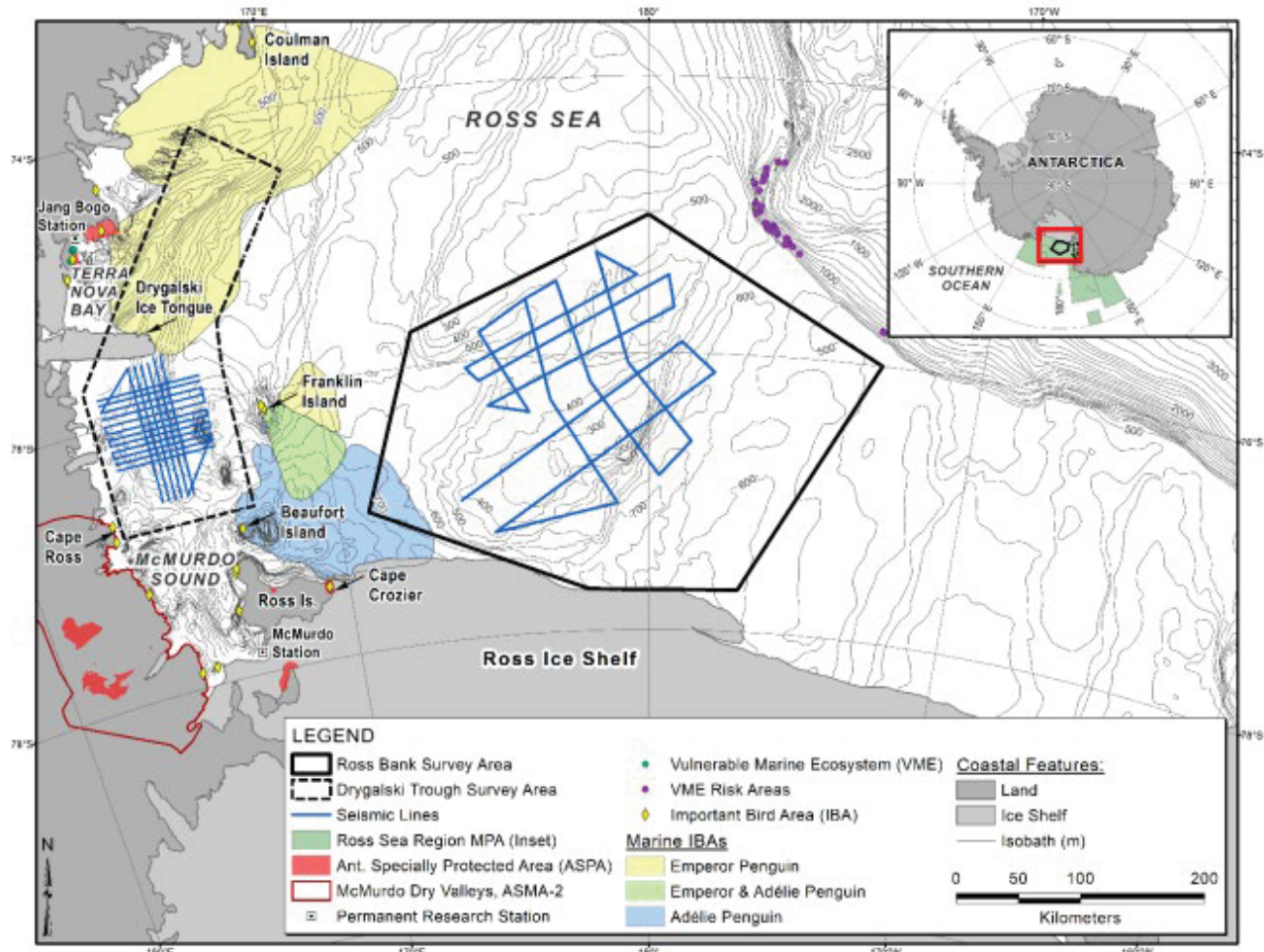


Figure 1: Location and survey points of the 2024 Drygalski Trough marine geophysical survey. The Ross Bank Survey area was completed in 2023.

Seismic operations were conducted within the Drygalski Trough survey area between 12 and 22 February 2024. There were 14 survey level sequences acquired, including a line acquired twice, one time for OBS data, and a second time for MCS data.

2.1.1 Energy Source and Receiving Systems

The energy source utilized during the survey consisted of one array of two generator injector (GI) elements deployed aft the starboard stern of the vessel. The array had a total volume of 210 cubic inches (in^3) (105 in^3 for each element). However, on 19 February 2024, the configuration was modified to only one element active during acquisition until completion of the survey. The operating pressure was 2,000

pounds per square inch and the dominant frequency components ranged from 0 to 188 Hertz (Hz). The shot point interval was 11.6 to 30 meters (5 to 13 seconds respectively) dependent on vessel speed which ranged from 3 to 5 knots during acquisition. During seismic activity, the source elements emitted a brief (approximately 0.1 second) pulse of sound. The source elements were towed at a depth of one meter. The center of the source was 103 meters from the navigation reference point (NRP), which was located 50 meters from the stern of the vessel. This positioned the closest element on the array 53 meters from the starboard stern of the vessel and the second element at 54 meters.

There were two receiving systems utilized during the survey, including 11 OBSs and a towed MCS hydrophone streamer that was 700 meters in length. While the streamer transmitted data immediately to the onboard processing systems, the OBSs stored data for later analysis after the devices were retrieved. The OBSs were in use from 12 to 13 February 2024 and were deployed kilometers apart on the sea floor. For recovery of the OBSs, an acoustic release transponder (pinger) communicated with the OBS to trigger the burn-wire assembly that released the instrument from its anchorage to the seafloor, and then the vessel retrieved the device after it reached the surface of the water. The MCS streamer was in use from 14 February 2024 to completion of the seismic operation on 22 February 2024. The streamer had 120 channels and was towed from the port stern of the vessel.

Additional sound sources used in support of research efforts included a Kongsberg EM 122 multi-beam echosounder (MBES), Knudsen CHIRP 3260 single-beam echosounder (SBES), and a Teledyne RDI 75 kHz Ocean Surveyor acoustic Doppler current profiler (ADCP). The hull-mounted, MBES operates at a frequency of 12 kHz, with an estimated maximum source energy level of 242 dB rms re 1 μ Pa and emits a very narrow (< 2°) beam fore to aft and 150° in cross-track. The MBES emits a series of nine consecutive 15 millisecond (ms) pulses. The hull-mounted SBES is operated at 12 kHz or at 3.5 kHz, and emits energy in a 30° beam from the bottom of the ship and has a sound level of 224 decibel (dB) root-mean-square (rms) re 1 micropascal (μ Pa) at 1 m. The hull-mounted ADCP operates at a frequency of 150 kHz, with an estimated acoustic output level at the source of 223.6 dB rms re 1 μ Pa and emits sound energy as a 30° conically shaped beam. The MBES and SBES 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 and emperor penguins, as outlined in the IHA, BiOp, and IEE. 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). If an emperor penguin was observed in the water any distance from the vessel, operation of active sources was shut down and initiation of inactive sources was delayed.

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* with a calf** 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-dB radius.	Delayed operation of inactive source and shutdown of active source.
Any marine mammal species for which the total authorized takes has been met is observed approaching, entering, or within the 160-decibel radius.	Delayed operation of inactive source and shutdown of active source.

Detection of:	Mitigation Action Required
A large whale with a calf, aggregations of six or more whales, or beaked whales observed approaching, entering, or within the 500-meter mitigation zone.	Delayed operation of inactive source and shutdown of active source.
Any other marine mammal observed approaching, entering, or within their specific mitigation zone.	Delayed operation of inactive source and shutdown of active source.
An emperor penguin observed in the water any distance from the vessel.	Delayed operation of inactive source and shutdown of active source.

*A large whale is defined as a sperm whale or any mysticete whale.

**A calf is defined as an animal less than two thirds the body size of an adult and observed in close association with an adult.

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 (m)	Buffer Zones (m)	Exclusion Zones (m)	Delay Duration (min.)
Large whale with calf and aggregations of six or more whales*	100	-	500	30
Beaked whales*	50	500	500	30
Mysticetes and sperm whales	100	200	100	30
All other odontocetes	50	200	100	15
Pinnipeds	50	200	100	15
ESA-listed sea birds (emperor penguins)**	-	-	-	-
ESA-listed sea turtles	45	-	-	-

*For these species, a 1,000-meter distance was implemented as a warning measure per request of the survey team.

**Airgun(s) operations would be delayed or shut down upon observation of emperor penguins in water at any distance.

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 (marine mammals) would require a shutdown of the seismic source if the animal was observed approaching, entering, or within their designated zone. Upon the implementation of a shutdown for the 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 EZ. For detections of small odontocetes or pinnipeds, this time was 15 minutes following last sighting. For detections of mysticetes and 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 105 in³ element, with the second 105 in³ element added after 5 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 (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 watch and a ramp-up were required.

Table 3 describes the distances to the 160 decibel sound level (Level B harassment zone for marine mammals) for the two 105 in³ GI guns and smaller source (one 105 in³ GI Gun) used 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 (m)
Two 105 in ³ seismic elements	210 in ³	>1000	726
		100-1000	1089
Ice breaking			6456

*Distances are from any single element on the array

3.2 Visual Monitoring Survey Methodology

There were six 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 and are listed in Appendix B. Visual monitoring was primarily carried out from inside the bridge and bridge deck, and occasionally from the ice tower (Figure 2). Monitoring from the ice tower was limited to occasions when calm weather and seas allowed the visual observers to be up there safely. However, monitoring was preferentially carried out from the bridge and bridge deck as the extended sides of the bridge gave an excellent view around the vessel and allowed for quick and easy access to the big-eye binoculars, which were mounted on the deck in front of the bridge (Figure 3). The bridge and bridge deck were located 17.8 meters above the surface of the water and the ice tower was located 25.8 meters above the surface of the water. Visual observers also occasionally went down to the bow of the vessel to take pictures of nearby animals, located 9.3 meters above the water's surface.

The PSOs were equipped with reticle 7x50 and 10x50 binoculars and Digital Single Lens Reflex (DSLR) cameras with telephoto lenses ranging between 300 millimeters (mm) and 600 mm. In addition, two sets of Fujinon 25x150 Big-Eye binoculars were mounted on the bridge wing decks (Figure 3). PSOs were provided with two radios to communicate to the bridge and 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.



Figure 2: Front view of the *NBP* showing the extended bridge and bridge deck, and the ice tower above the bridge.



Figure 3: Big Eye binoculars mounted on the 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, but to the maximum extent practicable two PSOs, were required to be on duty and conduct visual monitoring during all daylight hours during survey operations whenever the acoustic source was in the water, whether activated or not. Visual PSOs also conducted observations when the acoustic source was 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. Visual monitoring during the transits between ports and survey area was 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 4 hours followed by at least 1 hour of scheduled break time.

As required by the IHA (section 5(d)(ii) and 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., BSS, wind force, swell height, visibility, and glare) and vessel activity were logged.

Species identifications were made when the distance from the observer, length of the sighting, and visual observation conditions allowed. Whenever possible, photographs of the individuals were also taken with DSLR and mirrorless cameras to be compared with the consulted marine mammal identification guides (*A Complete Guide to Antarctic Wildlife*; *Marine Mammals of the World: A Comprehensive Guide to their Identification*; *Seabirds of the World*; *Antarctic Wildlife: A Folding Pocket Guide to Familiar Species of the Antarctic and Subantarctic Environments*).

4 MONITORING EFFORT SUMMARY

4.1 Survey Operations Summary

4.1.1 General Survey Parameters

The Drygalski Trough survey began on 3 February 2024 when the *NBP* departed port in Lyttleton, New Zealand. Seismic data acquisition operations were conducted between 12 and 22 February 2024. The survey concluded on 22 February 2024 when the vessel arrived at port in McMurdo Station, Antarctica (Table 4).

Table 4: Survey parameters.

Survey Parameter	Date	Time (UTC)	Location
Mobilization (depart port)	03 February 2024	19:35	Lyttleton, New Zealand
Start OBS deployment	12 February 2024	10:15	survey site
First seismic source activity	12 February 2024	22:15	survey site
Start of acquisition (OBS line)	12 February 2024	22:59	survey site
End of acquisition (OBS line)	13 February 2024	15:41	survey site
Start of acquisition (MCS lines)	18 February 2024	19:10	survey site
End of acquisition (MCS lines)	22 February 2024	09:30	survey site
Last seismic source activity	22 February 2024	09:30	survey site
All gear onboard - end of survey	22 February 2024	11:28	survey site
De-mobilization (arrive at port)	22 February 2024	21:50	McMurdo Station, Antarctica

During the seismic survey, data was acquired continuously according to the survey plan, with source operations only suspended when required as outlined in Figure 5. Most of the interruptions of source activity were for mechanical/technical issues with the seismic source. There were also two instances where the towed gear was damaged by ice and had to be retrieved for repairs.

Table 5: Suspension of source operations during the survey.

Date	Time Source Silenced (UTC)	Date	Time Source Re-activated (UTC)	Reason for Interruption to Acquisition
13 February 2024	01:12	13 February 2024	01:19	Mechanical/technical silence - seismic source issues.
13 February 2024	01:33	13 February 2024	06:48	Mechanical/technical silence - vessel circled around to repair seismic source and re-shoot gap in data.
13 February 2024	07:12	13 February 2024	07:28	Mechanical/technical silence – seismic source issues
13 February 2024	15:41	14 February 2024	19:30	End of OBS line, OBS retrieval operations (which were suspended for weather), and transit to start MCS operations.
14 February 2024	20:41	17 February 2024	16:40	Mechanical/technical silence - seismic source and streamer damaged by the ice, extended downtime for repairs and then resuming and completing OBS retrieval operations.

Date	Time Source Silenced (UTC)	Date	Time Source Re-activated (UTC)	Reason for Interruption to Acquisition
17 February 2024	17:12	17 February 2024	22:15	Mechanical/technical silence - seismic source issues.
17 February 2024	23:23	18 February 2024	02:44	Mechanical/technical silence - seismic source issues.
18 February 2024	07:55	18 February 2024	18:14	Mechanical/technical silence - seismic source issues.
19 February 2024	07:31	19 February 2024	07:32	Mechanical/technical silence - seismic source issues.
20 February 2024	21:02	21 February 2024	06:30	Mechanical/technical silence - seismic source issues - resumption of source activity delayed several hours by reduced visibility (heavy fog and snow) and streamer maintenance.
21 February 2024	06:36	21 February 2024	06:44	Mechanical/technical silence - seismic source issues.
21 February 2024	14:29	21 February 2024	16:34	Mechanical/technical silence - seismic source float damaged by ice.

4.1.2 MBES, SBES, and ADCP Operations

The MBES, the SBES, and the ADCP were active throughout the survey for a total of 438 hours and 14 minutes. The SBES and ADCP were activated for the first time on 3 February 2024 at 19:35 UTC shortly after the vessel departed port, and the MBES was activated for the first time at 00:53 UTC on 4 February 2024. All systems were de-activated and re-activated multiple times throughout the transit and operations within the survey area, mainly for technical issues with the equipment and OBS deployment and retrieval operations. The systems were all disabled for the last time at 21:50 UTC on 22 February 2024 when the vessel arrived at dock in McMurdo, Antarctica.

4.1.3 Seismic Source Operations

The seismic source was active over nine days for 94 hours and 54 minutes throughout the survey. At the beginning of operations, the seismic source was mainly active at a full volume of 210 in³ with both elements active; however, after 18 February 2024, all operations of the seismic source occurred at a reduced volume of 105 in³ with only one element active. The total seismic source operations included: 1 hour 4 minutes of ramp-up, 75 hours and 24 minutes of operations on a survey level (15 hours and 34 minutes at full volume and 51 hours and 20 minutes at reduced volume), 9 hours and 29 minutes of operations not on a survey level (42 minutes at full volume and 7 hours and 50 minutes at reduced volume), and 8 hours and 57 minutes of source testing (7 hours at full volume and one hour and 57 minutes at reduced volume).

Table 6 summarizes the acoustic source operations during the seismic survey.

The seismic source was ramped up eight times during the survey to commence full volume testing or data acquisition. Operations of only one element did not require a ramp-up. All ramp-ups were cleared by visual monitoring, occurred during daylight hours, and totaled between 6 and 12 minutes in duration.

There were two occasions where seismic source operators did not request clearance to resume source operations after brief periods of mechanical/technical silence, including once on 13 February 2024 after seven minutes of silence and once on 19 February 2024 after 1 minute of silence. On both occasions, the PSOs were informed of the silence after the seismic source was already re-enabled, and the operators

were reminded both times that they need to immediately inform PSOs of any period of silence and request clearance of the mitigation zones before re-initiating the seismic source. During both periods of silence, the PSOs were on continuous visual monitoring and there were no detections while the seismic source was silent.

There were 12 occasions of source testing, including eight tests at full volume and four tests at reduced volume. Two of the tests were to begin OBS and MCS operations, while the remaining 10 tests were after maintenance of the source elements.

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.

Table 6: Total acoustic source operations during the survey.

Acoustic Source Operation	Number	Duration (hh:mm)
Source tests	12	08:57
Ramp-up	8	01:04
Day-time ramp-ups	8	01:04
Night-time ramp-ups	0	00:00
Full (210 in³)/reduced volume (105 in³) on a survey level		75:24
Full (210 in³)/reduced volume (105 in³) not on a survey level		09:29
Total time acoustic source was active		94:54

4.1.4 Interactions with Other Vessels

In addition to visual 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 level, increase/decrease speed) because of another vessel.

There were no instances where the *NBP* had such an interaction with another vessel during the survey. However, there were several occasions where the vessel had to deviate slightly offline due to an iceberg.

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 vessel's arrival to dock at the end of the program (Table 7). On 10 February 2024, 24-hour daylight began as the vessel transited south, and visual monitoring was continuous from then until the vessel was docked at the end of the program. During transit and other periods with no source operations, observations were undertaken by two PSOs for VSA and to collect baseline data about protected species abundance in the survey areas. Visual monitoring was also conducted at night on two occasions for night-time pre-clearance searches and ramp-ups.

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

Visual Monitoring	Date	Time (UTC)
Initiation for the survey	03 February 2024	19:35
Termination for the survey	22 February 2024	21:50

Visual monitoring on the *NBP* was conducted over 20 days for a total of 421 hours 10 minutes. Of the overall total visual monitoring effort, 23% (94 hours and 54 minutes) was undertaken while the acoustic source was active, and 77% (326 hours and 16 minutes) was undertaken while the acoustic source was silent. Visual monitoring while the acoustic source was silent was mainly conducted during the transits, deployment and retrieval of the survey equipment, and standby periods for weather and equipment maintenance. There were no instances during the survey where the vessel conducted icebreaking. 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	94:54	23
Total monitoring while acoustic source silent	326:16	77
Total monitoring while vessel was ice breaking	00:00	-
Total monitoring effort	421:10	100%

Visual observations on the *NBP* were mainly undertaken from the bridge and bridge deck which extended out beyond the vessel's sides and allowed for a 180-degree view on each side of the vessel and access to the big-eye binoculars, which were mounted on the bridge deck in front of the bridge. Frequently, visual watch was conducted simultaneously from the bridge and the deck depending on weather and ice conditions. Visual monitoring from the ice tower was limited (only 2% of the total observations) due to safety concerns (rough seas during the transit and then climbing up and down the vertical ladders with all the heavy extreme cold weather gear and required visual monitoring equipment).

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. 20% and 29% of monitoring effort on the *NBP* was undertaken at 'excellent' and 'very good' visibility levels, respectively (Table 9). The entire predicted harassment zone radii, BZs, and EZs were not visible on multiple occasions, with 19% of visual monitoring effort occurring in reduced visibility or 1,000 meters or less, mainly due to several periods of heavy snow and fog. During these times, it is possible that protected species were not detected within these zones.

Table 9: Visibility during the survey

Visibility	<0.05 km	0.05-0.1 km	0.1-0.3 km	0.3-0.5 km	0.5-1 km	1-2 km	2-5 km	5-7 km	7-10 km	>10 km
Duration (hh:mm)	00:24	09:58	25:40	24:07	17:50	37:54	38:41	59:38	121:30	85:28

Precipitation was recorded during visual monitoring on the *NBP* for a total of 325 hours 53 minutes. Most of the precipitation recorded was fog (12%) or snow (38%) (Table 10). There were multiple occasions where both snow and fog were observed simultaneously, but only snow was recorded as the precipitation if it was falling over the vessel. There were also several occasions of blizzard conditions, with heavy snow, fog, and high winds which greatly reduced visibility.

Table 10: Precipitation during the survey.

Precipitation	None	Heavy Rain	Moderate Rain	Light Rain	Heavy Fog	Moderate Fog	Thin Fog	Haze	Sleet	Snow
Duration (hh:mm)	95:17	00:00	02:21	06:12	17:37	23:05	132:03	00:00	08:43	124:36

Beaufort Sea States recorded during visual monitoring ranged from level one to level seven. Most visual observations on the *NBP* were undertaken in conditions where the BSS was level three (21%) or level two (20%), which were considered 'very good' conditions for the detection of protected species (Table 11). There were several occasions on the last few days of the survey where an increase in the amount of new/pancake ice kept the sea state lower in higher winds.

Table 11: Beaufort Sea State during the survey.

Beaufort Sea State	B0	B1	B2	B3	B4	B5	B6	B7	B8	B9
Duration (hh:mm)	00:00	35:21	82:43	77:48	89:49	71:57	58:52	04:40	00:00	00:00

Wind speeds recorded during visual monitoring ranged between 2 and 39 knots. Most of the visual monitoring on the *NBP* occurred during recorded wind speeds of 10 to 15 knots (31%) and from 16 to 20 knots (21%) (Table 12). The highest winds recorded occurred during a storm that the vessel transited through at the beginning of the project and several blizzards that occurred while in the survey area.

Table 12: Wind speed during the survey.

Wind Speed	<10 kts	10-15 kts	16-20 kts	21-25 kts	26-30 kts	>31 kts
Duration (hh:mm)	59:30	131:26	87:07	75:13	40:30	27:24

Swell heights during visual observations were generally low, with swells of less than 2 meters recorded for most of the visual observations (83%) (Table 13). Swells greater than 4 meters occurred on the transit to the survey site.

Table 13: Swell height during the survey.

Swell Height	<2 m	2-4 m	>4 m
Duration (hh:mm)	349:41	66:39	04:50

Visual monitoring was conducted when no glare (70%) 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.

Glare	None	Mild	Moderate	Severe
Duration (hh:mm)	292:59	29:58	37:21	60:52

5 MONITORING AND DETECTION RESULTS

5.1 Visual Detections

Visual monitoring efforts during the survey program resulted in a total of 83 visual detections events of protected species totaling 164 individuals (summarized in Appendix F). This total included 38 detections of whales, four detections of dolphins, 34 detections of pinnipeds, and seven detections of ESA-listed seabirds (emperor penguins). The majority of detections (61) occurred while the source was not active.

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	30	48
Humpback whale	2	3
Fin whale	1	2
Sei whale	1	2
Unidentified whale	2	2
Unidentified baleen whale	2	2
Whales	38	59
Dusky dolphin	1	4
Hector's dolphin	1	2
Hourglass dolphin	1	3
Long-finned pilot whale	1	2
Dolphins	4	11
Crabeater seal	1	3
Leopard seal	1	1
New Zealand fur seal	7	7
Weddell seal	16	22
Unidentified pinniped	2	2
Unidentified otariid pinniped	2	2
Unidentified phocid pinniped	4	24
Unidentified seal	1	1
Pinnipeds	34	62
Emperor penguin	7	32
Total	83	164

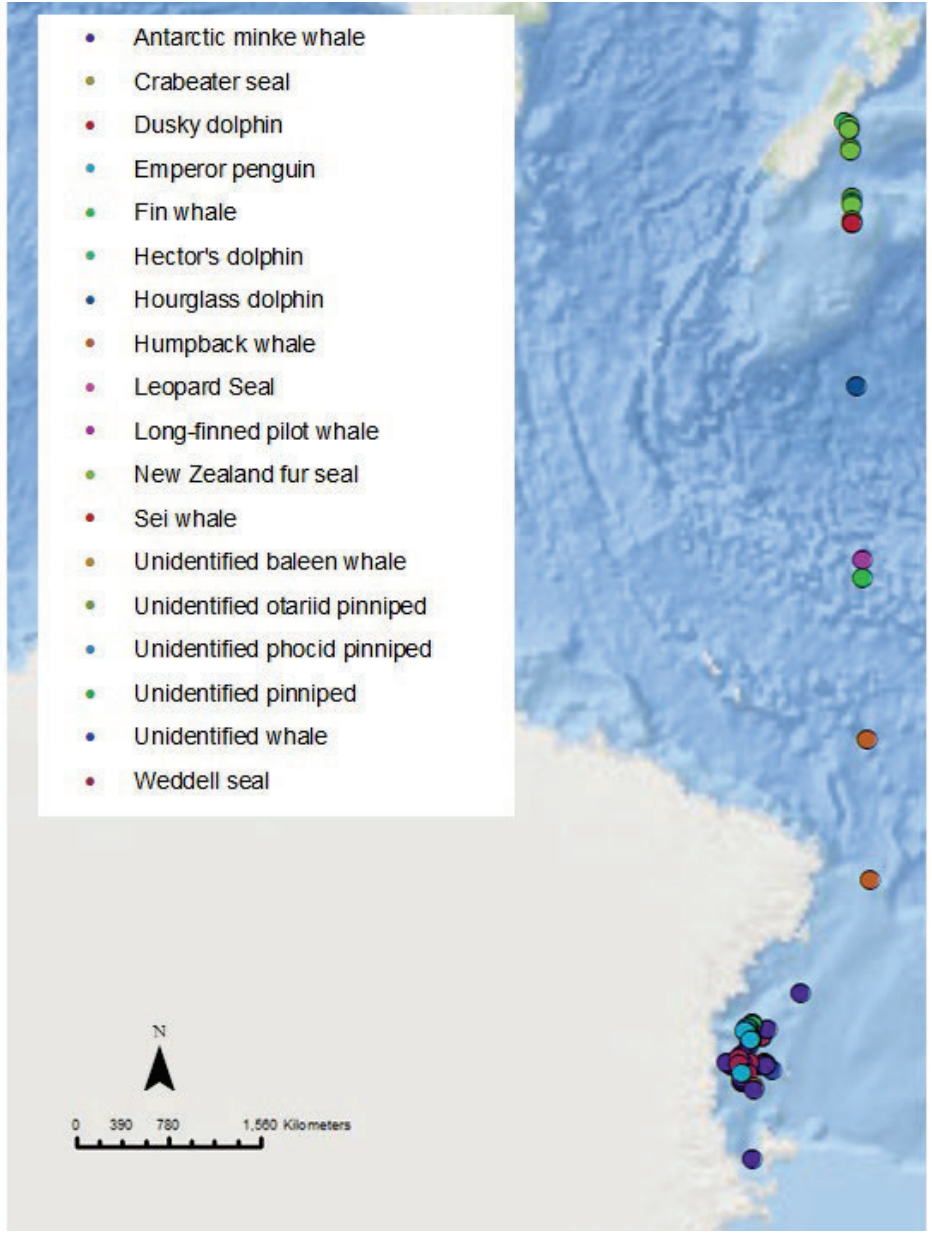


Figure 4: All protected species detections during the survey.

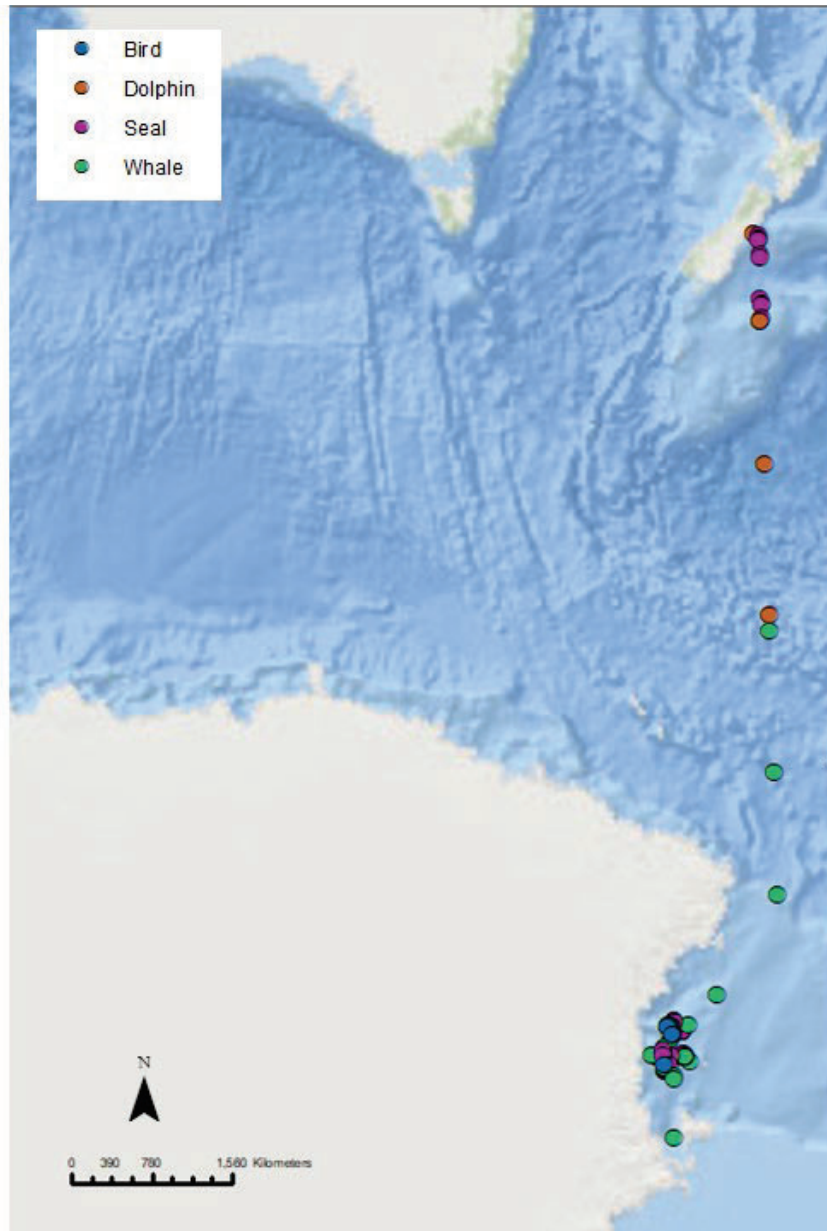


Figure 5: All protected species detections by group during the survey.

Of the 83 visual detections of protected species, 22 detections occurred while the seismic source was deployed and active, with four of those detections also occurring with the source deployed but silent after a mitigation shutdown. There were no instances of the vessel conducting icebreaking operations during the survey. 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.

While the seismic source was active, whales had an average closest approach of 669 meters and pinnipeds had an average closest approach of 105 meters. After the seismic source was silenced, whales had a closest approach of 100 meters and pinnipeds had a closest approach of 50 meters. The single emperor penguin was visually sighted while the seismic source was active remained on the ice for the duration of the detection.

Of the remaining 61 detections, 39 occurred while the vessel was in transit (25 during the transit to the survey area, eight during transits within the survey area, and four during the transit to port at the end of the survey), eight occurred while the vessel was deploying or retrieving equipment, and 14 occurred while the vessel was on standby or stopped. Detections while the vessel was in transit included 16 sightings of whales, all four sightings of dolphins, 17 sightings of pinnipeds, and two sightings of emperor penguins. Detections while the vessel was deploying/retrieving equipment included two sightings of whales, five sightings of pinnipeds, and one sighting of an emperor penguin. This sighting of an emperor penguin and three of these pinniped sightings occurred while the vessel was retrieving part of the streamer and the tail buoy, which had gotten caught in an ice floe and broken away from the vessel. Detections while the vessel was on standby or stopped/milling included five sightings of whales, six sightings of pinnipeds, and three sightings of emperor penguins. Most of these pinniped and emperor penguin detections occurred within the same period of time while the vessel was stopped/milling in a large ice flow in the Drygalski Basin during gear maintenance.

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	13	622	1*	100	-	-
Unidentified whale	1	1,020	-	-	-	-
Unidentified baleen whale	1	928	-	-	-	-
Weddell seal	5	171	3*	50	-	-
Unidentified phocid pinniped	1	699	-	-	-	-
Emperor penguin	1	1,249	-	-	-	-

*These detections began with the regulated source active but due to a mitigation shutdown also had a closest observed approach to the inactive source and are therefore counted in both number of detections.

In general, whales detected during the survey were observed surfacing and blowing while traveling at vigorous or moderate paces away from or in the opposite direction as the vessel. Additionally, there were several Antarctic minke whales observed breaching, diving, and exhibiting feeding behaviors. Dolphins sighted while the vessel in transit to the survey site were observed surfacing and porpoising mainly at moderate or vigorous paces in variable directions to the vessel. Pinnipeds sighted while the vessel was in transit to the survey site or sighted in the southern part of the survey site were mainly observed surfacing and porpoising at moderate or vigorous paces in variable directions. Pinnipeds sighted in the northern part of the survey area were mainly observed stationary or moving about sedately on the ice. Only a few were observed diving into the water and/or hauling out on the ice, and one leopard seal was observed

spy hopping in between pieces of ice. The emperor penguins sighted were all observed on the ice either stationary or moving about at a sedate or moderate pace on the ice.

5.1.1 Other Wildlife

Observations of other wildlife included 33 species of birds, the majority of which were sighted on the transit to the survey site. 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 G. No adverse impacts to any other wildlife species as a result of research activities were observed.

6 MITIGATION ACTION SUMMARY

There were four mitigation actions implemented during the survey, all consisting of shutdowns totaling 30 minutes. This included one shutdown for an Antarctic minke whale totaling 3 minutes and three shutdowns for Weddell seals totaling 27 minutes. At the time of each shutdown, the seismic source was active at a reduced volume of 105 in³ with only one element active while the vessel was acquiring data on a survey level. For all four mitigation shutdowns, the seismic source was silenced as the animals were approaching and about to enter the 100-meter EZ, and the closest observed distance to the active source was 100 meters for one of the Weddell seals. All individuals were observed exiting the exclusion zone and clearance was then given for source activity to resume. There were no highly distinctive/different behaviors observed in these individuals before or after the seismic source was silenced.

6.1 Vessel Strike Avoidance (VSA) Maneuvers

There were 18 VSA maneuvers implemented for protected species detections during the survey, including three times when the vessel reduced speed and shift the engine to neutral, one time when the vessel altered course, two times where the vessel remaining stationary, and 12 times where the vessel maintain course and speed.

The three times of the vessel reducing speed and shifting the engine to neutral VSAs were for two sightings of humpback whales and one sighting of an Antarctic minke whale that were observed within the 100-meter required separation distance while the vessel was in transit.

The one time where the vessel altered course VSA was for an Antarctic minke whale that was sighted close to the bow crossing ahead of the vessel while the vessel was towing equipment and acquiring data on a survey level. The vessel was able to alter course slightly opposite the whales' direction of travel to keep it out of the required separation distance.

The two times the vessel remained stationary was for an Antarctic minke whale and a leopard seal that approached the vessel while the vessel was stationary on DP during equipment maintenance. The vessel remained stationary on DP for the entire duration that the animals were within the required separation distance.

The 12 times that the vessel maintained course and speed VSA were implemented for three sighting of Antarctic minke whales, four sighting of Weddell seals, one for a sighting of Hector's dolphins, three for sightings of New Zealand fur seals, and one for a sighting of Dusky dolphins. All of these VSAs were implemented for animals that voluntarily approached the vessel while the vessel was either in transit or towing gear and restricted in maneuverability.

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 14,650 individual takes from 17 species, including nine species of whales, three delphinid species, and five species of pinnipeds. No Level A harassment takes (exposure to sound pressure levels where there is a potential for auditory injury based upon each species hearing range) were authorized. All takes were authorized for Level B harassment 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 683 takes for

endangered/threatened species. These total authorized takes were combined for both seismic source operations and icebreaking operations. For icebreaking, the animals were considered exposed to the sound and potentially taken with Level B harassment if they were in the water within the 6,456-meter radius, and if they were on the ice within that radius if they displayed a behavioral change; however, there were no icebreaking operations during the survey.

During acoustic source operations, 19 marine mammals, including 11 Antarctic minke whales, five Weddell seals, two unidentified whales, and one unidentified phocid pinniped, were observed within the predicted 160 decibel radius (where there is a potential for a behavioral response) while the seismic 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.

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	425	-	-	-
Blue whale	86	-	-	-
Fin whale	405	-	-	-
Sei whale	61	-	-	-
Antarctic minke whale	1118	11	-	11
Sperm whale	131	-	-	-
Southern bottlenose whale	156	-	-	-
Arnoux's beaked whale	178	-	-	-
Strap-toothed whale	59	-	-	-
Hourglass dolphin	251	-	-	-
Killer whale	276	-	-	-
Long-finned pilot whale	529	-	-	-
Crabeater seal	8990	-	-	-
Leopard seal	353	-	-	-
Weddell seal	1410	5	-	5
Ross seal	220	-	-	-
Southern elephant seal	2	-	-	-
Unidentified whale	-	2	-	2
Unidentified dolphin	-	-	-	-
Unidentified seal	-	-	-	-
Unidentified phocid pinniped	-	1	-	1

Table 18 describes the behavior of all animals, including unidentified species, which were visually observed within the predicted Level B harassment zones while the seismic source was active. There were no highly distinctive behavioral reactions observed in relation to the vessel or acoustic source during the seismic survey that were not observed in individuals of the same species sighted while the seismic source was not active.

Table 18: Behavior of species visually observed to be exposed to seismic source 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
Unidentified whale	26	1	1020	210	blowing	unknown	blowing	unknown
Unidentified Baleen whale	28	1	928	210	blowing	unknown	Blowing	unknown
Antarctic minke whale	56	1	125	210	surfacing	towards vessel	surfacing, blowing, fast travel, diving, swimming below surface, breaching / jumping / acrobatic behavior	away from vessel
Antarctic minke whale	57	1	137	105	surfacing	away from vessel	surfacing, blowing	away from vessel
Antarctic minke whale	58	1	308	105	blowing	crossing ahead of vessel	blowing, surfacing, swimming	away from vessel
Antarctic minke whale	59	1	600	105	blowing	parallel in opposite direction as vessel	blowing, surfacing	away from vessel
Antarctic minke whale	61	1	743	105	surfacing	towards vessel	surfacing, blowing, fast travel	towards vessel
Weddell seal	62	1	100	105	porpoising	towards vessel	porpoising, surfacing, fast travel	crossing astern of vessel
Weddell seal	63	1	106	105	surfacing	towards vessel	surfacing, porpoising, fast travel	parallel in same direction as vessel
Antarctic minke whale	64	1	523	105	surfacing	parallel in opposite direction as vessel	surfacing, blowing, fast travel	parallel in opposite direction as vessel

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	65	1	500	105	blowing	parallel in opposite direction as vessel	blowing, surfacing	away from vessel
Antarctic minke whale	66	1	144	105	breaching / jumping / acrobatic behavior	away from vessel	breaching / jumping / acrobatic behavior, blowing, swimming below surface, fast travel	away from vessel
Unidentified phocid pinniped	68	1	699	105	stationary	stationary	stationary, spy hopping	stationary
Antarctic minke whale	69	1	490	105	surfacing	crossing astern of vessel	surfacing, blowing	crossing astern of vessel
Antarctic minke whale	70	1	120	105	surfacing	parallel in opposite direction as vessel	surfacing, swimming below surface, blowing	away from vessel
Weddell seal	71	1	200	105	surfacing	variable	surfacing, swimming, spy hopping, diving	variable
Weddell seal	72	2	300	105	surfacing	variable	surfacing, diving, swimming	variable
Weddell seal	73	1	300	105	stationary	stationary	stationary	stationary

6.3 Implementation and Effectiveness of the Biological Opinion and IHA

To minimize the potential impacts during the seismic survey, NSF and PSOs were prepared to implement mitigation measures, including whenever protected species were detected approaching, entering, or within their designated exclusion zones as outlined in the IHA and BiOp. There were four mitigation actions implemented consisting of a shut-down of the seismic source for one Antarctic minke whale and three Weddell seals. 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 18 instances during the survey where avoidance maneuvers were required to be implemented for protected species detections: three reductions of speed and engine shifts to neutral for whales, one course alteration for a whale, two times the vessel remained stationary for a whale and a pinniped, and 12 times the vessel maintained course and speed for dolphins, pinnipeds, and 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 take 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: NMFS Biological Opinion, Incidental Harassment Authorization

Appendix B: Protected Species Observers Onboard the *NBP*

RPS PSOs Onboard the <i>NBP</i>	
Name	Initials
Amanda Dubuque	AD
Michelle Klein	MK
Edgar Alvarado	EA
Jimena Ortega	JO
Heber Huizar	HH
Leonardo de la Rosa	LD

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

Appendix D: Basic Data Summary Form

BASIC DATA FORM			
NSF Project Number	NBP2402		
Seismic Contractor	NSF		
Area Surveyed During Project	Drygalski Trough, Antarctic coast		
Survey Type	2D OBS and MCS seismic		
Vessel and/or Rig Name	<i>Nathaniel B. Palmer</i>		
Permit Number	BiOp issued on 2022/12/13, IHA issued on 2022/12/14, IEE issued on 2023/01/05, IHA renewal issued on 2023/11/15,		
Location / Distance of Source Deployment	53 meters astern		
Water Depth in survey area	150-1,100 meters		
Dates of project	03 February 2024	Through	22 February 2024
Total time source operating – all power levels:	94:54		
Time source operating on survey level:	75:24		
Time source operating not on a survey level:	09:29		
Amount of time single 40 in³ element operations:	N/A		
Amount of time in ramp-up:	01:04		
Number daytime ramp-ups:	8		
Number of nighttime ramp-ups:	0		
Number of ramp-ups from mitigation source:	0		
Amount of time conducted in source testing:	08:57		
Duration of visual observations:	421:10		
Duration of observations while source active:	94:54		
Duration of observation during source silence:	326:16		
Lead Protected Species Observer:	Amanda Dubuque, Michelle Klein (co-lead)		
Protected Species Observers:	Edgar Alvarado, Heber Huizar, Jimena Ortega, Leonardo de la Rosa		
Number of Marine Mammal Visual Detections:	76		
Total Number of Protected Species Detections:	83		
List Mitigation Actions	one shutdown for an Antarctic minke whale totaling 3 minutes; three shutdowns for Weddell seals totaling 27 minutes		
Duration of Mitigation Actions:	00:30		

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

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; **SR:** surfacing; **HO:** hauling out; **SH:** spy hopping; **ST:** stationary; **FS:** tail or pectoral fin slapping; **UN:** undetermined

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement Behavior	CPA Source/Source Activity	Mitigation Action	Comments
1	03 February 2024	20:14	Hector's dolphin	2	43.59998°S 172.80892°E	Source not deployed	TV, PE(BH)NS, SS	N/A	None	Vessel was in transit to the survey site. VSA was maintain course and speed.
2	03 February 2024	22:57	New Zealand fur seal	1	43.71930°S 173.24710°E	Source not deployed	PV/OD, AV NS	N/A	None	Vessel was in transit to the survey site. No VSA required.
3	04 February 2024	00:24	Unidentified otariid pinniped	1	43.96000°S 173.24829°E	Source not deployed	AV	N/A	None	Vessel was in transit to the survey site. No VSA required.
4	04 February 2024	00:42	New Zealand fur seal	1	44.00963°S 173.24926°E	Source not deployed	PV/SD	N/A	None	Vessel was in transit to the survey site. No VSA required.
5	04 February 2024	06:10	New Zealand fur seal	1	44.95887°S 173.28918°E	Source not deployed	PE(AH), AV NS, PO, SS, DI	N/A	None	Vessel was in transit to the survey site. VSA was maintain course and speed.
6	04 February 2024	07:26	New Zealand fur seal	1	45.16133°S 173.29567°E	Source not deployed	SA, AV BA, N, SA, DI	N/A	None	Vessel was in transit to the survey site. No VSA required.
7	04 February 2024	22:48	Unidentified otariid pinniped	1	47.56110°S 173.39640°E	Source not deployed	PV/OD, AV NS, DI	N/A	None	Vessel was in transit to the survey site. No VSA required.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/Source Activity	Mitigation Action	Comments
8	04 February 2024	23:43	Unidentified pinniped	1	47.83725°S 173.40269°E	Source not deployed	PV/OD, AV	NS, DI	N/A	None	Vessel was in transit to the survey site. No VSA required.
9	05 February 2024	00:26	New Zealand fur seal	1	47.95122°S 173.41147°E	Source not deployed	PV/OD, AV	FT, PO, DI	N/A	None	Vessel was in transit to the survey site. No VSA required.
10	05 February 2024	05:07	New Zealand fur seal	1	48.73876°S 173.41426°E	Source not deployed	PV/OD, AV	PO, FT	N/A	None	Vessel was in transit to the survey site. VSA was maintain course and speed.
11	05 February 2024	05:52	New Zealand fur seal	1	48.85860°S 173.40020°E	Source not deployed	AV	PO, FT	N/A	None	Vessel was in transit to the survey site. VSA was maintain course and speed.
12	05 February 2024	05:54	Dusky dolphin	4	48.86901°S 173.39923°E	Source not deployed	V, PV/SD	SS, BR, PO, FT	N/A	None	Vessel was in transit to the survey site. VSA was maintain course and speed.
13	07 February 2024	04:11	Hourglass dolphin	3	56.40549°S 173.71817°E	Source not deployed	PV/OD	SA, PO, FT	N/A	None	Vessel was in transit to the survey site. No VSA required.
14	08 February 2024	20:31	Long-finned pilot whale	2	63.02510°S 174.17870°E	Source not deployed	PE(AH), AV	NS, DI, SS	N/A	None	Vessel was in transit to the survey site. No VSA required.
15	09 February 2024	00:25	Fin whale	2	63.65349°S 174.21460°E	Source not deployed	PE(AH), AV	BV, FT, MI	N/A	None	Vessel was in transit to the survey site. No VSA required.
16	10 February 2024	05:13	Humpback whale	1	68.62595°S 174.56790°E	Source not deployed	AV, PV/SD, AV	BV, DI, NS	N/A	None	Vessel was in transit to the survey site. The whale was a juvenile. VSA was to reduce speed and shift the engine to neutral while the whale was within 100 meters of the vessel.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/Source Activity	Mitigation Action	Comments
17	11 February 2024	03:45	Humpback whale	2	72.18100°S, 174.79617°E	Source not deployed	AV, AV	SR, BV, NS, SS	N/A	none	Vessel was in transit to the survey site. VSA was reduced speed and shifted the engine to neutral – CPA to vessel was 70 meters.
18	11 February 2024	22:51	Antarctic minke whale	5	74.65355°S, 169.56557°E	Source not deployed	SA, AV	BV, SR, ST, FF	N/A	none	Vessel was in transit to the survey site. No VSA required.
19	12 February 2024	03:39	Antarctic minke whale	2	75.49271°S, 166.51627°E	Source not deployed	PV/SD, PV/SD	BV, DI, SS	N/A	none	Vessel was in transit to the survey site. No VSA required.
20	12 February 2024	03:39	Unidentified pinniped	1	75.49271°S, 166.51627°E	Source not deployed	SA, SA	OB	N/A	none	Vessel was in transit to the survey site moving through some brash/pancake ice and the seal was resting on a larger piece of the ice. No VSA required.
21	12 February 2024	03:48	Weddell seal	1	75.49434°S, 166.50977°E	Source not deployed	SA, SA	OB	N/A	none	Vessel was in transit to the survey site moving through some brash/pancake ice and the seal was resting on a larger piece of the ice. No VSA required.
22	12 February 2024	04:42	Antarctic minke whale	2	75.35183°S, 167.03550°E	Source not deployed	PE(AH), PV/OD	BV, SR, DI	N/A	none	Vessel was in transit to the survey site. VSA was to reduce speed and shift the engine to neutral. CPA to vessel was 70 meters.
23	12 February 2024	08:13	Antarctic minke whale	2	75.79567°S, 165.36417°E	Source not deployed	PV/OD, AV	SR, BV	N/A	none	Vessel was in transit to the survey site. No VSA required.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/Source Activity	Mitigation Action	Comments
24	12 February 2024	09:15	Antarctic minke whale	1	75.92300°S, 164.88733°E	Source not deployed	PE(AH), AV	BV, SR, NS	N/A	none	Vessel was in transit to the survey site. No VSA required.
25	12 February 2024	10:11	Sei whale	2	76.04767°S, 164.40267°E	Source not deployed	MI, MI	BV, SR	N/A	none	Vessel was in transit to the survey site. No VSA required.
26	13 February 2024	01:32	Unidentified whale	1	76.04333°S, 165.95600°E	Full volume	UN, UN	BV	1020 meters / active	none	Source was active at full volume at start of detection and disabled one minute later for maintenance. Whale only sighted once by the second mate and not by the PSOs. Whale was a potential level B take (exposure). No VSA required.
27	13 February 2024	04:51	Antarctic minke whale	2	76.03200°S, 165.99767°E	Source not deployed	UN, AV	BV, SR, MI	N/A	none	Source was onboard for maintenance. No VSA required.
28	13 February 2024	07:52	Unidentified baleen whale	1	76.04783°S, 166.07217°E	Full volume	UN, UN	BV	928 meters / active	none	Source was active at full volume throughout the detection. Whale was a potential level B take (exposure). No VSA required.
29	13 February 2024	09:00	Antarctic minke whale	1	76.04817°S, 165.72067°E	Full volume	MI, AV	BV, MI	1301 meters / active	none	Source was active at full volume throughout the detection. Whale did not enter the level B harassment zone. No VSA required.
30	14 February 2024	03:32	Antarctic minke whale	1	75.65583°S, 165.60333°E	Source not deployed	AV, AV	BV, SR, NS	N/A	none	The vessel was in transit within the survey area. No VSA required.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/Source Activity	Mitigation Action	Comments
31	14 February 2024	04:20	Unidentified seal	1	75.51583°S, 165.68744°E	Source not deployed	SA, SA	ST	N/A	none	Vessel was in transit within the survey area moving through some brash/pancake ice and the seal was resting on a larger piece of the ice. No VSA required.
32	14 February 2024	05:46	Weddell seal	6	75.34350°S, 165.42817°E	Source not deployed	SA, SA	ST, DI	N/A	none	Vessel completed transit within the survey area and stopped within a large patch of ice a few minutes into the detection. The seals were all sighted resting on pieces of ice around the vessel. No VSA required.
EP1	14 February 2024	05:51	Emperor penguin	21	75.34033°S, 165.43067°E	Source not deployed	SA, SA	ST, MI	N/A	none	Vessel was stopped/milling within a large patch of ice. The penguins were all sighted on nearby patches/pieces of ice. No VSA required.
33	14 February 2024	05:51	Unidentified seal	20	75.34350°S, 165.42817°E	Source not deployed	SA, SA	ST	N/A	none	Vessel was stopped/milling within a large patch of ice. The seals were all sighted resting on pieces of ice around the vessel. No VSA required.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/Source Activity	Mitigation Action	Comments
34	14 February 2024	05:57	Crabeater seal	3	75.33883°S, 165.42150°E	Source not deployed	SA, SA	ST	N/A	none	Vessel was stopped/milling within a large patch of ice. The seals were all sighted resting on pieces of ice around the vessel. No VSA required.
35	14 February 2024	08:36	Leopard seal	1	75.34350°S, 165.42817°E	Source not deployed	V, V	SR, DI, SS	N/A	none	Vessel was stopped/milling within a large patch of ice. The seal was sighted surfacing a few times between pieces of ice. VSA was for the vessel to remain stationary. CPA to vessel was 20 meters.
36	14 February 2024	13:02	Antarctic minke whale	4	75.33533°S, 165.35167°E	Source not deployed	PV/OD, V	BV, SR, FF	N/A	none	Vessel was in transit within the survey area. No VSA required.
37	14 February 2024	14:00	Antarctic minke whale	1	75.25167°S, 165.84900°E	Source not deployed	PV/OD, PV/OD	BV, SR	N/A	none	Vessel was on standby awaiting gear deployment within the survey area. No VSA required.
38	14 February 2024	16:09	Unidentified seal	2	75.27533°S, 165.79350°E	Source not deployed	SA, SA	BA	N/A	none	Vessel was deploying towed equipment in the survey area. No VSA required.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/Source Activity	Mitigation Action	Comments
39	15 February 2024	01:51	Weddell seal	1	75.38617°S, 165.68867°E	Source not deployed	SA, AV	ST, DI, HO, DI	N/A	none	Vessel was retrieving the tail buoy and part of the streamer which had broken away from the vessel. The seal was resting on a piece of ice near the gear and dove into the water as the vessel approached. No VSA required.
40	15 February 2024	04:50	Weddell seal	1	75.33667°S, 165.50467°E	Source not deployed	SA, SA	ST	N/A	none	Vessel was retrieving gear that had broken away from the vessel and the seal was resting on a nearby piece of ice. No VSA required.
41	15 February 2024	04:50	Weddell seal	1	75.33667°S, 165.50467°E	Source not deployed	SA, SA	ST	N/A	none	Vessel was retrieving gear that had broken away from the vessel and the seal was resting on a nearby piece of ice. Detection concluded due to loss of visibility from heavy snow. No VSA required.
EP2	15 February 2024	04:53	Emperor penguin	1	75.33683°S, 165.50033°E	Source not deployed	SA, SA	ST	N/A	none	Vessel was retrieving gear that had broken away from the vessel and the penguin was sighted on a nearby piece of ice. No VSA required.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/Source Activity	Mitigation Action	Comments
42	15 February 2024	15:39	Antarctic minke whale	3	75.38033°S, 165.32383°E	Source not deployed	PV/OD, PE(BH)	BV, FF, MI, SS	N/A	none	Vessel on standby on DP in the survey area during gear maintenance. No VSA required.
EP3	16 February 2024	05:52	Emperor penguin	1	75.38317°S, 165.32933°E	Source not deployed	SA, SA	ST	N/A	none	Vessel was on standby in the survey area and stopped on DP during gear maintenance. Penguin was sighted on an iceberg that floated by the vessel. No VSA required.
43	16 February 2024	06:19	Antarctic minke whale	1	75.38250°S, 165.33300°E	Source not deployed	V, PV/OD	BV, SA, DI, SH, SS	N/A	none	Vessel on standby on DP in the survey area during gear maintenance. VSA was for the vessel to remain stationary. CPA to vessel was five meters.
EP4	16 February 2024	08:48	Emperor penguin	3	75.38033°S, 165.33617°E	Source not deployed	SA, SA	ST	N/A	none	Vessel was on standby in the survey area and stopped on DP during gear maintenance. Penguin was sighted on an ice floe near the vessel. No VSA required.
EP5	16 February 2024	10:35	Emperor penguin	4	75.38233°S, 165.32283°E	Source not deployed	SA, SA	ST	N/A	none	Vessel was on standby in the survey area and stopped on DP during gear maintenance. Penguin was sighted on an ice floe near the vessel. No VSA required.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/Source Activity	Mitigation Action	Comments
44	16 February 2024	12:13	Weddell seal	1	75.54067°S, 165.72683°E	Source not deployed	SA, SA	ST	N/A	none	Vessel was in transit back to the first OBS line moving through some brash/pancake ice and the seal was resting on a larger piece of the ice. No VSA required.
EP6	16 February 2024	12:26	Emperor penguin	1	75.56250°S, 165.74250°E	Source not deployed	SA, SA	ST	N/A	none	Vessel was in transit back to the first OBS line moving through some brash/pancake ice and the penguin was on a larger piece of the ice. No VSA required.
45	16 February 2024	12:31	Weddell seal	1	75.56050°S, 165.73800°E	Source not deployed	SA, SA	ST	N/A	none	Vessel was in transit back to the first OBS line moving through some brash/pancake ice and the seal was resting on a larger piece of the ice. No VSA required.
46	16 February 2024	12:40	Weddell seal	1	75.57100°S, 165.76167°E	Source not deployed	SA, UN	ST	N/A	none	Vessel was in transit back to the first OBS line moving through some brash/pancake ice and the seal was resting on a larger piece of the ice. No VSA required.
47	16 February 2024	14:45	Antarctic minke whale	1	75.84500°S, 165.05617°E	Source not deployed	PV/OD, AV	BV, SR, SS	N/A	none	Vessel was in transit back to the first OBS line. No VSA required.
48	16 February 2024	16:00	Antarctic minke whale	1	76.00067°S, 164.47967°E	Source not deployed	PE(AH), PE(AH)	BV, SR	N/A	none	Vessel was in transit back to the first OBS line. No VSA required.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/Source Activity	Mitigation Action	Comments
49	17 February 2024	02:07	Antarctic minke whale	1	76.04300°S, 165.99567°E	Source not deployed	AV, AV	BV, SR	N/A	none	Vessel was stationary on DP in the survey site awaiting an OBS to surface. No VSA required.
50	17 February 2024	14:34	Weddell seal	1	76.04400°S, 166.62600°E	Source not deployed	PV/SD, PV/SD	SR, SS	N/A	none	Vessel was deploying the streamer in the survey area. No VSA required.
51	17 February 2024	15:37	Antarctic minke whale	1	76.04500°S, 166.76500°E	Source not deployed	PV/OD, AV	BV, SR, SS	N/A	none	Vessel was deploying towed survey equipment in the survey area – streamer deployed but seismic source still on deck. No VSA required.
52	17 February 2024	19:36	Unidentified whale	1	76.12750°S, 167.30433°E	Source not deployed	PV/OD, PV/OD	BV	N/A	none	Vessel was on standby for source maintenance with the streamer deployed. No VSA required.
53	18 February 2024	09:23	Weddell seal	1	75.97367°S, 166.70717°E	Source not deployed	TV, TV	SR, PO, DI	N/A	none	Vessel on standby for equipment maintenance. Streamer deployed but seismic source onboard. No VSA required
54	18 February 2024	11:00	Unidentified seal	1	76.00950°S, 166.88700°E	Source not deployed	PV/SD, PV/SD	SR, DI,	N/A	none	Vessel on standby for equipment maintenance. Streamer deployed but seismic source onboard. No VSA required

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/Source Activity	Mitigation Action	Comments
55	18 February 2024	15:36	Weddell seal	1	76.01883°S, 166.77183°E	Source not deployed	PV/OD, PV/OD	SR, NS	N/A	none	Vessel on standby for equipment maintenance. Streamer deployed but seismic source onboard. VSA was to maintain course and speed due to vessel restricted maneuverability while towing gear and voluntary approach of the seal to the vessel. CPA to vessel was 30 meters.
56	18 February 2024	20:10	Antarctic minke whale	1	76.04617°S, 166.87433°E	Full volume	TV, AV	SR, BV, FT, DI, SS, SA	125 meters / active	none	Vessel was acquiring data with the seismic source active at full volume. Whale was a potential level B exposure/take. VSA was to maintain course and speed due to vessel restricted maneuverability while towing gear. CPA to vessel was 10 meters.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/Source Activity	Mitigation Action	Comments
57	19 February 2024	00:30	Antarctic minke whale	1	76.04800°S, 165.57217°E	Reduced volume	AV, AV	SR, BV	137 meters / active and 100 meters / silent	shutdown of source	Vessel was acquiring data with the seismic source active at reduced volume. Whale was a potential level B exposure/take. VSA was to maintain course and speed due to vessel restricted maneuverability while towing gear. CPA to vessel was 50 meters. Mitigation shutdown totaled 3 minutes.
58	19 February 2024	03:16	Antarctic minke whale	1	76.04817°S, 164.56917°E	Reduced volume	PE(AH), AV/BV, SR, NS		308 meters / active	none	Vessel was acquiring data with the source active at reduced volume. Whale was a potential level B exposure/take. VSA was to alter course slightly to port side, opposite to the whale's travel direction ahead of the vessel, due to vessel restricted maneuverability while towing gear. CPA to vessel was 200 meters.
59	19 February 2024	03:46	Antarctic minke whale	1	76.04800°S, 164.36783°E	Reduced volume	PV/OD, AV BV, SR		600 meters / active	none	Vessel was acquiring data with the seismic source active at reduced volume. Whale was a potential level B exposure/take. No VSA required, or potential take/exposure.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/Source Activity	Mitigation Action	Comments
60	19 February 2024	04:05	Antarctic minke whale	4	76.04817°S, 164.27767°E	Reduced volume	PV/OD, PV/OD	BV, NS, SR	2,003 meters / active	none	Vessel was acquiring data with the seismic source active at reduced volume. No VSA required, or potential take/exposure.
61	19 February 2024	06:43	Antarctic minke whale	1	75.99317°S, 164.21100°E	Reduced volume	TV, TV	SR, BV, FT	743 meters / active	none	Vessel was acquiring data with the seismic source active at reduced volume. Whale was a potential level B take/exposure. No VSA required.
62	19 February 2024	09:40	Weddell seal	1	75.99317°S, 165.25933°E	Reduced volume	TV, PE(BH)	PO, SR, FT	100 meters / active and 10 meters / silent	shutdown of source	Vessel was acquiring data with the seismic source active at reduced volume. Seal was a potential level B exposure/take. VSA was to maintain course and speed due to vessel restricted maneuverability while towing gear and voluntary approach of the seal. CPA to vessel was 25 meters. Mitigation shutdown totaled 8 minutes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/Source Activity	Mitigation Action	Comments
63	19 February 2024	10:37	Weddell seal	1	75.99300°S, 165.59467°E	Reduced volume	TV, PV/SD	SR, PO, FT	106 meters / active and 90 meters / silent	shutdown of source	Vessel was acquiring data with the seismic source active at reduced volume. Seal was a potential level B exposure/take. VSA was to maintain course and speed due to vessel restricted maneuverability while towing gear and voluntary approach of the seal. CPA to vessel was 50 meters. Mitigation shutdown totaled 13 minutes.
64	20 February 2024	15:50	Antarctic minke whale	1	75.98633°S, 163.86650°E	Reduced volume	PV/OD, PV/OD	SR, BV, FT	523 meters / active	none	Vessel was acquiring data with the seismic source active at reduced volume. Whale was a potential level B exposure/take. No VSA required.
65	20 February 2024	16:50	Antarctic minke whale	1	76.13783°S, 165.12950°E	Reduced volume	PV/OD, AV	BV, SR	500 meters / active	none	Vessel was acquiring data with the seismic source active at reduced volume. Whale was a potential level B exposure/take. No VSA required.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/Source Activity	Mitigation Action	Comments
66	21 February 2024	09:02	Antarctic minke whale	1	76.34533°S, 165.05417°E	Reduced volume	AV, AV	SA, BV, SS, FT	144 meters / active	none	Vessel was acquiring data with the seismic source active at reduced volume. Whale was a potential level B exposure/take. VSA was to maintain course and speed due to vessel restricted maneuverability while towing gear. CPA to vessel was 30 meters.
67	21 February 2024	09:35	Antarctic minke whale	1	76.29967°S, 165.04483°E	Reduced volume	PV/OD, AV	BV, SR, SS	1,096 meters / active	none	Vessel was acquiring data with the seismic source active at reduced volume. Whale was a potential level B exposure/take. No VSA required.
68	21 February 2024	09:54	Unidentified phocid pinniped	1	76.26950°S, 165.04450°E	Reduced volume	SA, SA	ST, SH	699 meters / active	none	Vessel was acquiring data with the seismic source active at reduced volume. Seal was a potential level B exposure/take. No VSA required.
69	21 February 2024	09:57	Antarctic minke whale	1	76.26950°S, 165.04450°E	Reduced volume	PE(BH), PE(BH)	SR, BV	490 meters / active	none	Vessel was acquiring data with the seismic source active at reduced volume. Whale was a potential level B exposure/take. No VSA required.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/Source Activity	Mitigation Action	Comments
70	21 February 2024	13:16	Antarctic minke whale	1	75.98817°S, 165.04517°E	Reduced volume	PV/OD, AV	SR, SS, BV	120 meters / active	none	Vessel was acquiring data with the seismic source active at reduced volume. Whale was a potential level B exposure/take. No VSA required.
71	21 February 2024	20:14	Weddell seal	1	75.90650°S, 164.83100°E	Reduced volume	V, V	SR, NS, SH, DI	200 meters / active	none	Vessel was acquiring data with the seismic source active at reduced volume. Seal was a potential level B exposure/take. No VSA required.
72	21 February 2024	21:22	Weddell seal	2	76.00250°S, 164.83050°E	Reduced volume	V, V	SR, DI, NS	300 meters / active and 50 meters / silent	shutdown of source	Vessel was acquiring data with the seismic source active at reduced volume. Both seals were potential level B exposures/takes. VSA was to maintain course and speed due to vessel restricted maneuverability while towing gear and voluntary approach of the seal. CPA to vessel was 30 meters. Mitigation shutdown totaled 6 minutes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement	Behavior	CPA Source/Source Activity	Mitigation Action	Comments
EP7	22 February 2024	07:57	Emperor penguin	1	76.18633°S, 065.02900°E	Reduced volume	SA, SA	ST	1,249 meters / active	none	Vessel was acquiring data with the seismic source active at reduced volume. Penguin remained on the ice the entire detection. No VSA required.
73	22 February 2024	09:12	Weddell seal	1	76.18617°S, 165.47800°E	Reduced volume	SA, SA	ST	300 meters / active	none	Vessel was acquiring data with the seismic source active at reduced volume. Seal was not a potential level B exposure/take. No VSA required.
74	22 February 2024	12:47	Unidentified baleen whale	1	76.42150°S, 165.91150°E	Source not deployed	UN, PV/OD	BV, SR, SS	N/A	none	Vessel was in transit to port after the end of the survey will all equipment onboard. No VSA required.
75	22 February 2024	13:06	Antarctic minke whale	3	76.48033°S, 165.90750°E	Source not deployed	MI, MI	SR, FF, MI, BV, SS,	N/A	none	Vessel was in transit to port after the end of the survey will all equipment onboard. No VSA required.
76	22 February 2024	19:36	Antarctic minke whale	1	77.64780°S, 165.86210°E	Source not deployed	PV/OD, PV/OD	SR, BV	N/A	none	Vessel was in transit to port after the end of the survey will all equipment onboard. No VSA required.

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



Figure 1: Hector's dolphin, 3 February 2024 (VD#1).

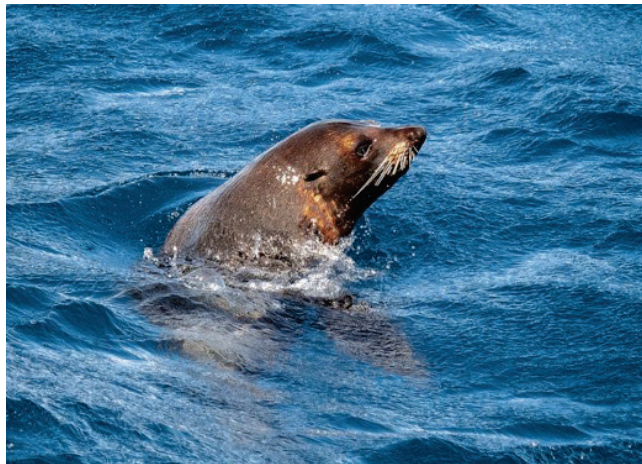


Figure 2: New Zealand fur seal, 4 February 2024 (VD#2).



Figure 3: Unidentified otariid pinniped, 4 February 2024 (VD#3).



Figure 4: New Zealand fur seal, 4 February 2024 (VD#4).



Figure 5: New Zealand fur seal, 4 February 2024 (VD#4).



Figure 6: New Zealand fur seal, 4 February 2024 (VD#6).



Figure 7: New Zealand fur seal, 5 February 2024 (VD#9).



Figure 8: New Zealand fur seal, 5 February 2024 (VD#10).

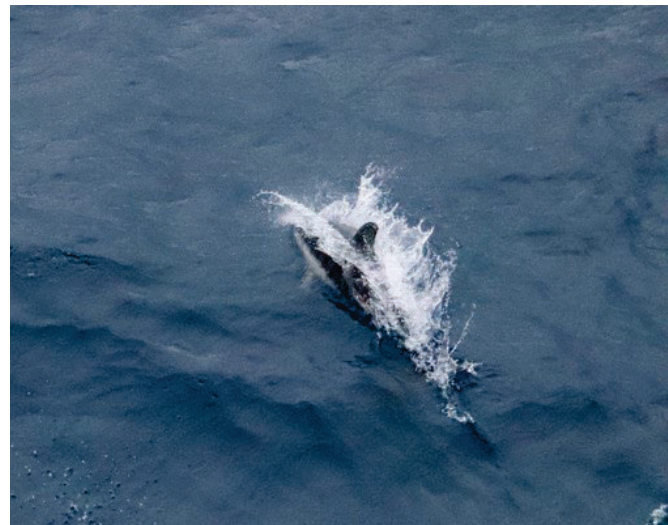


Figure 9: Dusky dolphin, 5 February 2024 (VD#12).



Figure 10: Hourglass dolphin, 7 February 2024 (VD#13).



Figure 11: Fin whale, 9 February 2024 (VD#15).



Figure 12: Humpback whale, 10 February 2024 (VD#16).



Figure 13: Humpback whale, 11 February 2024 (VD#17).



Figure 14: Antarctic minke whale, 11 February 2024 (VD#18).



Figure 15: Antarctic minke whale, 12 February 2024 (VD#19).



Figure 16: Unidentified pinniped, 12 February 2024 (VD#20).



Figure 17: Weddell seal, 12 February 2024 (VD#21).

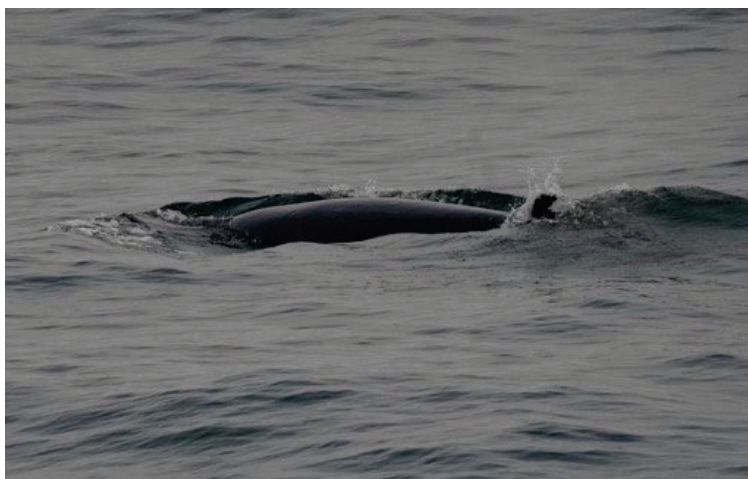


Figure 18: Antarctic minke whale, 12 February 2024 (VD#23).



Figure 19: Antarctic minke whale, 12 February 2024 (VD#24).

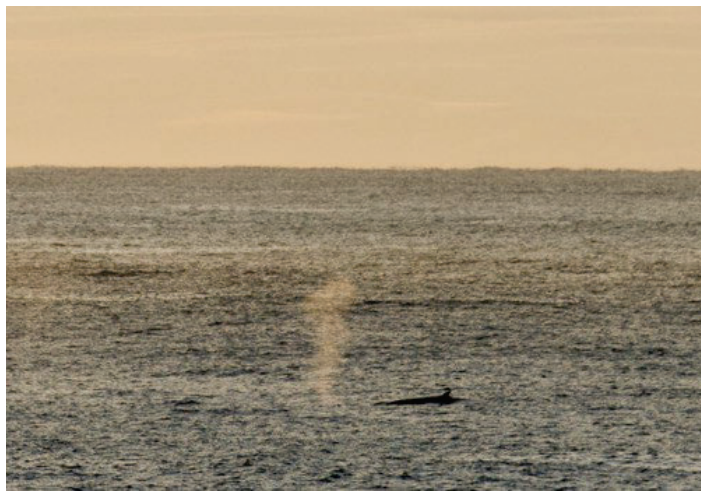


Figure 20: Sei whale, 13 February 2024 (VD#25).



Figure 21: Antarctic minke whale, 13 February 2024 (VD#27).



Figure 22: Unidentified seal, 14 February 2024 (VD#31).



Figure 23: Weddell seal, 14 February 2024 (VD#32).



Figure 24: Unidentified seal, 14 February 2024 (VD#33).



Figure 25: Crabeater seal, 14 February 2024 (VD#34).



Figure 26: Leopard seal, 14 February 2024 (VD#35).



Figure 27: Antarctic minke whale, 14 February 2024 (VD#36).



Figure 28: Antarctic minke whale, 14 February 2024 (VD#37).



Figure 29: Unidentified seal, 14 February 2024 (VD#38).



Figure 30: Weddell seal, 15 February 2024 (VD#39).



Figure 31: Weddell seal, 15 February 2024 (VD#40).



Figure 32: Weddell seal, 15 February 2024 (VD#41).



Figure 33: Antarctic minke whale, 15 February 2024 (VD#42).



Figure 34: Antarctic minke whale, 16 February 2024 (VD#43).



Figure 35: Weddell seal, 16 February 2024 (VD#44).



Figure 36: Weddell seal, 16 February 2024 (VD#46).



Figure 37: Antarctic minke whale, 16 February 2024 (VD#47).



Figure 38: Antarctic minke whale, 17 February 2024 (VD#51).



Figure 39: Weddell seal, 18 February 2024 (VD#53).



Figure 40: Weddell seal, 18 February 2024 (VD#55).



Figure 41: Antarctic minke whale, 18 February 2024 (VD#56).



Figure 42: Antarctic minke whale, 19 February 2024 (VD#57).



Figure 43: Antarctic minke whale, 19 February 2024 (VD#58).



Figure 44: Antarctic minke whale, 19 February 2024 (VD#59).



Figure 45: Antarctic minke whale, 19 February 2024 (VD#60).



Figure 46: Weddell seal, 19 February 2024 (VD#62).



Figure 47: Weddell seal, 19 February 2024 (VD#63).



Figure 48: Antarctic minke whale, 20 February 2024 (VD#64).



Figure 49: Antarctic minke whale, 20 February 2024 (VD#65).



Figure 50: Antarctic minke whale, 21 February 2024 (VD#66).

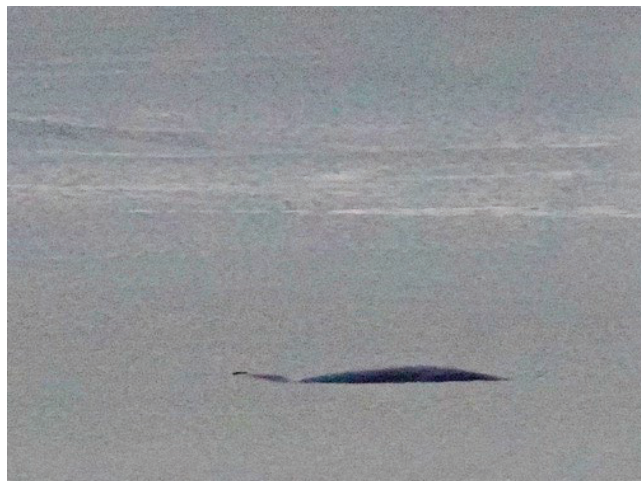


Figure 51: Antarctic minke whale, 21 February 2024 (VD#67).



Figure 52: Unidentified phocid pinniped, 21 February 2024 (VD#68).



Figure 53: Antarctic minke whale, 21 February 2024 (VD#69).



Figure 54: Antarctic minke whale, 21 February 2024 (VD#70).



Figure 55: Weddell seal, 21 February 2024 (VD#71).



Figure 56: Weddell seal, 21 February 2024 (VD#72).



Figure 57: Weddell seal, 22 February 2024 (VD#73).



Figure 58: Antarctic minke whale, 22 February 2024 (VD#75).



Figure 59: Emperor penguin, 14 February 2024 (SBVD#1).



Figure 60: Emperor penguin, 15 February 2024 (SBVD#2).



Figure 61: Emperor penguin, 16 February 2024 (SBVD#3).



Figure 62: Emperor penguin, 16 February 2024 (SBVD#4).



Figure 63: Emperor penguin, 16 February 2024 (SBVD#5).



Figure 64: Emperor penguin, 16 February 2024 (SBVD#6).



Figure 65: Emperor penguin, 22 February 2024 (SBVD#7).

Appendix G: 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>	10	109
Antarctic Petrel	<i>Thalassoica antarctica</i>	4	72
Antarctic Prion	<i>Pachyptila desolata</i>	4	14
Antarctic Southern Fulmar	<i>Fulmarus glacialoides</i>	1	1
Antipodean Albatross	<i>Diomedea antipodensis</i>	2	2
Black-bellied Storm Petrel	<i>Fregetta tropica</i>	4	9
Black-winged Petrel	<i>Pterodroma nigripennis</i>	1	2
Buller's Albatross	<i>Thalassarche bulleri</i>	1	1
Buller's Shearwater	<i>Puffinus bulleri</i>	1	4
Campbell Albatross	<i>Thalassarche impavida</i>	5	7
Cape/Pintado Petrel	<i>Daption capense</i>	6	26
Gray-backed Storm Petrel	<i>Garrodia nereis</i>	1	1
Hutton's Shearwater	<i>Puffinus huttoni</i>	1	1
Kelp Gull	<i>Larus dominicanus</i>	2	4
Light-mantled Sooty Albatross	<i>Phoebastria palpebrata</i>	5	13
Northern Giant Petrel	<i>Macronectes halli</i>	2	2
Pied Cormorant	<i>Phalacrocorax varius</i>	1	2
Rock Pigeon	<i>Columba livia</i>	1	2
Salvin's Albatross	<i>Thalassarche salvini</i>	4	12
Slender-billed Prion	<i>Pachyptila belcheri</i>	1	1
Snow Petrel	<i>Pagodroma nivea</i>	13	108
Snowy (Wandering) Albatross	<i>Diomedea exulans</i>	3	4
Sooty Shearwater	<i>Ardenna grisea</i>	4	30
South Polar Skua	<i>Catharacta maccormicki</i>	10	42
Southern Giant-Petrel	<i>Macronectes giganteus</i>	1	2
Southern Royal Albatross	<i>Diomedea epomorpha</i>	5	11
White-bellied Storm Petrel	<i>Fregetta grallaria</i>	1	3
White-Capped (Auckland Shy) Albatross	<i>Thalassarche cauta steadyi</i>	5	12
White-chinned Petrel	<i>Procellaria aequinoctialis</i>	4	27
White-faced Storm-petrel	<i>Pelagodroma marina</i>	1	3
White-fronted Tern	<i>Sterna striata</i>	1	2
White-headed Petrel	<i>Pterodroma lessonii</i>	5	8
Wilson's Storm-Petrel	<i>Oceanites oceanicus</i>	4	5