



Protected Species Mitigation and Monitoring Report

Marine Geophysical (Seismic) Surveys
Southwest Pacific Ocean – New Zealand

North Island 2D Survey
01 November 2017 – 06 December 2017

North Island 3D Survey
06 January 2018 – 08 February 2018

South Island 2D Survey
18 February 2018 – 19 March 2018

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1. EXECUTIVE SUMMARY

The U.S. National Science Foundation (NSF) owned research vessel (R/V) *Marcus G. Langseth (Langseth)*, operating under an existing cooperative agreement by Columbia University's Lamont-Doherty Earth Observatory (L-DEO), conducted three marine geophysical (seismic) surveys in the Southwest Pacific Ocean off the coast of New Zealand. The operational activities were conducted for research surveys proposed by Principal Investigators (PIs) Drs. N. Bangs, K. McIntosh, H. Van Avendonk, L. Wallace, C. Proctor and S. Gulick of University of Texas; Dr. G. Moore of University of Hawaii at Manoa; Dr. H. Tobin of University of Wisconsin Madison; Dr. J. Marshall of California State Polytechnic University Pomona; Dr. D. Okaya of University of Southern California; Dr. J. Pilarczyk of University of Southern Mississippi; Dr. D. Saffer of Pennsylvania State University; and Drs. M. Gurnis and J. Stock of California Institute of Technology; with funding from NSF. Additional research support for ancillary activities was provided by international collaborators from GNS Science, Japan Agency for Marine-Earth Science and Technology, University of Tokyo, Imperial College London and Victoria University New Zealand.

The three surveys included a 2-D survey off the east coast of the North Island conducted from 01 November 2017 to 06 December 2017, a 3-D survey off the east coast of the North Island conducted from 06 January 2018 to 08 February 2018, and a 2-D survey off the south coast of the South Island conducted from 18 February 2018 to 19 March 2018.

The primary purpose of the surveys was to collect seismic reflection and refraction data to better understand subduction zones, slip behavior, and what controls the development of slow-slip faults instead of earthquake prone faults. The data collected will provide important information for anticipating future earthquake activity and tsunamis off the coast of New Zealand and elsewhere. The primary purpose of the of the North Island 2-D survey was to collect seismic data to create images of the plate boundary fault zone in multiple locations from north to south, and also to show other faults and folding of the upper (New Zealand) plate and the underlying, westward-moving Pacific plate. The primary purpose of the North Island 3-D survey was to investigate the megathrust fault slip in the subduction zone, map subduction zone fault systems, and measure physical conditions along the subduction zone thrust fault. The primary purpose of the South Island 2-D survey was to test models for the formation of new subduction zones and to measure several fundamental aspects of the poorly understood process.

This report serves to comply with the reporting obligations for the survey required pursuant to the Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA). On 17 May 2017, L-DEO submitted an application to the National Marine Fisheries Service (NMFS) for an Incidental Harassment Authorization (IHA) that would allow for the potential harassment of small numbers of marine mammals incidental to the seismic surveys. On 27 October 2017, NMFS issued an IHA, and Incidental Take Statement (ITS), Biological Opinion (BO), an Environmental Assessment (EA), and a Finding of No Significant Impact (FONSI) for the project. In addition, the U.S. Fish and Wildlife Service (USFWS) issued a Letter of concurrence (LOC) on 25 October 2017 that the proposed seismic survey "may affect" but was not likely to "adversely affect" the endangered Chatham petrel (*Pterodroma axillaris*), magenta petrel (*Pterodroma magenta*), New Zealand shore plover (*Thinornis novaeseelandiae*), black stilt (*Himantopus novaeseelandiae*), and the threatened yellow-eyed penguin (*Megadyptes antipodes*), white-flipped penguin (*Eudyptula minor albosignata*), Fiordland crested penguin (*Eudyptes pachyrhynchus*), erect-crested penguin (*Eudyptes sclateri*), and the southern rockhopper penguin (*Eudyptes chrysocome*). Mitigation measures were implemented to minimize potential impacts to marine mammals and endangered or threatened sea turtles and sea birds during the survey program. These measures included, but were not limited to, the use of NMFS approved Protected Species Observers (PSOs) for both visual and acoustic monitoring, the establishment of a 1000 meter buffer zone from any source element (where the PAM and source operators would be alerted to the presence of the animal(s)), a 500 meter exclusion zone from any source element (where the source would be powered down), a 100 meter exclusion zone from a single operating source element (where the source would be shut down), and the implementation of ramp-up procedures.

Continuous protected species observation coverage during the survey was provided by RPS, the environmental consulting company contracted by L-DEO for the project. Pursuant to the contract, PSOs monitored and reported on the presence and behavior of protected species, and directed the implementation of the mitigation measures as described in the NSF Environmental Analysis (EA) and FONSI (prepared pursuant to Executive Order 12114, Environmental Effects Abroad of Major Federal Actions (E.O. 12114)), and the IHA and ITS issued by NMFS. Additionally, PSO activities were consistent with the PSO standards identified in the Programmatic Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) for Marine Seismic Research funded by the NSF or Conducted by the U.S. Geological Survey and Record of Decision (referred to herein as the PEIS), to which the NSF EA tiered. Five PSOs, of which one was designated as the Lead PSO and one of which was designated as the Lead Passive Acoustic Monitoring (PAM) operator, were present on board the R/V *Langseth* throughout each of the three surveys of the program. Although not required, three PSOs were also on board and conducted visual monitoring during the transit between the North and South Island from 11 to 14 February 2018.

Over the course of the entire survey program, PSOs conducted visual observations for a total of 1,476 hours 39 minutes and acoustic monitoring for a total of 1,641 hours six minutes. Visual and acoustic monitoring was conducted simultaneously for a total of 1,047 hours 50 minutes.

The acoustic source was active for a total of 1,601 hours 23 minutes throughout the entire survey program, which occurred during 69% (1,018 hours 10 minutes) of the total visual monitoring and during 97% (1,596 hours nine minutes) of the total acoustic monitoring.

There were a total of 164 protected species detections during the New Zealand survey program. This total included 135 visual detections and 40 acoustic detections. Eleven of the visual and acoustic detections occurred concurrently, and were therefore only counted as one detection towards the overall project total.

Visual detections included: 16 detections of whales, 50 detections of dolphins, 68 detections of pinnipeds, and one detection of sea turtles. Visual detections of positively identified whales included: one detection of a blue whale (*Balaenoptera musculus*), three detections of Bryde's whales (*Balaenoptera edeni*), one detection of a common "dwarf" minke whale (*Balaenoptera acutorostrata* sp.), one detection of a humpback whale (*Megaptera novaeangliae*), and two detections of sperm whales (*Physeter macrocephalus*). There were also four detections of unidentified whales and four detections of unidentified baleen whales. Visual detections of positively identified dolphins included: seven detections of long-finned pilot whales (*Globicephala melas*), 30 detections of short-beaked common dolphins (*Delphinus delphis*), and three detections of a mixed pod of long-finned pilot whales and bottlenose dolphins (*Tursiops truncatus*). There were also 10 detections of unidentified dolphins. Visual detections of positively identified pinnipeds included: 47 detections of New Zealand fur seals (*Arctocephalus forsteri*) and six detections of New Zealand sea lions (*Phocarctos hookeri*). There were also 14 detections of unidentified otariid pinnipeds and one detection of an unidentified pinniped. Visual detections of positively identified sea turtles included: one detection of a leatherback sea turtle (*Dermochelys coriacea*).

Acoustic detections included 40 detections of dolphins. Acoustic detections of positively identified dolphins included: one detection long-finned pilot whales and 10 detections of short-beaked common dolphins. All 11 acoustic detections of positively identified dolphins were concurrent with visual sightings of the dolphins. There were also 29 acoustic only detections of unidentified dolphins.

Protected species detections resulted in the implementation of 36 mitigation actions throughout the survey program. These mitigation actions included 35 power downs and one shut down. Overall, there were 21 hours 47 minutes of downtime attributed to mitigation actions implemented for detections of protected species, of which 20 hours 11 minutes were considered to be production loss.

NMFS issued an IHA and ITS authorizing takes for marine mammals observed outside of New Zealand territorial waters. A total of 23,714 individual marine mammals from 38 species (including six whale species and one dolphin species listed as endangered species) were authorized for takes in the IHA and ITS. Of this total, 23,584 individuals from all 38 species were authorized for Level B takes; 130 individuals, from only 27 of these species, were

authorized for Level A takes. Takes for endangered species totaled 859 individuals, including eight blue whales (*Balaenoptera musculus*), 55 fin whales (*Balaenoptera physalus*), 33 sei whales (*Balaenoptera borealis*), 51 humpback whales (*Megaptera novaengliae*), 54 southern right whales (*Eubalaena australis*), 656 sperm whales (*Physeter macrocephalus*), and two south island Hector's dolphins (*Cephalorhynchus hectori hectori*). Of this total, only three fin whales, two sei whales, three humpback whales, three southern right whales, and two sperm whales were authorized for Level A takes. The remaining 846 individuals were authorized for Level B takes. Takes for endangered green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricate*), leatherback (*Dermochyls coriacea*), loggerhead (*Caretta caretta*) and olive ridley (*Lepidochelys olivacea*) sea turtles were authorized; however, there were no specific number of Level A or Level B takes issued for sea turtle species.

During acoustic source operations outside of New Zealand territorial waters, one protected species, a Bryde's whale, was 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 a potential Level A take.

A total of 559 protected species were observed outside of New Zealand territorial waters and within the predicted 160 decibel radius (where there is a potential for a behavioral response), constituting potential Level B takes. This total included: one humpback whale, three Bryde's whales, one common "dwarf" minke whale, one blue whale, one sperm whale, seven bottlenose dolphins, 319 short-beaked common dolphins, 82 long-finned pilot whales, 25 New Zealand fur seals, two New Zealand sea lions, five unidentified whales, 106 unidentified dolphins, and five unidentified pinnipeds.

One leatherback sea turtle was observed outside of New Zealand territorial waters and within the predicted 175 decibel radius (where there is a potential for a behavioral response) constituting a potential Level B take. No sea turtles were observed outside of New Zealand territorial waters and within the predicted 195 decibel radius (where there is a potential for auditory injury based on the species hearing range) constituting potential Level A takes. Mitigation measures for sea turtles included shutting down the acoustic source if the individual was observed approaching, entering or within the predicted 195 decibel exclusion zone.

Although the IHA and ITS were not applicable to protected species observed within New Zealand territorial waters, standard mitigation measures were still applied and observations recorded. There were 386 protected species observed within New Zealand territorial waters and within the predicted 160/175/195 decibel radii while the acoustic source was active. This total included: one Bryde's whale, 347 short-beaked common dolphins, 33 unidentified dolphins, and five New Zealand fur seals. There were no protected species observed within New Zealand territorial waters and within the predicted Level A radii while the acoustic source was active.

In addition to marine mammal and sea turtle protected species detection, there were three sightings of protected seabirds throughout the New Zealand survey program. This total included: one sighting of an erect-crested penguin, one sighting of a southern rockhopper penguin, and one sighting of an unidentified yellow-crested penguin. Only the sighting of an unidentified yellow-crested penguin occurred during active acoustic source operations and resulted in the implementation of a power-down mitigation action.

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

2. INTRODUCTION

The following report details protected species monitoring and mitigation as well as seismic survey operations undertaken as part of three marine geophysical surveys on board the *R/V Langseth* in the Southwest Pacific Ocean off the coasts of New Zealand from 01 November 2017 to 06 December 2017 (North Island 2-D survey), from 06 January 2018 to 08 February 2018 (North Island 3-D survey), and from 18 February 2018 to 19 March 2018 (South Island 2-D survey). Although not required, also included in this report are visual protected species monitoring details for the transit from the North Island to the South Island from 11 February to 14 February 2018, found in Appendix M.

This document serves to meet the reporting requirements dictated in the IHA and ITS issued to L-DEO by NMFS on 27 October 2017. The IHA and ITS authorized “takes” of Level A and Level B harassment of specific marine mammals, incidental to the marine seismic survey. NMFS has stated that seismic source received sound levels equal to or greater than 160 dB re 1 μ Pa (root mean square (rms)) could potentially disturb marine mammals, temporarily disrupting behavior, such that they could be considered non-lethal ‘takes’ (Level B harassment). In July 2016, NMFS released new technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing, which established new thresholds for permanent threshold shift (PTS) onset or Level A harassment (auditory injury) for marine mammal species. Predicted distances to Level A harassment vary based on marine mammal hearing groups – low frequency cetaceans, mid frequency cetaceans, high frequency cetaceans, phocid pinnipeds and otariid pinnipeds – and how each group’s hearing range overlaps with the frequencies produced by the sound source. For sea turtles, per the ESA, NMFS has stated that received sound levels equal to or greater than 175 dB re 1 μ Pa (root mean square (rms)) represents the current best understanding of the threshold at which they exhibit behavioral responses, and that received sound levels equal to or greater than 195 dB re 1 μ Pa (root mean square (rms)) represents the current best understanding of the threshold at which they experience PTS.

NMFS requires that provisions such as exclusion zones (EZ), delayed operations, ramp-ups, power-downs and shut-downs be implemented to mitigate for potentially adverse effects of the acoustic source sounds on protected species. Exclusion zones of 500 meters for a full active source and 100 meters for a single active 40 in³ element were established from any single element on the array. With a few exceptions (see section 3.1), the occurrence of a marine mammal detected approaching, entering, or within the EZ would trigger the implementation of a mitigation action, including a power-down of the acoustic source for the 500 meter EZ and a shutdown of the acoustic source for the 100 meter EZ. The 500 meter EZ is intended to be precautionary as it encompasses the zones for most species within which auditory injury (Level A harassment) could occur on the basis of instantaneous exposure. It also provides additional protection 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. For sea turtles, the predicted 195 dB threshold distances to which sound source levels will be received from a single 40 in³ element and the full array in shallow, intermediate, and deep water depths was used as their EZ. The occurrence of a sea turtle detected approaching, entering, or within this EZ would trigger the implementation of a shut-down of the acoustic source. For protected sea birds, the detection of one foraging or diving within the 500 meter and 100 meter EZs would trigger a power-down and shut-down respectively.

The ESA and MMPA only applied to portions of the seismic survey which occurred outside of New Zealand territorial waters. Mitigation and monitoring measures were still implemented for detections of protected species within these territories and the information has been included in this report as Appendix M.

2.1. PROJECT OVERVIEW AND LOCATION

The survey program was comprised of three separate seismic surveys that were conducted in the Southwest Pacific Ocean within the Exclusive Economic Zone (EEZ) and territorial waters of New Zealand. New Zealand considers its territorial seas to extend out to 12 nautical miles (22.2 kilometers). The majority of the survey was located within international waters, with only 16 percent of the survey areas (nine percent in the North Island 2-D

survey, one percent in the North Island 3-D survey, and six percent in the South Island 2-D survey) located within New Zealand territorial seas.

While each of the three surveys had a separate specific goal, the overall purpose of the survey program was to collect and analyze reflection and refraction seismic data along the New Zealand coasts to better understand the subduction zone located there. The data collected will provide important information for anticipating future earthquake activity and tsunamis off the coast of New Zealand and elsewhere.

The first survey of the program consisted of a 2-D seismic survey along the Hikurangi margin. The survey area was located in the Bay of Plenty and along the east coast of the North Island, between approximately 37 to 43 degrees south, and between 180 degrees east and the east coast of the North Island (Figure 1). The primary purpose of the North Island 2-D survey was to image the plate boundary fault zone and to show other faults and folding of the upper New Zealand plate and the underlying Pacific plate. Multi-channel seismic (MCS) reflection data and seismic refraction data recorded by ocean bottom seismometers (OBSs) was collected to characterize the incoming Hikurangi Plateau, the seaward portion of the accretionary prism, and to document subducted sediment variations. The data will be used to improve the understanding of why the different parts of the same plate boundary are behaving so differently to produce slow slip events and large stick-slip events.

The second survey consisted of a 3-D seismic survey over a 15x60 kilometer (8.1x32.4 nautical miles) area offshore New Zealand's Hikurangi trench and forearc off the North Island, between approximately 38 to 29.5 degrees south and approximately 178 to 179.5 degrees east (Figure 2). The survey area extended within approximately 20 kilometers (10.8 nautical miles) of the shoreline. The primary purpose of the North Island 3-D survey was to determine what conditions are associated with slow slip behavior, how they differ from conditions associated with subduction zones that generate great earthquakes, and what controls the development of slow slip faults instead of earthquake prone faults. MCS seismic reflection data was acquired to more accurately document the structural, stratigraphic, and hydrogeological conditions that lead to slow slip events along a subduction megathrust.

The third survey consisted of a 2-D seismic survey along the Puysegur ridge and trench off the South Island between approximately 163 to 168 degrees east and between 50 degrees south and the south coast of the South Island (Figure 3). The primary purpose of the South Island 2-D survey was to test models for the formation of new subduction zones and to measure several fundamental aspects of the poorly understood process. MCS reflection data and OBS refraction profiles were acquired to: (1) measure the angle of the new fault which forms the new plate boundary and test ideas of how the faults form; (2) measure the thickness of the oceanic crust at the Puysegur ridge and test models of how the force from the nascent slab is transmitted into the plate; and (3) measure the nature of the faults, especially the thrust fault, on the over-rising plate, and test models for how the forces on the over-riding plate change with time.

Both North Island surveys included the use of 90 short-period land seismometers, which recorded seismic energy from the *Langseth* during the surveys, and will remain in place for three to four months after the surveys were completed to record any earthquakes that may occur. Seismic waves were also recorded onshore during the South Island survey to test models for tectonic evolution and the nature of the shallow mantle directly below the plates.

Water depths in the survey areas ranged from approximately 30 to 5,000 meters (98 to 16,404 feet). For the North Island 2-D survey, 8%, 23% and 69% of the survey lines were located in shallow (less than 100 meters), intermediate (100 to 1,000 meters), and deep (greater than 1,000 meters) water, respectively. For the North Island 3-D survey, 0%, 42% and 58% of the survey lines of the survey lines occur in shallow, intermediate, and deep water, respectively. For the South Island 2-D survey, 1%, 17%, and 82% of the survey lines of the survey lines occur in shallow, intermediate, and deep water, respectively.

The seismic survey was conducted by one source vessel, the *R/V Marcus G. Langseth*. The vessel is 72 meters (235 feet) in length and utilizes a particularly quiet propulsion system to avoid interference with the seismic signals. During the North Island 2-D survey, the *R/V Tangaroa* (funded by GNS Science) coordinated with the *Langseth* to

deploy and retrieve the OBSs used during the survey. All operations for the North Island 3-D survey and South Island 2-D survey were conducted solely by the *Langseth*.

One hundred fourteen transect lines totaling approximately 10,793.8 kilometers (5,828.18 nautical miles) were surveyed during the project. The North Island 2-D survey included 53 transect lines totaling approximately 5,489.25 kilometers (2,963.96 nautical miles). The North Island 3-D survey included 47 transect lines, spaced 300 meters apart, totaling approximately 3,631.1 kilometers (1,960.6 nautical miles). The South Island 2-D survey included 48 planned transect lines, of which 14 were surveyed totaling approximately 1,673.45 kilometers (903.6 nautical miles). The *Langseth's* cruising speed was approximately 10 to 11 knots during transits, and varied between three and five knots during the seismic surveys. Seismic acquisition was conducted from 01 November 2017 to 05 December 2017 for the North Island 2-D survey, from 06 January to 06 February 2018 for the North Island 3-D survey, and between 21 February and 18 March 2018 for the South Island 2-D survey.

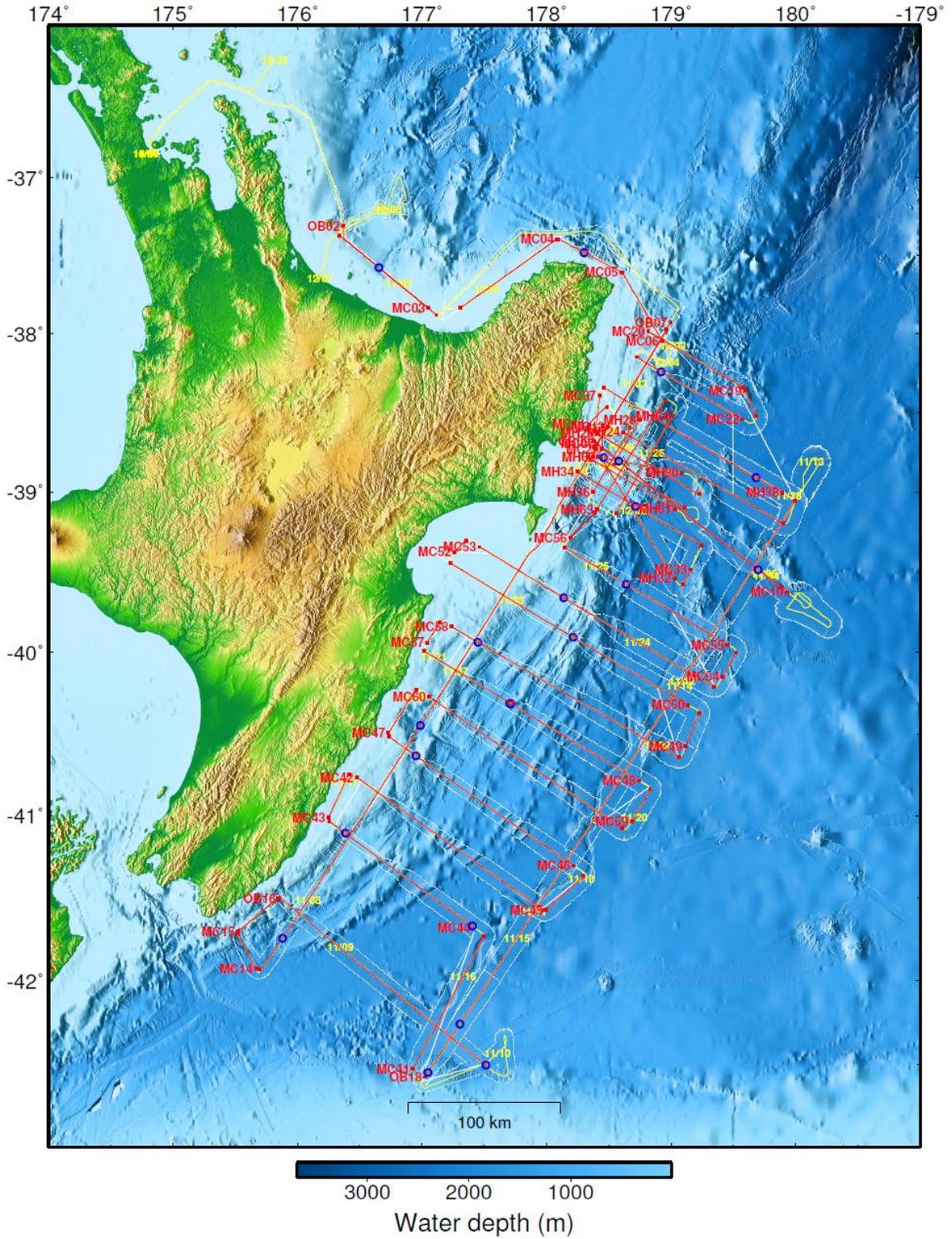


Figure 1. Location and survey lines of the New Zealand North Island 2-D Marine Geophysical Survey.

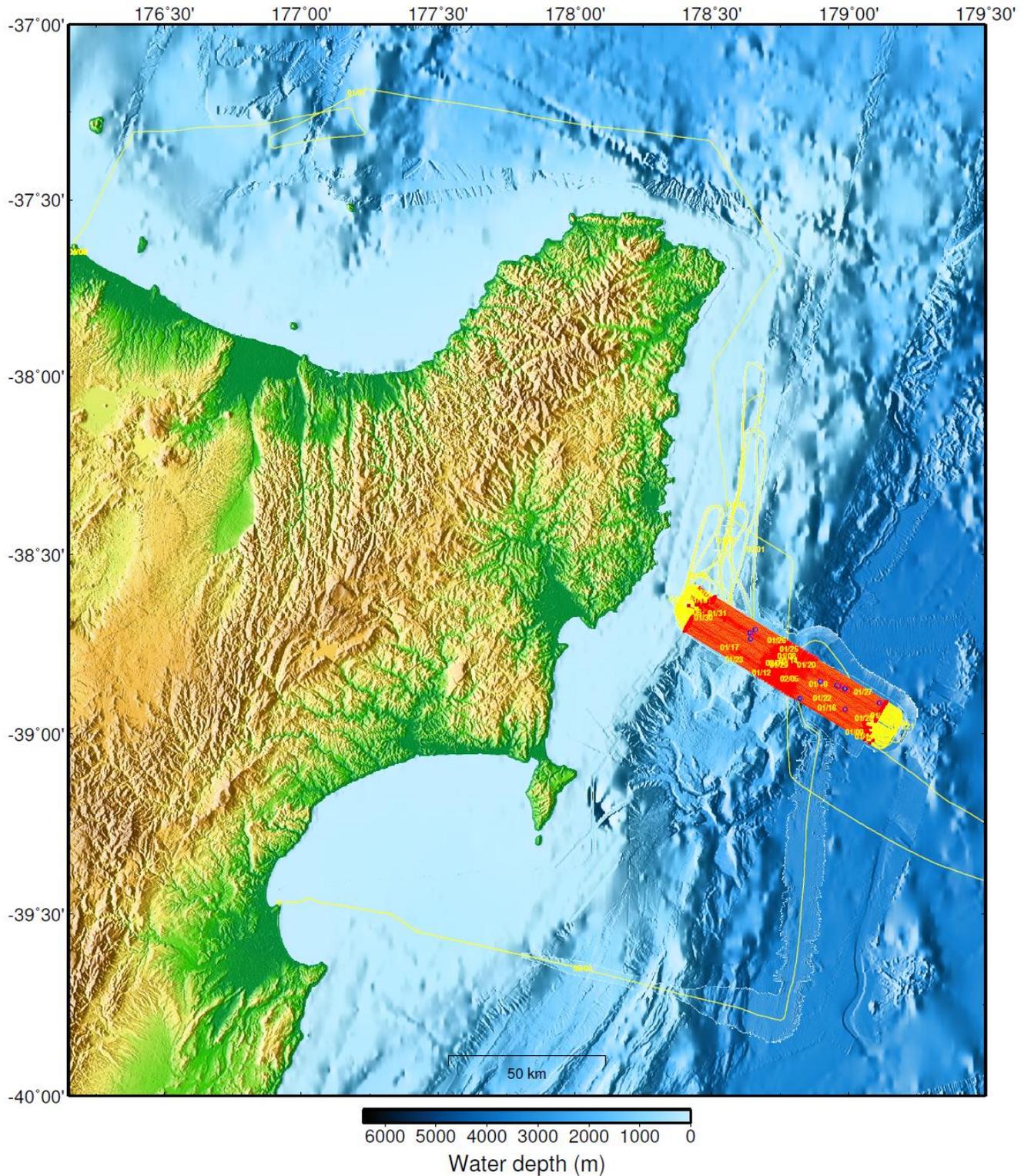


Figure 2: Location and survey lines of the New Zealand North Island 3-D Marine Geophysical Survey.

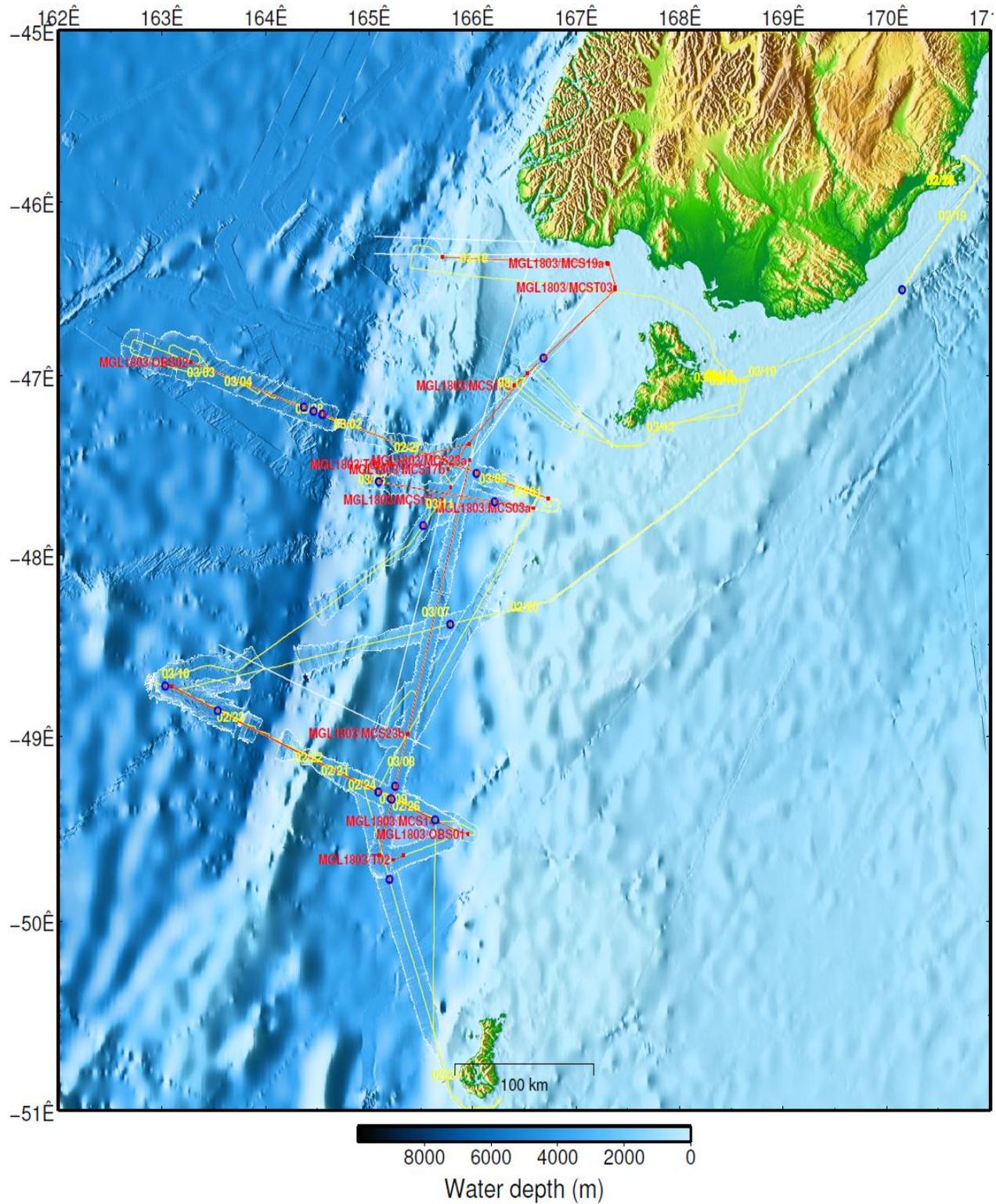


Figure 3: Location and survey lines of the New Zealand South Island 2-D Marine Geophysical Survey.

2.1.1. Energy Source and Receiving Systems

The energy source utilized during the surveys consisted of four towed acoustic source sub-arrays, each with ten source elements (for a total of 40 source elements), deployed just aft of the vessel. During survey production operations, only 36 or 18 elements (2-D surveys and 3-D survey respectively) were active at any time, with the additional elements considered spares in the event that one of the main elements could not be utilized. The source elements were towed at a depth of nine meters for the North and South Island 2-D surveys, and at a depth of seven meters for the North Island 3-D survey. For the North and South Island 2-D surveys, the center of the source was situated 232 meters from the Navigational Reference Point (NRP), which was located on the PSO observation tower. This location positioned the first elements on the arrays approximately 195 meters from the stern of the vessel. For the North Island 3-D survey, the center of the source was re-positioned several times between 265 and 290 meters from the NRP, which positioned the first elements on the arrays between approximately 261 and 286 meters from the stern of the vessel.

The source array utilized a mixture of Bolt 1500LL and Bolt 1900LLX elements ranging in size from 40 to 360 cubic inches (in³), with an operating pressure of 1,950 pounds per square inch. The dominant frequency components ranged from two to 188 Hertz (Hz) and nominal source levels ranged from 259 to 265 dB re: 1 μPa (peak-to-peak). The total volume of the seismic source array with all main 36 source elements active was 6600 in³. This was the source configuration for both the North Island and South Island 2-D surveys. For the North Island 3-D survey, the total source volume was 3300 in³ with only 18 source elements active. With this configuration, only two of the sub-arrays were active at one time, with each set of two sub-arrays active alternately in a flip-flop pattern.

During times when acoustic source arrays were brought on board for maintenance or repair, the total source volume was reduced from 6600 in³ or 3300 in³ to varying volumes down to a single source element with a total volume of 40 in³. The total reduced volume during these times depended on how many of the elements and arrays were disabled.

The shot point interval for the North and South Island 2-D surveys was approximately 150 meters (60 seconds) for the OBS survey lines, approximately 37.5 meters (21 to 22 seconds) for the high resolution MCS lines and approximately 50 meters (16 to 17 seconds) for the standard MCS lines. The shot point interval for the North Island 3-D survey was 50 meters (16 to 17 seconds). During acquisition the source elements would emit a brief (approximately 0.1 second) pulse of sound. During the intervening periods of operations, the source elements would be silent.

The receiving system for the survey program consisted of hydrophone streamers and OBSs. For the North Island 2-D survey, the hydrophone cable was configured as a single 12.6 kilometer (6.8 nautical mile) streamer. For the North Island 3-D survey, the hydrophone cable was configured as four separate six kilometer (3.2 nautical mile) streamers. For the South Island 2-D survey, the hydrophone cable was initially configured as a single 12.6 kilometer (6.8 nautical mile) streamer for survey operations between 21 February 2018 to 9 March 2018, and then as a single four kilometer (2.2 nautical mile) streamer for operations between 10 March 2018 and 18 March 2018. As the acoustic source array was towed along the track lines, the hydrophone streamer received the returning acoustic signals and transferred the data to the on board processing system.

The OBSs for the North Island 2-D survey consisted of 114 OBSs provided by the Japan Agency for Marine-Earth Science Technology deployed and recovered by the *R/V Tangaroa*. The OBSs are spherical in design with a 22 inch diameter. The anchors were 55x55x17 centimeters in dimension and weighed nine kilograms (20 pounds). For the South Island 2-D survey, 43 OBSs provided by the University of Texas were deployed and recovered by the *R/V Langseth*. These OBSs have a height and diameter of approximately one meter. The anchors were 120x120x33 centimeters in dimension and weighed 50 kilograms (110 pounds). There were no OBSs utilized during the North Island 3-D survey. To retrieve the OBSs from the sea floor, an acoustic release transponder transmits a signal to the instrument at a frequency of eight to 11 kilohertz, and a response is received at the frequency of 11.5 to 13 kilohertz to activate and release the instrument. The transponder will trigger the burn-wire assembly that releases the instrument from the anchor on the sea floor, and the device floats to the surface where it can be retrieved by

the vessel. The anchor for the OBS is scuttled and left on the sea floor. The OBSs receive and store the returning acoustic signals internally for later analysis.

Additional sound sources included a Kongsberg EM 122 multi-beam echosounder (MBES), Knudsen Chirp 3260 sub-bottom profiler (SBP), and a Teledyne RDI 75 kHz Ocean Surveyor acoustic Doppler current profiler (ADCP). The hull-mounted MBES operated at frequencies between 10.5 and 13 (usually 12) kilohertz. Each ping consists of eight (in water greater than 1,000 meters) or four (in water less than 1,000 meters) successive fan-shaped transmissions. The transmitting beam width is one or two degrees fore-aft and 150 degrees perpendicular to the ship's line of travel. The maximum source level is 242 dB re: 1 μ Pa (root mean square [rms]). The hull-mounted SBP beam is transmitted as a 27 degree cone, which is directed downward by a 3.5 kilohertz transducer. The nominal power output is 10 kilowatts, however, the actual maximum radiated power is three kilowatts or 222 dB re: 1 μ Pa m (rms). The ping duration is 64 seconds and the interval is one second. The hull-mounted ADCP operates at a frequency of 75 kilohertz and a maximum source level of 224 dB re: 1 μ Pa m (rms) over a conically-shaped 30 degree beam. The MBES and SBP operated simultaneously to provide information about near sea floor sedimentary features and to map the topography of the ocean floor. The ADCP was used to measure water current velocities. The *Langseth* also towed a Geometrics G822 Cesium magnetometer approximately 116 meters off the starboard stern of the vessel, which was also utilized in the process of mapping the sea floor.

3. MITIGATION AND MONITORING METHODS

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

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

3.1. MITIGATION METHODOLOGY

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

Before the acoustic source could be activated after a period of silence, two PSOs and one PAM operator conducted a 30 minute clearance survey of the EZ. If a marine mammal or sea turtle were detected approaching, entering, or within the 500 or 100 meter EZ, or if a protected sea bird was sighted diving or foraging within the designated EZ, source operations would be delayed until the animals were observed exiting the 1,000 meter buffer zone. If the animal(s) were not detected leaving the designated zones (i.e. if they dove within the zone and were not re-sighted), operations would not be cleared to begin until a specific time following the final detection of the animals. For detections of small odontocetes, pinnipeds, sea turtles or sea birds, this time was 15 minutes following last sighting. For detections of mysticetes or large odontocetes, this time was 30 minutes following last sighting.

A 1,000 meter buffer zone from any element on the acoustic source arrays was established as an area in which the presence of a protected species would initiate an alert to the seismic and PAM operators that the animal was sighted and that the implementation of a mitigation action may soon be required. PSOs would keep in frequent contact with the PAM operator, relaying information on the location and movement of the animal(s), and the PAM operator would then relay the information to the seismic operator who was stationed nearby. This process ensured that everyone remained fully informed on the detection information.

A 500 meter exclusion zone (EZ) from any element on the acoustic source arrays was established as the area in which the presence of a marine mammal observed approaching, entering, or within the zone would initiate a power-down of the acoustic source. This reduced the EZ to 100 meters from the single active element on the arrays. If the animal was then observed approaching or entering the smaller EZ, the acoustic source would then be shut-down. When the acoustic source was active at full volume, the 100 meter EZ was also from any element on the arrays. If a marine mammal was initially observed approaching, entering, or already within the smaller EZ, the acoustic source would be immediately shut-down at that time.

The 500 meter and 100 meter EZ were also utilized for protected sea birds. If a protected sea bird was visibly observed foraging or diving within these EZ, the acoustic source would be powered-down (500 meter EZ) or shut-

down (100 meter EZ). For sea turtles, the 195 decibel radius was utilized as the EZ. If a sea turtle was detected approaching, entering or already within the 195 decibel zone, the acoustic source would be immediately shut-down.

Once the acoustic source had been powered-down or shut-down for a protected species detection, the acoustic source would not resume normal operations until the animal(s) were confirmed exiting the 500 meter EZ, or until a specific time had passed following the last detection. As with delayed operations, this time was 15 minutes for small odontocetes, pinnipeds, sea turtles or sea birds, and 30 minutes for mysticetes or large odontocetes. A ramp-up of the acoustic source was required after the implementation of a power-down or shut-down for protected species in order for full volume operations to resume.

The IHA and ITS also outlined several exceptions for mitigation actions as well several extra mitigation actions required for specific detections of marine mammals, both visually and acoustically. There were mitigation exceptions for three specific delphinid species. If upon initial detection the PSOs could positively identify the species as short-beaked common dolphins (*Delphinus delphis*), dusky dolphins (*Lagenorhynchus obscurus*) or southern right whale dolphins (*Lissodelphis peronei*), a mitigation action would not be required if they were observed approaching, entering, or within the 500 meter and 100 meter EZ. However, if there was any uncertainty to the species identification, a mitigation action would be implemented per normal procedures.

If a Hector's dolphin (*Cephalorhynchus hectori hectori*), a Maui's dolphin (*Cephalorhynchus hectori maui*), a beaked whale or Kogia whale (of any species), a large whale with a calf (defined as two-thirds the body size of the adult), or a group of large whales (six individuals or more), were sighted at any distance to the acoustic source, a shut-down would be immediately implemented. The source would remain shut-down for 15 minutes following the last sighting of a Hector's or Maui's dolphins, and for 30 minutes following the last sighting of any of these specified whale detections.

For acoustic only detections of dolphins, if the PAM operator could definitively confirm that the animal(s) were within the designated EZ, a mitigation action would be implemented as normal. However, if the operator could not determine the location or range of the animal(s), a power-down or shut-down was not required, but if the source was silent at the time, the detection would delay operations. The only exception to this was for acoustic detections of positively identified Hector's or Maui dolphins, which required an immediate shut-down at any distance to the source. A shut-down of the acoustic source was also required for an acoustic only detection of a sperm whale that could not be definitively located outside of the designated EZ. A power-down of the acoustic source was required for any acoustic only detection where there existed a possibility that the vocalizations could be from a beak whale, Kogia sp., or sperm whale and the distance to the source was uncertain.

Table 1 describes the predicted 160 decibel radius (Level B harassment zone for marine mammals), the predicted 175 decibel radius (sea turtles), and the 195 decibel radius (mitigation zone for sea turtles). Table 2 describes the predicted Level A harassment zones for each marine mammal hearing group per the NMFS new guidelines, and the species that could occur in the survey areas assigned to each group.

3.2. VISUAL MONITORING SURVEY METHODOLOGY

There were five trained and experienced PSOs on board the *Langseth* for each survey during the program to conduct the monitoring for protected species, record and report detections, and request mitigation actions in accordance with the PEIS, EA, IHA and ITS. Although not required, three trained and experienced PSOs were on board the *Langseth* and monitored for marine species during the transit between the North and South Islands. The PSOs on board were NMFS approved and held certifications from a recognized Bureau of Ocean Energy Management (BOEM) course, an approved Joint Nature Conservation Committee (JNCC) course, and/or an approved New Zealand Department of Conservation (DOC) course. Visual monitoring was primarily carried out from an observation tower (Figure 4) located 18.9 meters above the surface of the water, which allowed a 360 degree viewpoint around the vessel and acoustic source.



Figure 4. Protected Species Observer observation tower with mounted big-eye binoculars, as seen from the stern of the vessel.

The PSO tower was equipped with Fujinon 7x50 and Steiner Marine 7x50 binoculars, as well as two mounted 25x150 Big-eye binoculars, and a D-300-2MS Night Optics USA, Inc. monocular (for visual clearance and monitoring of night time ramp-ups). In addition, a Butler Creek PVS-7 night vision monocular was secured in the bridge and could be requested for use by the PSOs when needed. Inside the tarpaulin tent located in the middle of the platform was a laptop for data collection, and a telephone for communication with the PAM station, bridge, and main lab. Also inside the tent was a monitor that displayed current information about the vessel (e.g. position, speed, heading, etc.), sea conditions (e.g. water depth, sea temperature, etc.), weather (e.g. wind speed and direction, air temperature, etc.), and source activity (e.g. survey line number, total number of active elements, volume, etc.). Environmental conditions along with vessel and acoustic source activity were recorded at least once an hour, or every time there was a change of one or more of the variables. Most observations were held from the tower; however, during severe weather or when the ships exhaust was blowing on the tower, observations would be conducted from the bridge (approximately 12.8 meters above sea level) or the catwalk (approximately 12.3 meters above sea level) around the bridge.

Visual monitoring methods were implemented in accordance with the survey requirements outlined in the IHA and ITS. Two PSOs visually monitored for protected species at all times during daylight hours throughout each survey, from the moment the vessel departed the dock at the beginning of the survey until the vessel returned to dock at the end of the survey, regardless of acoustic source activity. Visual monitoring during periods of acoustic source silence were conducted to gather baseline data on the presence and abundance of protected species in the areas. Brief periods of visual monitoring with only one PSO on duty were conducted during meal times, to allow each team member the opportunity to eat while maintaining both visual and acoustic monitoring. If a sighting occurred

during a time when only one PSO was on watch, the second PSO was notified to immediately return to assist observations. When the acoustic source was activated from silence, PSOs maintained a two-person watch for at least 30 minutes prior to the activation of the source. During ramp-ups, the two-person watch was maintained until the acoustic source reached full operating volume.

Monitoring was conducted each day from 30 minutes before sunrise until 30 minutes after sunset as required by the IHA and ITS. For the North Island 2-D survey, observation times ranged between 16:00 to 17:52 Coordinated Universal Time (UTC) (05:00 to 20:52 local time). For the North Island 3-D survey, observation times ranged between 16:15 to 08:05 UTC (05:15 to 21:05 local time). For the transit between the North and South Islands, observation times ranged between 17:00 to 08:06 UTC (06:00 to 21:06 local time). For the South Island 2-D survey, observation times ranged between 17:49 to 08:41 UTC (06:49 to 21:41 local time). A visual monitoring schedule was established by the PSOs where each person completed visual watches of varying lengths throughout the day. Scheduled watches were no more than four hours in duration, and were each followed by at least one hour of scheduled break time.

Visual observations were conducted around the entire area of the vessel and acoustic source, with each PSO on watch focused on a specific half of the area. The smaller monitoring area for each observer increased the probability of protected species being sighted. PSOs searched for blows, fins, splashes or disturbances of the sea surface, large flocks of feeding sea birds, and other sighting cues indicating the possible presence of a protected species. Upon the visual detection of a protected species, PSOs would first identify the animals' range to the vessel and acoustic source. Range estimations were made using reticle binoculars, the naked eye, and by relating the animal(s) to an object at a known distance, such as the acoustic source arrays and streamer head floats. PSOs would also identify the animals' species, if possible upon initial detection, to ensure that the proper mitigation measures were implemented, should any be required.

PSOs recorded the following information for each protected species detection:

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

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

Species identifications were made whenever the distance of the animal(s), length of the sighting, and visual observation conditions allowed. Whenever possible during detections, photographs were taken with two provided Canon EOS 70D cameras that had a 300-millimeter telephoto lens. Marine mammal identification manuals were consulted and photos were examined during observation breaks to confirm identifications.

3.3. PASSIVE ACOUSTIC MONITORING SURVEY METHODOLOGY

Passive Acoustic Monitoring (PAM) was used to augment visual monitoring efforts in the detection, identification, and locating of marine mammals. PAM was particularly beneficial during periods of darkness or low visibility when visual monitoring was not as effective. Acoustic monitoring was conducted continuously during all seismic operations and to the maximum extent possible during periods of acoustic source silence. When the acoustic source was activated from any period of silence, acoustic monitoring was conducted for at least 30 minutes prior to the activation of the source along with visual monitoring for the pre-clearance survey.

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

Five Protected Species Observers (PSOs) were on board to provide monitoring for protected species during the survey program. One PSO trained and experienced with the PAM system was designated as the Lead PAM Operator and oversaw all PAM operations during each survey. Other PSOs trained in the use of the PAM system also conducted acoustic monitoring to ensure continuous PAM operations. PAM shifts were no longer than six hours in duration followed by at least a one hour break. During the North Island 2-D survey, only one of the PSOs on the team was untrained in the PAM system and thus did not have any acoustic monitoring shifts. During the North Island 3-D survey and the South Island 2-D survey, all PSOs on the team undertook acoustic monitoring shifts.

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

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

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

- I. Date, time of first and last detection, operator on duty, if the detection was linked to a visual sighting, vessel information (e.g. position, speed, heading), water depth, and acoustic source activity (e.g. volume and number of active elements).
- II. Species (if determinable), group size, methods/modules on which vocalizations were detected during the event, and vocalization characteristics (e.g. signal type, frequency and amplitude range, inter-click interval, patterns, etc.)

the two pre-installed, wall-mounted monitors, keyboard, mouse and headphones. The EPU contained a buffer unit with Universal Serial Base (USB) output, an RME Fireface 800 ADC unit with firewire output, and a rack-mounted computer. A Global Positioning System (GPS) feed of GNGGA strings was supplied from the ship's Seapath navigation system and routed to the computer, reading data every 20 seconds. Data from the hydrophone cable's depth transducer was routed through the buffer unit to the computer, via USB connection. The *Pamguard Beta* software utilized for the North Island 2-D survey of the program was version 1.15.03. For the North Island 3-surveys *Pamguard Beta* version 1.15.11 was utilized, and for the South Island 2-D survey *Pamguard Beta* version 1.15.13 was utilized.

Raw feed from the two standard hydrophone elements (H2 and H3) was digitized in the buffer unit using an analogue-digital National Instruments data acquisition (DAQ) soundcard at a sampling rate of 500 kilohertz. The output was filtered for high frequency (HF) content and visualized using the *Pamguard* software. Clicks were measured at sixth order (Butterworth) with a high-pass digital pre-filter of 30 kilohertz and a high-pass trigger filter of 40 kilohertz. *Pamguard* used the difference between the time that a signal arrived at each of the two hydrophones to calculate and display the bearing to the source of the signal. A scrolling bearing/time module displayed the filtered data in real time, allowing for the detection and directional mapping of click trains. Additional components of the HF click detector system in *Pamguard* were an amplitude/time display, that registered click intensity data in real time, as well as click waveform, click spectrum, and Wigner plot displays, providing the PAM operator immediate review of individual click characteristics in the identification process. One of the two monitors was designated for displaying *Pamguard* HF click detector and sound recorder modules.

Raw feed from the two broadband hydrophone elements (H0 and H1) was routed from the buffer unit to the RME Fireface 800 unit, where it was digitized at a sampling rate of 48 kilohertz. The relatively low frequency (LF) output was further processed within *Pamguard* by applying Engine Noise Fast Fourier Transform (FFT) filters, including click suppression and spectral noise removal filters (e.g. median filter, average subtraction, Gaussian kernel smoothing and thresholding). Filtered LF content was visualized in two spectrograms, one displaying two channel feeds at frequency ranges of three to 24 kilohertz, and another displaying on channel feed at a frequency range of zero to three kilohertz. LF click detector modules allowed for review of individual click characteristics as well as the detection and tracking of click trains.

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

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

3.3.2. Hydrophone Deployment

The hydrophone cable was deployed from a hydraulic winch on the port stern of the vessel's main back deck where the acoustic source arrays were deployed from. Two deck cables, a main and a spare, were installed along the deck-head running from the winch to the main science lab. For the North and South Island 2-D surveys, the hydrophone cable was deployed off the port stern and attached via tow rope to the port side boom to move the cable further away from the vessel and arrays. This deployment placed the trailing end of the hydrophone cable

120 meters from the port stern of the vessel, and 86 meters forward of the center of the source (COS) (Figure 6). During the North Island 3-D survey, the deployment of the hydrophone cable was altered several times to reduce entanglement risks and damage to the cable. The initial deployment method had the hydrophone cable deployed off the port side winch to the center of the stern and then into the water between the array umbilicals (Figure 7). This was done in order to prevent entanglement of the cable with the arrays due to the wide separation configuration used for the survey. This deployment placed the trailing end of the cable directly ahead of the center of the source. The distance of the hydrophones from the source changed several times throughout the survey as the arrays were re-positioned to adjust the separation, and varied between 95 and 230 meters. When either the port or starboard arrays needed to be retrieved for maintenance, the hydrophone cable was pulled to the opposite side of the stern by hand to prevent any entanglement. The initial deployment method during the North Island 3-D survey was only utilized for the first week, as all of the movement of the cable damaged the hydrophone array. The deployment method was then changed for the remainder of the survey to where the hydrophone cable was deployed off the streamer four lead-in via sliding/rolling collar (Figure 8). This final deployment method moved the hydrophone cable further away from the source arrays, and reduced the need for moving the cable to only when the most port side source array needed to be retrieved. PAM system specifications can be found in Appendix C, and a more detailed description of the hydrophone deployment method, including photos of the installation, can be found in Appendix D.

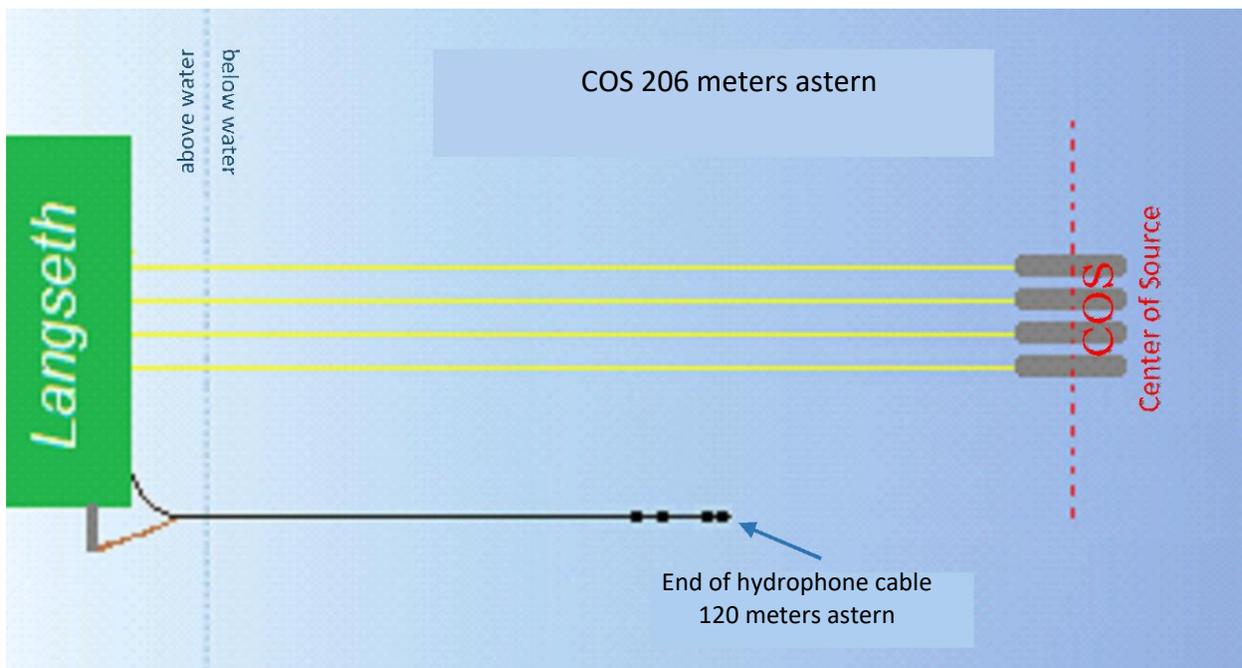


Figure 6. Location of the PAM Cable in Relation to the Seismic Gear during the North and South Island 2-D Surveys of the Southwest Pacific Ocean New Zealand Seismic Survey Program.

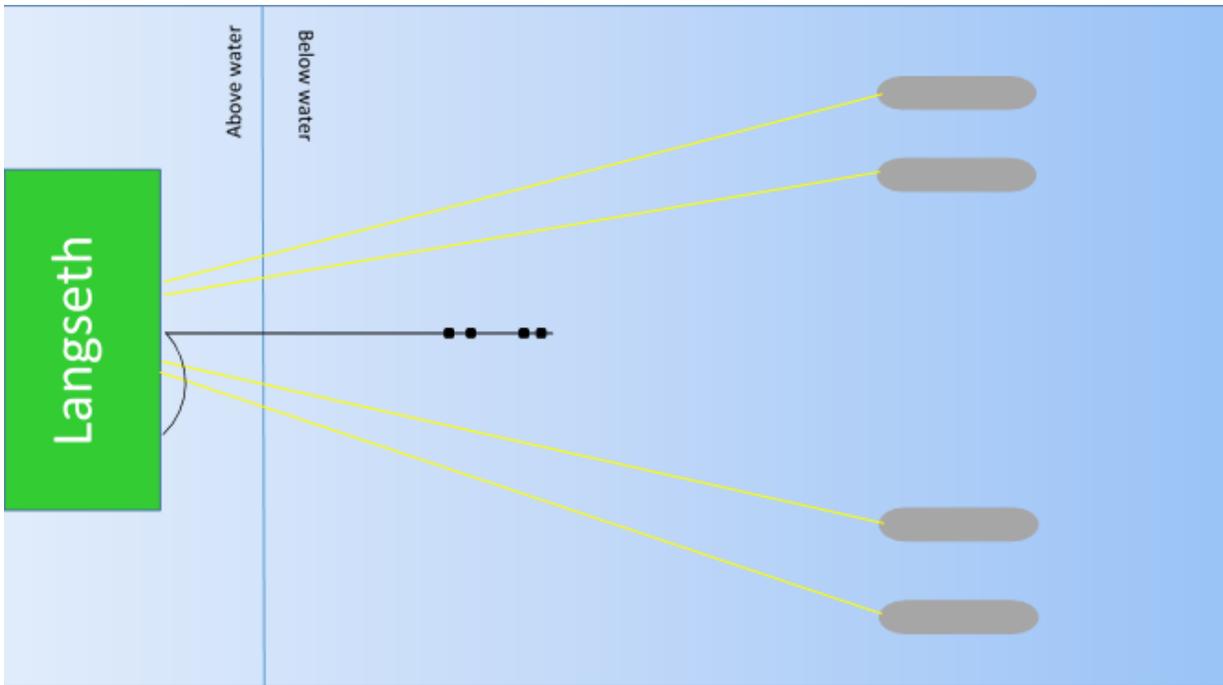


Figure 7: Initial Location of the PAM Cable in Relation to the Seismic Gear during the North Island 3-D Survey of the Southwest Pacific Ocean New Zealand Seismic Survey Program.

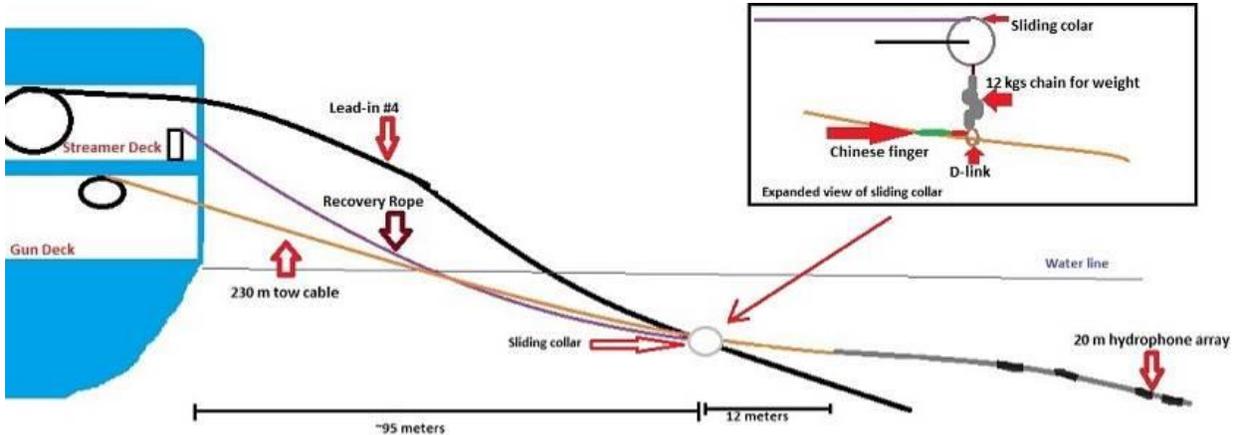


Figure 8: Final Location of the PAM Cable in Relation to the Seismic Gear during the North Island 3-D Survey of the Southwest Pacific Ocean New Zealand Seismic Survey Program.

4. MONITORING EFFORT SUMMARY

4.1. SURVEY OPERATIONS SUMMARY

4.1.1. General survey parameters

The Southwest Pacific Ocean New Zealand seismic survey program was conducted in three separate surveys (Table 3). The dates and times of acquisition for each survey line on all three programs can be found in Appendix E.

Table 3: Survey parameters of programs

Survey	Mobilization Location / Date	First Airgun Source Activity (UTC)	Start of Acquisition	End of Acquisition	Demobilization Location / Date
North Island 2-D	Auckland / 01 Nov 2017	Ramp-up / 16:48 / 01 Nov 2017	17:23 UTC 01 Nov 2017	15:50 UTC 05 Dec 2017	Tauranga / 06 Dec 2017
North Island 3-D	Taruranga / 06 Jan 2018	Ramp-up / 18:21 / 08 Jan 2018	18:23 UTC 09 Jan 2018	20:50 UTC 06 Feb 2018	Napier / 08 Feb 2018
South Island 2-D	Dunedin / 18 Feb 2018	Ramp-up / 09:50 21 Feb 2018	10:41 UTC 21 Feb 2018	03:00 UTC 18 Mar 2018	Dunedin / 19 Mar 2018

Acquisition continued during each program according to the survey plan and survey operations were only suspended when operationally necessary, as outlined in Table 4.

Table 4: Suspension of survey operations during New Zealand survey programs

Survey	Airguns silenced	Time Ramp-up Initiated	Reason for Interruption in Acquisition
North Island 2-D	04:30 UTC 02 Nov 2017	17:54 UTC 02 Nov 2017	Vessel transit between survey locations
North Island 2-D	01:38 UTC 04 Nov 2017	20:56 UTC 04 Nov 2017	Transition between OBS and MCS survey line (deployment of streamer cable)
North Island 2-D	13:56 UTC 09 Nov 2017	05:38 UTC 10 Nov 2017	Transition between MCS and OBS survey line (retrieval of streamer cable)
North Island 2-D	19:24 UTC 12 Nov 2017	07:03 UTC 13 Nov 2017	Transition between OBS an MCS survey line (deployment of streamer cable)
North Island 3-D	04:26 UTC 17 Jan 2018	02:34 UTC 18 Jan 2018	Severe weather conditions. A sub-array was damaged during re-deployment, extending downtime.
North Island 3-D	01:01 UTC 01 Jan 2018	00:32 UTC 02 Feb 2018	Severe weather conditions.
North Island 3-D	01:59 UTC 02 Feb 2018	08:01 UTC 02 Feb 2018	Streamer entanglement with fishing gear following ramp-up after weather downtime (see above)
North Island 3-D	11:45 UTC 02 Feb 2018	18:33 UTC 02 Feb 2018	Power failure on a streamer before acquisition resumed following ramp-up conducted after fishing gear entanglement (see above)
North Island 3-D	00:17 UTC 03 Feb 2018	17:17 UTC 03 Feb 2018	Survey line aborted due to increasing rough seas.
South Island 2-D	12:27 UTC 22 Feb 2018	12:17 UTC 27 Feb 2018	Retrieval of OBSs at one site and redeployment at the next site in addition to downtime for severe weather.
South Island 2-D	20:48 UTC 28 Feb 2018	17:57 UTC 03 Mar 2018	Transition from OBS to MCS survey line (Retrieval of OBSs and deployment of the streamer cable).
South Island 2-D	10:03 UTC 09 Mar 2018	20:40 UTC 09 Mar 2018	Maintenance of source arrays
South	00:26 UTC	23:06 UTC	Transit between survey lines and change in streamer

Survey	Airguns silenced	Time Ramp-up Initiated	Reason for Interruption in Acquisition
Island 2-D	09 Mar 2018	10 Mar 2018	configuration (reduced to 4km in length from 12.6km)
South Island 2-D	11 Mar 2018	16 Mar 2018	Severe weather conditions

4.1.2. MBES, SBP and ADCP operations

The multi-beam echosounder (MBES), sub-bottom profiler (SBP), and the acoustic Doppler current profiler (ADCP) were active throughout the majority of each survey of the program. For the North Island 2-D survey, the sonars were initiated on 01 November 2017 at 03:00 UTC, and were disabled on 06 December 2017 at 20:28 UTC. For the North Island 3-D survey, the sonars were initiated on 06 January 2018 at 00:50 UTC, and were disabled on 08 February 2018 at 03:58 UTC. For the South Island 2-D survey, the sonars were initiated for the first time between 20:02 and 20:18 on 18 February 2018. Throughout the South Island 2-D survey, the sonars were disabled during each OBS deployment and retrieval as well as when the vessel was transiting outside of the survey area due to inclement weather and seas. The sonars were disabled for the final time at 04:46 UTC on 18 March 2018 during retrieval of the seismic gear upon completion of survey operations.

4.1.3. Airgun operations

The acoustic source was active for a total of 1,601 hours 23 minutes during the all three survey programs. This total includes ramp-up of the acoustic source, full and reduced volume operations on a survey line, full and reduced volume operations not on a survey line, operation of a single 40 in³ source element, and testing of the acoustic source elements. The acoustic source was ramped-up 54 times totaling 17 hours 43 minutes over the course of the survey programs to commence full volume operations from silence or resume full volume operations from a mitigation power down. Table 5 summarize the acoustic source operations over the course of the Southwest Pacific Ocean New Zealand seismic survey program.

Ramp-ups ranged averaged 20 minutes in duration and were conducted using the automated controller program, DigiShot, which added source elements sequentially to achieve the full source volume over the required period. Ramp-ups were performed by cycling each source element two times at a shot point interval of 17 seconds, adding an additional element after each cycle, resulting in an approximately 20 minute ramp-up when all 18 or 36 elements were operating. On 05 March 2018, there were three night-time ramp-ups from a single 40 in³ element conducted due to mitigation action power-downs for acoustic detections of protected species that were cleared and monitored by acoustic monitoring only due to a misunderstanding of the permit requirements. All other ramp-ups were cleared and monitored by both visual and acoustic monitoring per the survey requirements.

Operations with only a single 40 in³ source element were conducted for protected species mitigation power downs only. In accordance with the IHA and ITS, operation of a single 40 in³ source element was limited to 30 minutes in duration, after which the source would be ramped-up or silenced.

There was one occasion of acoustic source testing during the North Island 3-D survey New Zealand program. The test was conducted on 18 January 2018 and totaled two minutes in duration, with a volume of 1650 in³ over nine elements. No acoustic source testing was conducted during the North or South Island 2-D surveys.

Table 5. Total Acoustic Source Operations during the Southwest Pacific Ocean New Zealand Seismic Survey Program.

Acoustic Source Operations	Number				Duration (hh:mm)			
	Total	NI 2D	NI 3D	SI 2D	Total	NI 2D	NI 3D	SI 2D
Source Tests	1	0	1	0	00:02	00:00	00:02	00:00
Ramp-up	54	23	8	23	17:43	07:30	02:53	07:20
Day time ramp-ups from source silence	15	6	6	3	05:13	01:59	02:13	01:01
Day time ramp-ups from mitigation source	31	17	1	13	09:52	05:31	00:20	04:01
Night time ramp-ups from source silence	4	0	1	3	01:20	00:00	00:20	01:00
Night time ramp-ups from mitigation source	4	0	0	4	01:18	00:00	00:00	01:18
Full 6600 in³/Reduced Volume on a Survey Line¹					1301:28	669:38	430:31	201:19
Full 6600 in³/Reduced Volume not on a Survey Line²					272:22	72:59	175:14	24:09
Single Source Element (40 in³)					09:48	04:29	00:17	05:02
Total Time Acoustic Source Was Active					1601:23	754:36	608:57	237:50
<p>1. Total: 1,179:15 (full volume), 122:13 minutes (reduced volume); NI 2D: 566:02 (full volume), 103:36 (reduced volume); NI 3D: 414:33 (full volume), 15:58 (reduced volume) SI 2D: 198:40 (full volume), 2:39 (reduced volume)</p> <p>2. Total: 248:45 minutes (full volume), 23:37 minutes (reduced volume); NI 2D: 59:14 (full volume), 13:45(reduced volume) NI 3D: 167:19 (full volume), 7:55 (reduced volume); SI 2D: 22:19 (full volume), 1:57 (reduced volume)</p>								

Figure 9, Figure 10, and Figure 11 each show the geospatial data for source operations conducted during each of the three surveys of the program.

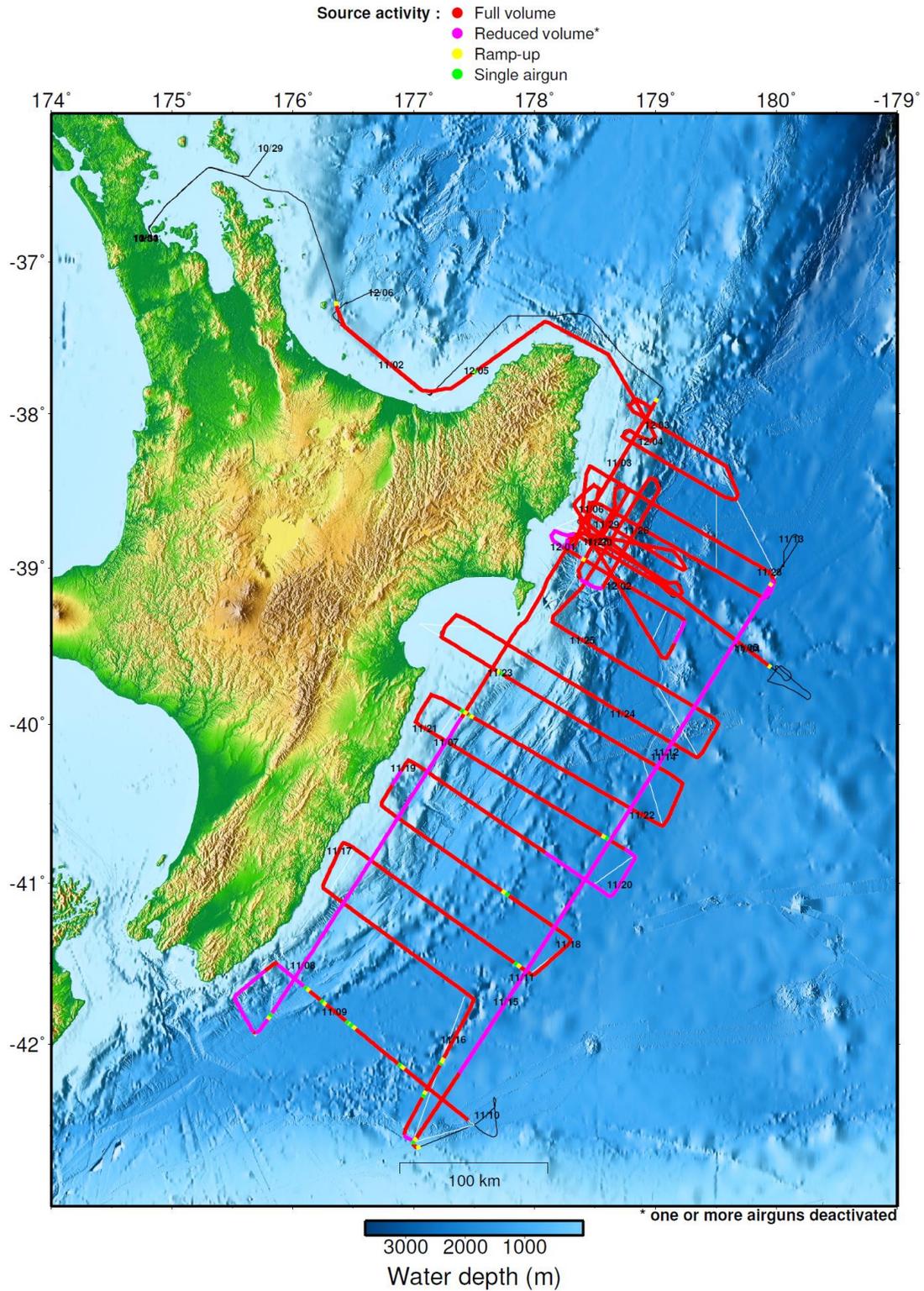


Figure 9: Geospatial Data of Source Operations for the North Island 2-D Survey Area.

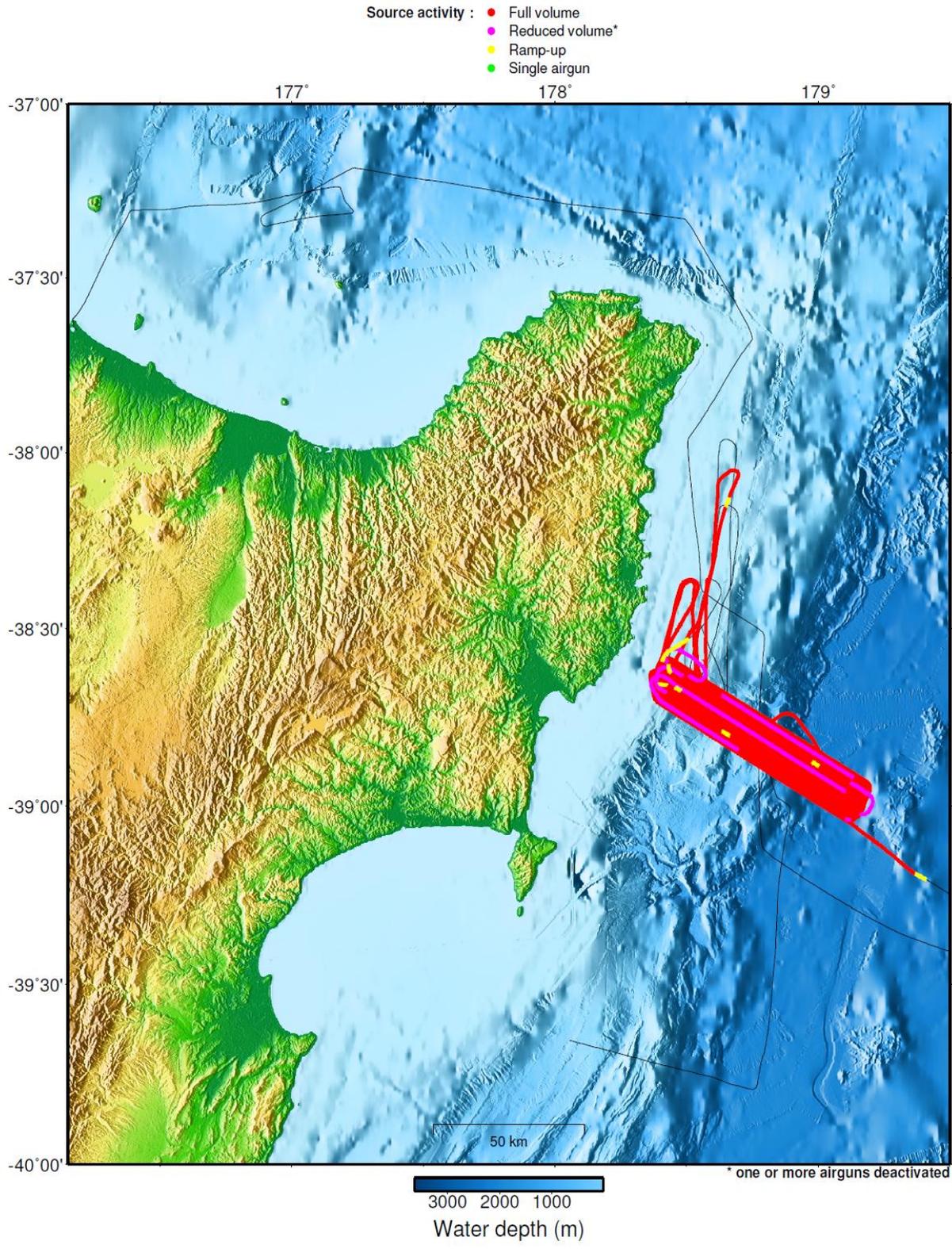


Figure 10: Geospatial Data of Source Operations for the North Island 3-D Survey Area.

In addition to the suspensions of operations outlined in Table 4, the acoustic source was silenced for mechanical/technical reasons on three occasions during the New Zealand survey programs, all during the North Island 2-D survey (Table 6).

Table 6: Mechanical and Technical Source Silence.

Date	Reason for Source Silence	Time Acoustic Source Silenced (UTC)	Time Acoustic Source Resumed (UTC)
02 November 2017	Technical issue with controller	18:14	18:16
15 November 2017	Shutdown during ramp-up due to a system error	21:39	22:01
30 November 2017	Troubleshooting of system error	17:31	17:38

Per the IHA and ITS, 30 minutes of operational silence due to mechanical/technical shut-downs where a ramp-up was not required to resume full volume operations provided that: (1) PSOs maintained constant visual and acoustic observations, (2) no visual detections of protected species occurred within the buffer or EZ zones, and (3) there were no acoustic only detections of protected species.

The volume of the acoustic source was changed (reduced or increased) on multiple occasions during the New Zealand survey programs for a variety of reasons including but not limited to issues with individual airgun elements, routine source maintenance, entanglement of the PAM cable, and operations being suspended for rough seas. Specific information about each instance where acoustic source volume changed can be found in Appendix F.

4.1.4. Interactions with Other Vessels

In addition to visually monitoring for protected species, PSOs also observed and documented interactions with other marine traffic. Over the course of the survey program, 200 other vessels were observed in the vicinity of the R/V *Langseth*, including 12 bunker vessels, one car carrier vessel, 63 cargo ships, one charter boat, 10 cruise ships, one fisheries patrol vessel, six fishing shellfish dredgers, 12 fishing trawlers, 47 fishing vessels, two naval ships, 21 recreational vessels, one research vessel, eight sail boats, five sport fishing boats, two tankers, and two yachts. These vessels had an average closest distance of 5,344 meters to the *Langseth*, ranging between 100 and 18,500 meters. Table 8 lists the number of each vessel type observed during the survey program as well as the closest, farthest, and average distances each vessel type was observed to the *Langseth*.

There were five occasions during the survey program where other vessels, or another vessels gear/equipment, were observed having some type of interaction with the *Langseth's* seismic gear (Table 7). This was mainly small fishing or recreational boats travelling over the streamers astern of the *Langseth*, and fishing gear becoming entangled with the deployed seismic equipment. No seismic gear was damaged during these interactions.

Table 7: Other Vessel Interaction with Langseth Seismic Gear.

Date	Interaction	Closest Point of Approach (meters)
16 November 2017	Small fishing boat observed crossing astern of the <i>Langseth</i> over the deployed streamer.	4,886
04 December 2017	Small recreational craft observed crossing astern of <i>Langseth</i> over the deployed streamer.	7,500

26 January 2018	Small recreational fishing vessel observed crossing astern of Langseth over deployed streamer.	800
27 January 2018	Long-line fishing gear became entangled with Langseth's deployed seismic equipment. Seismic operators removed the majority of the fishing gear from the streamers.	1,500
02 February 2018	One sea floor crab-trap with several buoys at the surface became entangled with one deployed streamer. Seismic operators retrieved the streamer and removed it without damage to the streamer. Fishing vessel whom gear belonged to was not in the area at time of entanglement.	N/A

There were no occasions during the survey program where the Langseth had to deviate from planned survey operations (e.g. diverge from the survey line, reduce speed) because of other vessels in the survey area.

Table 8: Other Vessels Observed during the Southwest Pacific Ocean New Zealand Seismic Survey Program.

Vessel Type	Total Number Observed	Recorded Distance to the <i>Langseth</i> (meters)		
		Average	Closest	Farthest
Bunker	12	6,275	2,500	10,700
Car Carrier	1	7,408	7,408	7,408
Cargo	63	6,553	2,200	18,500
Charter	1	4,500	4,500	4,500
Cruise Ship	10	6,507	1,500	10,000
Fisheries Patrol	1	4,000	4,000	4,000
Fishing Shellfish Dredger	6	2,309	400	4,400
Fishing Trawlers	12	5,827	1,000	10,000
Fishing Vessels	47	4,286	200	12,538
Naval Ship	2	3,952	1,500	5,858
Recreational	21	4,249	100	8,500
Research	1	5,928	2,594	12,460
Sail Boat	8	4,414	2,614	6,500
Sport Fishing Boat	5	2,694	1,100	6,500
Tanker	2	5,300	4,100	6,500
Yacht	2	3,350	2,200	4,500

4.2. VISUAL MONITORING SURVEY SUMMARY

Visual monitoring during the Southwest Pacific Ocean New Zealand seismic survey program was conducted during all daylight hours throughout each survey of the program, beginning 30 minutes before sunrise and ended 30 minutes after sunset each day, starting when the vessel left the dock and terminating upon return to port upon completion of the survey (Table 9). This included times when the vessel was in transit, and deploying and retrieving equipment. Visual monitoring during times with no source operations was conducted to collect baseline data about protected species abundance in the survey areas.

Table 9: Initiation and termination of visual monitoring watches during New Zealand survey programs

Survey program	Visual Monitoring Began	Visual Monitoring Ended
North Island 2-D	02:04 UTC, 01 Nov 2017	21:37 UTC, 06 Dec 2017
North Island 3-D	00:32 UTC, 06 Jan 2018	06:27 UTC, 08 Feb 2018
South Island 2-D	19:10 UTC, 18 Feb 2018	20:00 UTC, 19 Mar 2018

Throughout the entire Southwest Pacific Ocean New Zealand seismic survey program, visual monitoring was conducted over a period of 103 days for a total of 1476 hours 39 minutes. Of the overall total visual monitoring

effort, 69% was undertaken while the acoustic source was active, and 31% was undertaken while the acoustic source was silent. Visual monitoring while the acoustic source was silent was mainly conducted during the transits to and from the survey sites, and during equipment deployment, recovery and maintenance.

Table 10 detail visuals monitoring with acoustic source operations throughout the Southwest Pacific Ocean New Zealand seismic survey programs.

Table 10. Total Visual Monitoring Effort during the Southwest Pacific Ocean New Zealand Seismic Survey Program

Visual Monitoring Effort	Duration (hh:mm)	% of Overall Visual Monitoring Effort
North Island 2-D Survey		
Total monitoring while acoustic source active	482:07	88%
Total monitoring while acoustic source silent	66:41	12%
Total monitoring effort	548:48	37%
North Island 3-D Survey		
Total monitoring while acoustic source active	390:09	76%
Total monitoring while acoustic source silent	123:43	24%
Total monitoring effort	513:52	35%
South Island 2-D Survey		
Total monitoring while acoustic source active	145:54	35%
Total monitoring while acoustic source silent	268:05	65%
Total monitoring effort	413:59	28%
Southwest Pacific Ocean New Zealand Survey Program		
Total monitoring while acoustic source active	1018:10	69%
Total monitoring while acoustic source silent	489:25	31%
Total monitoring effort	1507:35	-

Two PSOs conducted visual monitoring during all daylight hours except for scheduled meal hours, when visual monitoring was conducted by one PSO while each person rotated for a meal break. During the entire survey program, visual monitoring effort conducted by a single PSO totaled 176 hours 24 minutes (Table 11). Solo watches lasted no longer than 30 minutes per person. If a sighting occurred during a solo PSO watch, the second PSO was notified via radio to immediately return to assist in the detection observations. The second PSO was called back to watch seven time throughout the survey program, as described below. Two PSOs maintained watch for 30 minutes prior to the activation of the acoustic source from silent and throughout all ramp-ups.

Table 11: Visual Monitoring Watches Conducted by a Single PSO

Survey program	Duration of Visual Monitoring Conducted by Single PSO (hh:mm)	Number of Times that a Sighting Event Began During a Solo Watch
North Island 2-D	71:05	03
North Island 3-D	51:35	01
South Island 2-D	51:30	02
All Programs	176: 24	07

* If a sighting occurred during a solo PSO watch, the second PSO was notified via radio to immediately return to assist in the detection observations.

Visual observations were preferentially conducted from the PSO tower, which provided a 360-degree view of the water around the vessel and the acoustic source. Visual watches were conducted from other locations including the catwalk, bridge and/or stern if monitoring conditions could not be undertaken from the tower, such as during rough weather and sea conditions which made the tower unsafe, or when the vessel was heading directly into the wind blowing the engine exhaust onto the tower.

During the Southwest Pacific Ocean New Zealand survey program, PSOs conducted visual monitoring from the tower (53.71%) and from the bridge (45.38%) more often than any other location. The majority of the monitoring from the bridge was conducted during the North Island 3-D survey, mainly due to the exhaust blowing out of the engine stacks and on to the tower, and during the South Island 2-D survey, due to most days having high winds and large swells which made monitoring from the tower unsafe. The majority of the simultaneous bridge and catwalk monitoring was conducted during the North Island 2-D survey while all of the simultaneous bridge and stern monitoring was conducted during the South Island 2-D survey (Table 12).

Table 12: Total visual monitoring effort from observation locations during the Southwest Pacific Ocean New Zealand seismic survey program

Survey Program	Observation Locations During Visual Effort							
	Tower		Bridge		Bridge / Catwalk		Bridge / stern	
	Duration (hh:mm)	% of Overall Effort	Duration (hh:mm)	% of Overall Effort	Duration (hh:mm)	% of Overall Effort	Duration (hh:mm)	% of Overall Effort
North Island 2-D survey	444:54	81%	92:32	17%	11:22	2%	00:00	0%
North Island 3-D Survey	297:15	58%	214:53	42%	01:44	0%	00:00	0%
South Island 2-D Survey	36:40	9%	376:44	91%	00:00	0%	00:35	0%
Southwest Pacific Ocean New Zealand Survey Program	809:45	55%	648:09	44%	13:06	1%	00:35	0%

4.3. ACOUSTIC MONITORING SURVEY SUMMARY

Acoustic monitoring during the Southwest Pacific Ocean New Zealand seismic survey program was conducted continuously throughout acoustic source operations and to the maximum extent possible while the acoustic source was silent from the first deployment of the PAM cable to the final retrieval of the cable upon completion of a survey program (Table 13). Brief periods of source activity without acoustic monitoring were infrequently conducted for any needed assessments, adjustments, or maintenance to the PAM system. Periods without source activity or acoustic monitoring occurred when the PAM hydrophone cable was secured on board the vessel during transits, during deployment and recovery of the seismic gear, and during times when operations were suspended due to rough weather and sea conditions.

Table 13: Initiation and termination of acoustic monitoring watches during New Zealand survey programs

Survey program	Acoustic Monitoring Began	Acoustic Monitoring Ended
North Island 2-D	16:00 UTC, 01 Nov 2017	16:00 UTC, 05 Dec 2017
North Island 3-D	14:47 UTC, 08 Jan 2018	20:57 UTC, 06 Feb 2018
South Island 2-D	06:25 UTC, 21 Feb 2018	03:00. UTC, 18 Mar 2018

Throughout the entire survey program, acoustic monitoring was conducted on 81 days for a total of 1,641 hours six minutes. This total includes 766 hours 27 minutes over 35 days during the North Island 2-D survey, 619 hours 50 minutes over 30 days during the North Island 3-D survey, and 254 hours 49 minutes over 16 days during the South Island 2-D survey.

Of the overall total acoustic monitoring effort, 97% (1,596 hours nine minutes) was undertaken while the acoustic source was active, and 3% (44 hours 57 minutes) was undertaken while the acoustic source was silent. Acoustic

monitoring while the acoustic source was silent was mainly conducted during the brief periods of time between recovery/deployment of the seismic gear and recovery/deployment of the PAM cable

Table 14 details acoustic monitoring with acoustic source operations throughout the Southwest Pacific Ocean New Zealand seismic survey program.

Table 14. Total Passive Acoustic Monitoring (PAM) Effort during the Southwest Pacific Ocean New Zealand Seismic Survey Program.

Acoustic Monitoring Effort	Duration (hh:mm)	% of Overall Acoustic Monitoring Effort
North Island 2-D Survey		
Total night time monitoring	273:36	36%
Total day time monitoring	492:51	64%
Total monitoring while the acoustic source was active	753:47	98%
Total monitoring while the acoustic source was silent	12:40	2%
Total acoustic monitoring	766:27	47%
North Island 3-D Survey		
Total night time monitoring	220:15	36%
Total day time monitoring	399:35	64%
Total monitoring while the acoustic source was active	606:30	98%
Total monitoring while the acoustic source was silent	13:20	2%
Total acoustic monitoring	619:50	38%
South Island 2-D Survey		
Total night time monitoring	102:19	40%
Total day time monitoring	152:30	60%
Total monitoring while the acoustic source was active	235:52	93%
Total monitoring while the acoustic source was silent	18:57	7%
Total acoustic monitoring	254:49	15%
Southwest Pacific Ocean New Zealand Survey Program		
Total night time monitoring	596:10	36%
Total day time monitoring	1044:56	64%
Total monitoring while the acoustic source was active	1596:09	97%
Total monitoring while the acoustic source was silent	44:57	3%
Total acoustic monitoring	1641:06	100%

Acoustic monitoring was suspended 18 times throughout the survey program for a variety of reasons including: debris removal and maintenance of the PAM cable, replacement of damaged PAM equipment, rough seas/risk of entanglement with towed seismic gear, assessment and adjustment of the PAM equipment, seismic gear deployment and retrievals, and transit. Acoustic monitoring downtime was calculated as any time acoustic monitoring was not conducted between the times when the hydrophone cable was deployed for the first time at the beginning of each survey, and the times when the hydrophone cable was retrieved for the final time at the end of each survey.

During the entire Southwest Pacific Ocean New Zealand survey program, acoustic monitoring downtime totaled 473 hours 26 minutes. Most of the downtime was due to seismic equipment operations or rough seas that necessitated the retrieval of the cable to minimize the risk of entanglement (Table 15). Most of the acoustic monitoring downtime occurred during the South Island (72%), as the hydrophone cable was on board during all the OBS deployment and retrieval operations as well as the times that operations were suspended due to rough weather. Each instance of acoustic monitoring downtime is recorded in Appendix G.

In accordance with the IHA and ITS, acoustic monitoring downtime occurred during acoustic source activity only

when the need was unavoidable. Throughout the entire survey program, only five hours 14 minutes of acoustic monitoring downtime occurred while the acoustic source was still active. These occurrences were attributed to the assessment, adjustment, and maintenance of the PAM equipment.

Table 15. Passive Acoustic Monitoring (PAM) Downtime during the Southwest Pacific Ocean New Zealand Seismic Survey Program.

Cause of Downtime	Duration (hh:mm)	% of Overall Downtime
Debris Removal and Maintenance Hydrophone Cable	00:41	0.07%
Replacement of Damaged PAM Equipment	00:00	0.00%
Rough Seas/Risk of Entanglement	171:13	18.08%
Assessment and Adjustment to PAM Equipment	03:36	0.38%
Seismic Gear Deployment/Retrieval/Maintenance	211:11	22.30%
Transit (after initial PAM cable deployment for the survey)	86:45	50.0%
Total Passive Acoustic Monitoring Downtime	473:26	-

During the North Island 2-D survey, acoustic monitoring was suspended for a total duration of 49 hours 33 minutes, only 49 minutes of which occurred while the acoustic source was active. During the North Island 3-D survey, acoustic monitoring was suspended on five occasions for a total of 82 hours seven minutes of acoustic monitoring downtime, 2 hours 27 minutes of which occurred while the acoustic source was active. During the South Island 2-D survey, acoustic monitoring was suspended for a total of 341 hours 46 minutes, one hour 58 minutes of which occurred while the acoustic source was active.

4.4. SIMULTANEOUS VISUAL AND ACOUSTIC MONITORING SUMMARY

Acoustic monitoring was conducted during all day and night hours during the survey program to the maximum extent possible for a total of 1,047 hours 50 minutes over all three programs (Table 16). Of the overall simultaneous monitoring effort, 97% were conducted while the acoustic source was active (Table 16). Additional visual monitoring conducted during transit periods was not accompanied by acoustic monitoring as the increased vessel speed caused the hydrophone cable to migrate to the water surface, out of the ideal tow position, where the increased background noise impaired acoustic detection capabilities.

Table 16: Simultaneous Visual and Acoustic Monitoring Effort during the Southwest Pacific Ocean New Zealand Seismic Survey Program

Survey Program	Simultaneous Visual and Acoustic Monitoring				
	Source Active		Source Silent		Overall
	Duration (hh:mm)	Percentage (%)	Duration (hh:mm)	Percentage (%)	Duration (hh:mm)
North Island 2-D survey	481:20	98	11:58	2	493:18
North Island 3-D Survey	387:42	97	11:53	3	399:35
South Island 2-D Survey	143:56	93	11:01	7	154:57
Southwest Pacific Ocean New Zealand Survey Program	1012:58	97	34:52	3	1047:50

4.5. ENVIRONMENTAL CONDITIONS

Environmental conditions can have an impact on the probability of detecting protected species in a survey area. The environmental conditions present during visual observations undertaken during this survey program were generally good to moderate for the North Island 2-D and 3-D surveys, and moderate to poor for the South Island 2-D survey.

Visibility was classified as ‘excellent’ if it extended to 10 kilometers or greater and good if they were between six to nine kilometers. During the Southeast Pacific Ocean survey program, 43% and 47% of monitoring effort was undertaken at excellent and good visibility levels respectively (Table 17).

Table 17. Visibility during the Southwest Pacific Ocean New Zealand Seismic Survey Program.

Survey	<2 km	2-5 km	6-9 km	>10 km
North Island 2D Survey	15:47	12:08	142:04	378:49
North Island 3D Survey	02:19	13:30	275:25	222:38
South Island 2D Survey	33:13	62:40	275:44	42:22
Overall Project Totals	51:19	88:18	693:13	643:49

Reduced visibility was mainly attributed to periods of rain and fog, and the brief periods of reduced lighting before sunrise and after sunset. Throughout the New Zealand survey program, precipitation was recorded during 18% of visual monitoring, for a total of 269 hours 35 minutes. The majority of the precipitation was fog (12%, 172 hours 47 minutes), the majority of which was recorded during the North Island 3-D survey (38%, 66 hours 23 minutes) and during the South Island 2-D survey (43%, 74 hours five minutes) (Table 18).

Table 18. Precipitation during the Southwest Pacific Ocean New Zealand Seismic Survey Program.

Survey	None	Light Rain	Heavy Rain	Squall	Fog
North Island 2D Survey	499:42	14:44	00:15	04:00	30:07
North Island 3D Survey	433:51	13:03	00:00	00:35	66:23
South Island 2D Survey	275:49	52:43	01:16	10:06	74:05
Overall Project Totals	1209:22	80:30	01:31	14:41	170:35

During visual monitoring throughout the survey program, the entire predicted 160 decibel radius was not visible for 334 hours 28 minutes, mainly due to precipitation and the large size of the radii, which in shallow water was never fully visible. The entire 1,000 meter buffer zone was not visible for 32 hours 28 minutes, the entire 500 meter exclusion zone was not visible for 11 hours six minutes, and the entire 100 meter exclusion zone was not visible for four hours 36 minutes (Table 19). The majority of the time where one of these predicted radii were not full visible occurred during the North Island 2-D survey due to a high amount of survey lines occurring within shallow water, and South Island 2-D survey due to a high amount of precipitation.

Table 19. Duration Radii were Not Fully Visible during the Southwest Pacific Ocean New Zealand Seismic Survey Program.

Survey	160 dB	1000 m	500 m	100 m
North Island 2D Survey	94:31	09:41	01:48	00:00
North Island 3D Survey	52:15	00:05	00:00	52:25
South Island 2D Survey	176:31	22:31	09:13	04:36
Overall Project Totals	323:17	32:17	11:06	04:36

The Beaufort Sea state recorded during visual monitoring ranged from level one to level nine over the course of the survey program. The majority of visual observations (754 hours 59 minutes, 50%) were undertaken in conditions where the Beaufort state was level three or less, which were considered good conditions for the

detection of protected species (Table 20). The majority of the level six to level nine sea states were recorded during the South Island 2-D survey (91 hours 44 minutes). Level nine sea states were only recorded during the South Island 2-D survey.

Table 20. Beaufort Sea State during the Southwest Pacific Ocean New Zealand Seismic Survey Program.

Survey	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
North Island 2D Survey	25:10	120:32	154:41	132:41	80:48	25:58	03:38	02:20	00:00	00:00
North Island 3D Survey	02:34	122:47	168:04	91:00	70:04	34:34	20:49	04:00	00:00	00:00
South Island 2D Survey	02:19	30:38	108:45	89:03	91:30	64:03	20:45	05:56	01:00	00:00
Overall Project Totals	30:03	273:57	431:30	312:44	242:22	127:35	45:12	12:16	01:00	00:00

The Beaufort wind force recorded during visual monitoring ranged from one (one to three knots) to nine (41 to 47 knots). The majority of visual monitoring occurred during a recorded wind force of four (11 to 16 knots) for a total of 412 hours 31 minutes (27% of all visual monitoring effort). The highest wind speeds, between 34 and 47 knots (levels 8 and 9), were recorded for a total of 29 hours 14 minutes (3% of the overall project total), mainly during the South Island 2-D survey (13 hours 33 minutes) (Table 21).

Table 21. Beaufort Wind Force during the Southwest Pacific Ocean New Zealand Seismic Survey Program.

Survey	B1 (1-3 knots)	B2 (4-6 knots)	B3 (7-10 knots)	B4 (11-16 knots)	B5 (17-21 knots)	B6 (22-27 knots)	B7 (28-33 knots)	B8 (34-40 knots)	B9 (41-47 knots)	B10 (48-55 knots)
North Island 2D Survey	24:11	65:14	89:23	170:24	114:25	62:14	18:31	02:23	02:03	00:00
North Island 3D Survey	22:45	60:04	116:14	136:56	69:00	67:18	30:20	09:10	02:05	00:00
South Island 2D Survey	06:09	16:08	52:12	94:36	97:25	104:03	29:53	11:03	02:30	00:00
Overall Project Totals	53:05	141:26	257:49	401:56	280:50	233:35	78:44	22:36	06:38	00:00

Swell heights during visual observations were generally low, with swells of less than two meters recorded for a majority of visual observations (968 hours 27 minutes, 64% of the total visual effort, Table 22). The majority of the two to four meter and greater than four meter swells recorded occurred during the South Island 2-D survey, totaling 262 hours 38 minutes, and 50 hours 42 minutes respectively.

Table 22. Swell Height during the Southwest Pacific Ocean New Zealand Seismic Survey Program.

Survey	<2m	2-4m	>4m
North Island 2D Survey	433:12	105:08	09:28
North Island 3D Survey	403:40	106:25	03:47
South Island 2D Survey	100:39	262:38	50:42
Overall Project Totals	937:31	475:11	63:57

The majority of visual monitoring effort during the survey program was conducted while no glare was present, for a total of 631 hours 12 minutes (42%, Table 23). During times of moderate to severe glare, it is possible that the detection of protected species was hindered.

Table 23. Summary of Glare during the Southwest Pacific Ocean New Zealand Seismic Survey Program.

Survey	None	Little	Moderate	Severe
North Island 2D Survey	206:57	121:25	103:39	116:47
North Island 3D Survey	197:07	124:59	83:32	108:14
South Island 2D Survey	214:52	68:37	60:05	70:25
Overall Project Totals	618:56	315:01	247:16	295:26

5. MONITORING AND DETECTION RESULTS

5.1. VISUAL DETECTIONS

Visual monitoring efforts during the Southwest Pacific Ocean seismic survey program resulted in a total of 135 detections of protected species (summarized in Appendix H). This total included: 16 detections of whales, 50 detections of dolphins, 68 detections of pinnipeds, and one detection of sea turtles. During the North Island 2-D survey, there were 36 detections, including: nine detections of whales, 13 detections of dolphins (two of which occurred concurrently with acoustic detections of the animals) and 14 detections of pinnipeds. During the North Island 3-D survey, there were 36 detections, including: two detections of whales, 30 detections of dolphins (eight of which occurred concurrently with acoustic detections of the animals), three detections of pinnipeds, and one detection of sea turtles. During the South Island 2-D survey, there were 63 detections, including: five detections of whales, seven detections of dolphins (one of which occurred concurrently with an acoustic detection of the animals), and 51 detections of pinnipeds. Table 24 lists the total number of detections and total number of animals recorded for each protected species observed during the survey program. Photographs taken of visual detections can be found in Appendix J. More detailed information about each sighting event can be found in Appendix H.

Table 24. Number of Visual Detection Records Collected for each Protected Species during the Southwest Pacific Ocean New Zealand Seismic Survey Program.

Species	North Island 2-D		North Island 3-D		South Island 2-D		Overall	
	Total Number Detection Records	Total Number Animals Recorded	Total Number Detection Records	Total Number Animals Recorded	Total Number Detection Records	Total Number Animals Recorded	Total Number Detection Records	Total Number Animals Recorded
Whales								
Blue Whale	1	1	0	0	0	0	1	1
Bryde's Whale	3	5	0	0	0	0	3	5
Common "Dwarf" Minke Whale	0	0	0	0	1	1	1	1
Humpback Whale	0	0	0	0	1	1	1	1
Sperm Whale	1	4	1	1	0	0	2	5
Unidentified Baleen Whale	2	2	0	0	2	2	4	4
Unidentified Whale	2	2	1	1	1	1	4	4
Dolphins								
Bottlenose Dolphins	1	3	1	4	1	7	3*	14
Long-finned Pilot Whales	5	37	1	6	4	74	10	117
Short-beaked Common Dolphins	5	130	23	540	2	53	30	723
Unidentified Dolphins	3	14	6	49	1	3	10	66
Pinnipeds								
New Zealand Fur Seals	14	19	3	4	30	42	47	65
New Zealand Sea Lions	0	0	0	0	6	7	6	7
Unidentified Otariid Pinniped	0	0	0	0	14	20	14	20
Unidentified Pinniped	0	0	0	0	1	1	1	1
Sea Turtles								
Leatherback Sea Turtle	0	0	1	1	0	0	1	1
TOTAL	37	217	37	606	64	212	135	1,035

*Three of the detections occurred simultaneously with a detection of another species as a mixed pod and were not counted as separate detections towards the overall project total.

During the Southwest Pacific Ocean seismic survey program, New Zealand fur seals were the most frequently observed species, totaling 36.24% of all protected species. In general, short-beaked common dolphins had the

largest number of individuals sighted per species group, with approximately 823 individuals sighted (71.63%). There were several large pods of short-beaked common dolphins sighted throughout the survey program, including a few pods with between 70 and 100 individuals. Whales and pinnipeds were mostly observed individually or in small groups of five or less individuals.

The majority of the protected species detections during the Southeast Pacific Ocean Survey program occurred within the project areas while the vessel was on a survey line (Figure 12, Figure 13, and Figure 14).

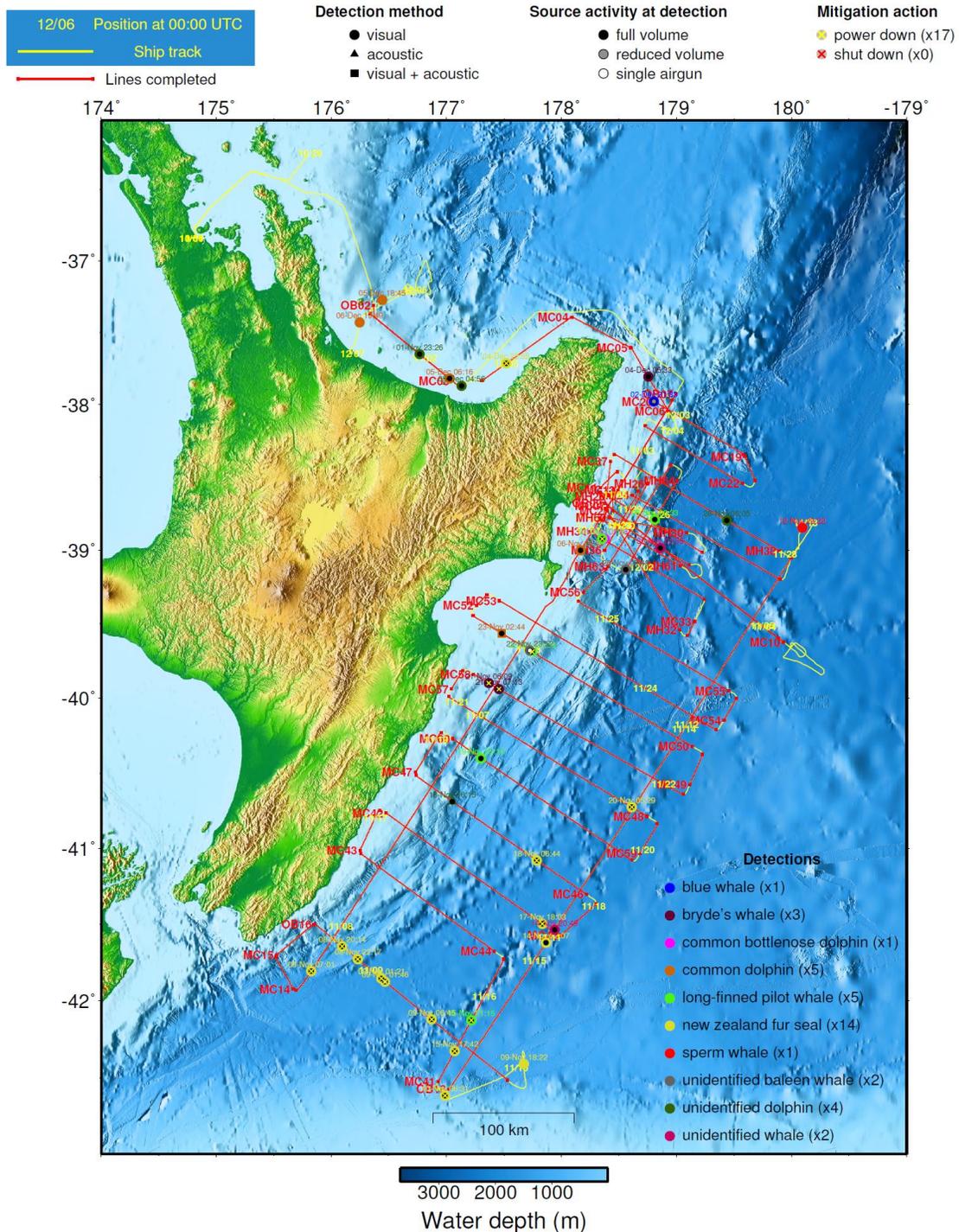


Figure 12: Protected Species Detections and Vessel Track Lines during the North Island 2-D Survey.

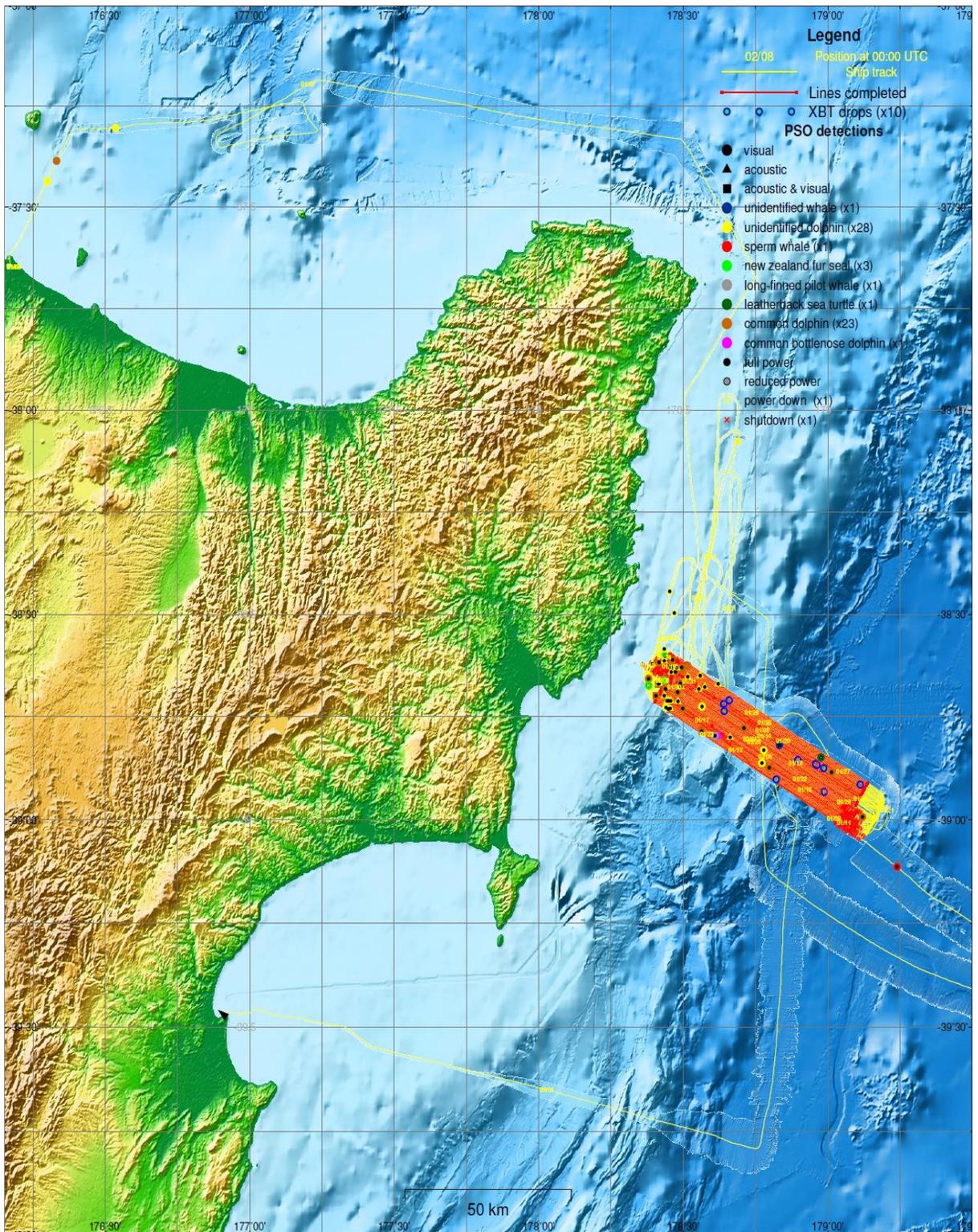


Figure 13: Protected Species Detections and Vessel Track Lines during the North Island 3-D Survey

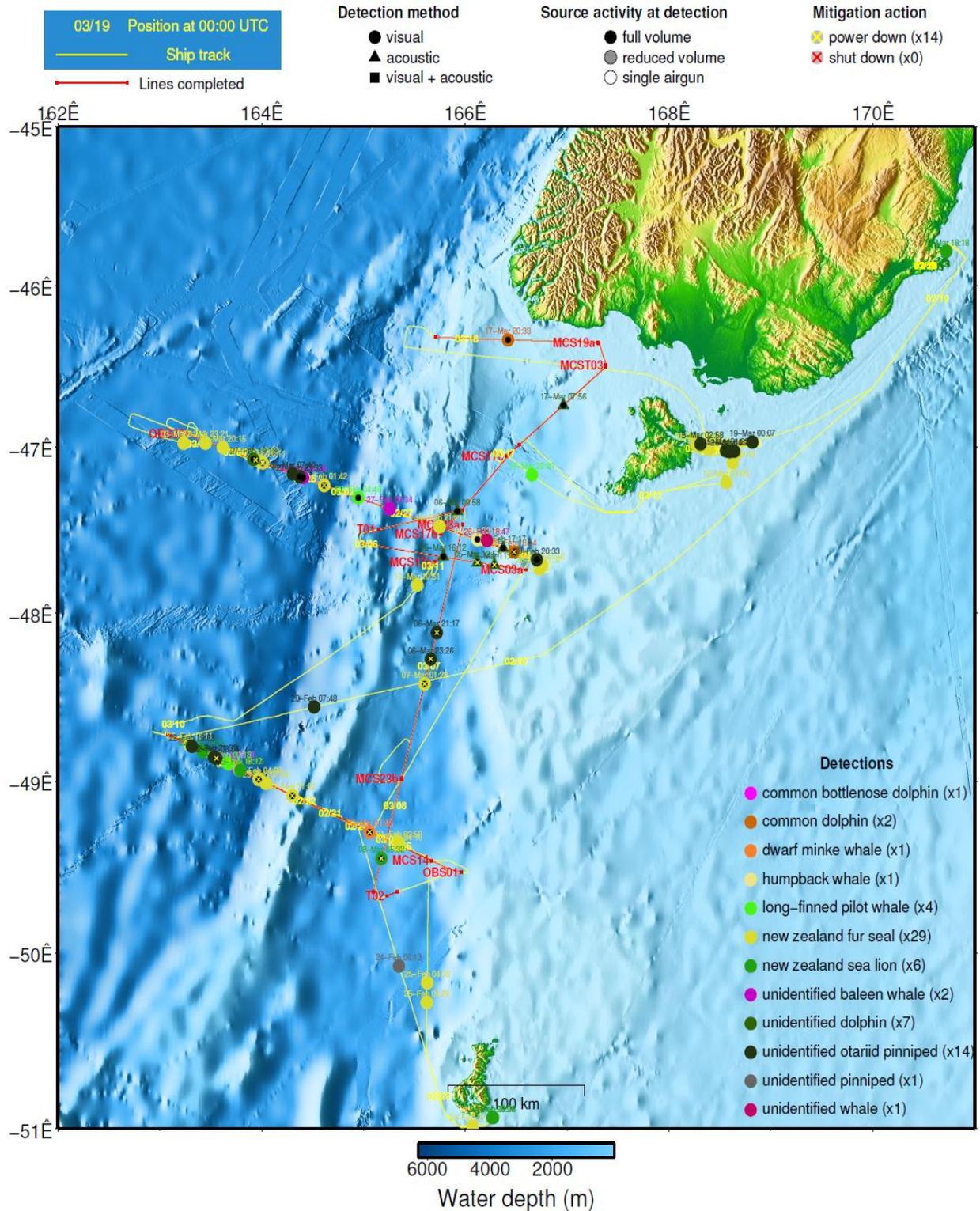


Figure 14: Protected Species Detections and Vessel Track Lines during the South Island 2-D Survey

During the North Island 2-D survey, the majority of the whale detections occurred along the northern section of the east coast of the North Island, with one detection of sperm whales and one detection of unidentified whales occurring further offshore. The dolphin detections were spread throughout the survey area relatively close to

shore except for one detection of long-finned pilot whales that occurred further offshore of the southern area of the east coast of the North Island. The pinniped detections mainly occurred off the southern section of the east coast of the North Island except for one detection which occurred in the Bay of Plenty (Figure 15).

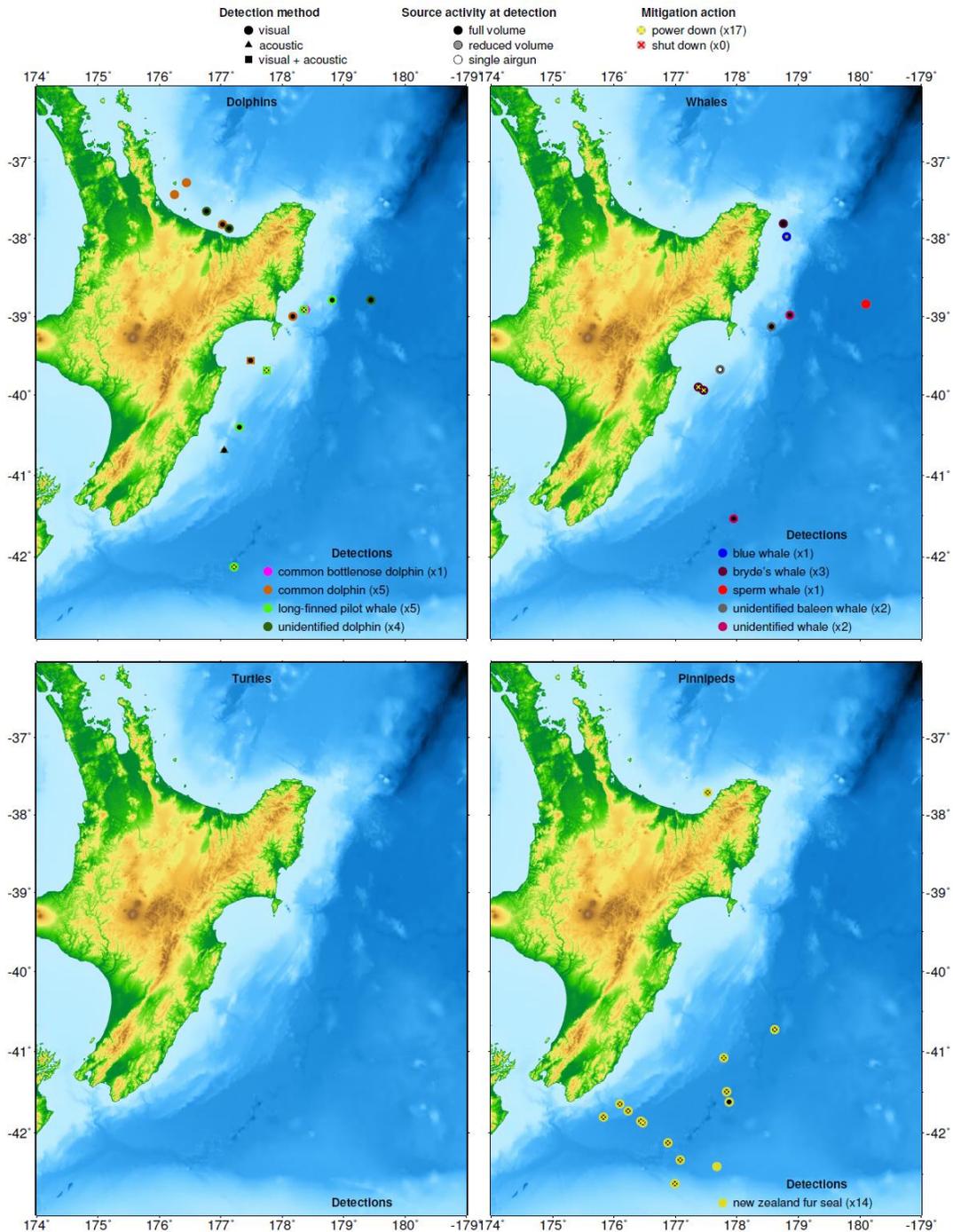


Figure 15: All Protected Species Observed during the North Island 2-D Survey.

During the North Island 3-D survey, the majority of the detections occurred in the northwest end of the survey area close to shore. Three of the dolphin detections occurred in the Bay of Plenty at the beginning of the survey,

and a few occurred scattered from the middle of the survey area to the southeast end, but the majority occurred in the northwest end of the prospect. The sperm whale detection occurred outside of the survey area to the southeast, while the detection of the unidentified whale occurred towards the center of the prospect. The three pinniped detections occurred in the northwest end of the survey area, while the one detection of a sea turtle occurred in the southeast end (Figure 16).

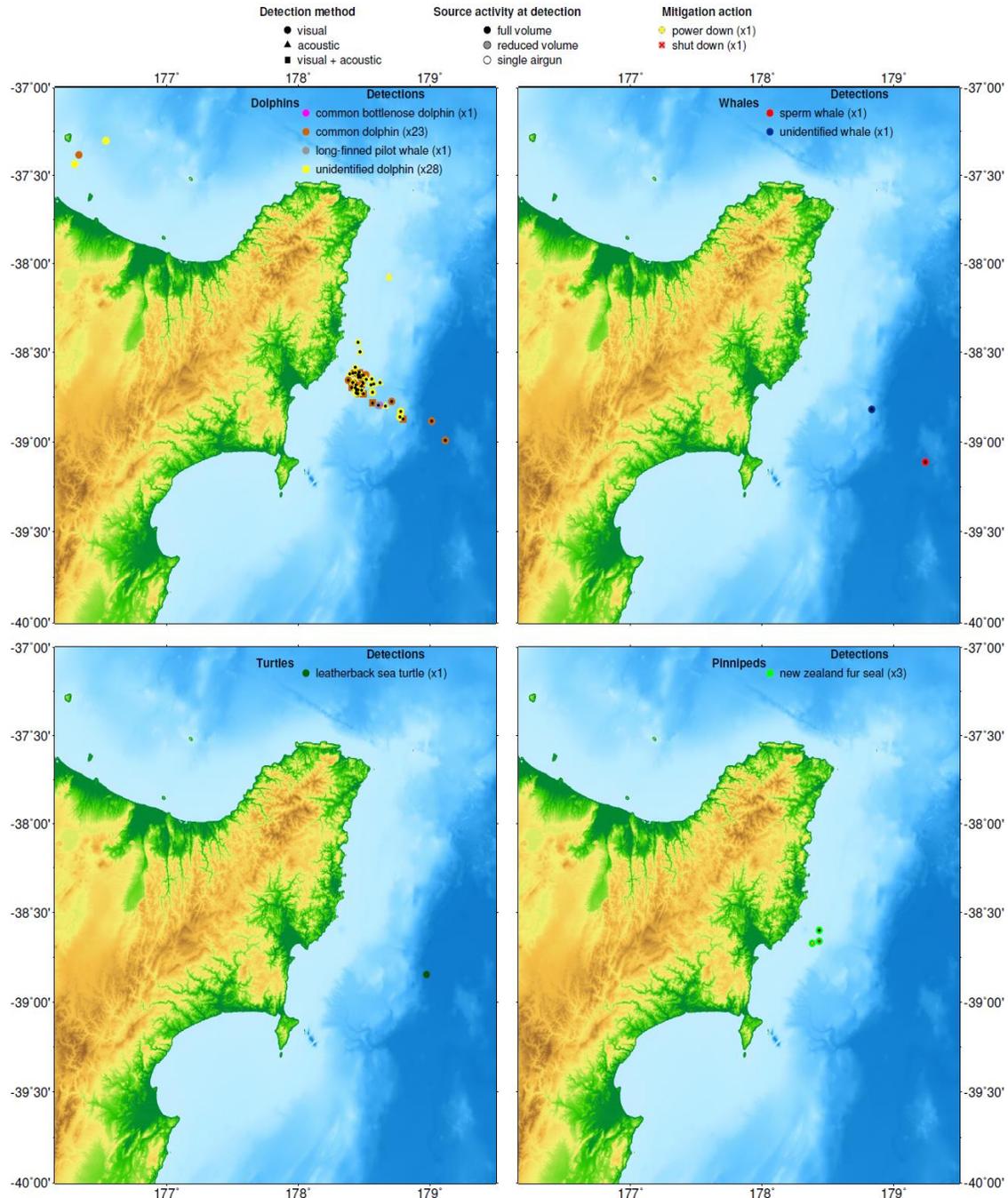


Figure 16: All Protected Species Observed during the North Island 3-D Survey.

During the South Island 2-D survey, the majority of the dolphin and whale detections occurred towards the north end of the survey area, except for the one detection of a common “dwarf” minke whale and the one detection of a mixed pod of long-finned pilot whales and bottlenose dolphins, which occurred towards center and south end of the survey area. The pinniped detections were generally scattered throughout the survey area, with several concentrations of detections near Auckland and Stewart Islands while the vessel was sheltering from inclement weather (Figure 17).

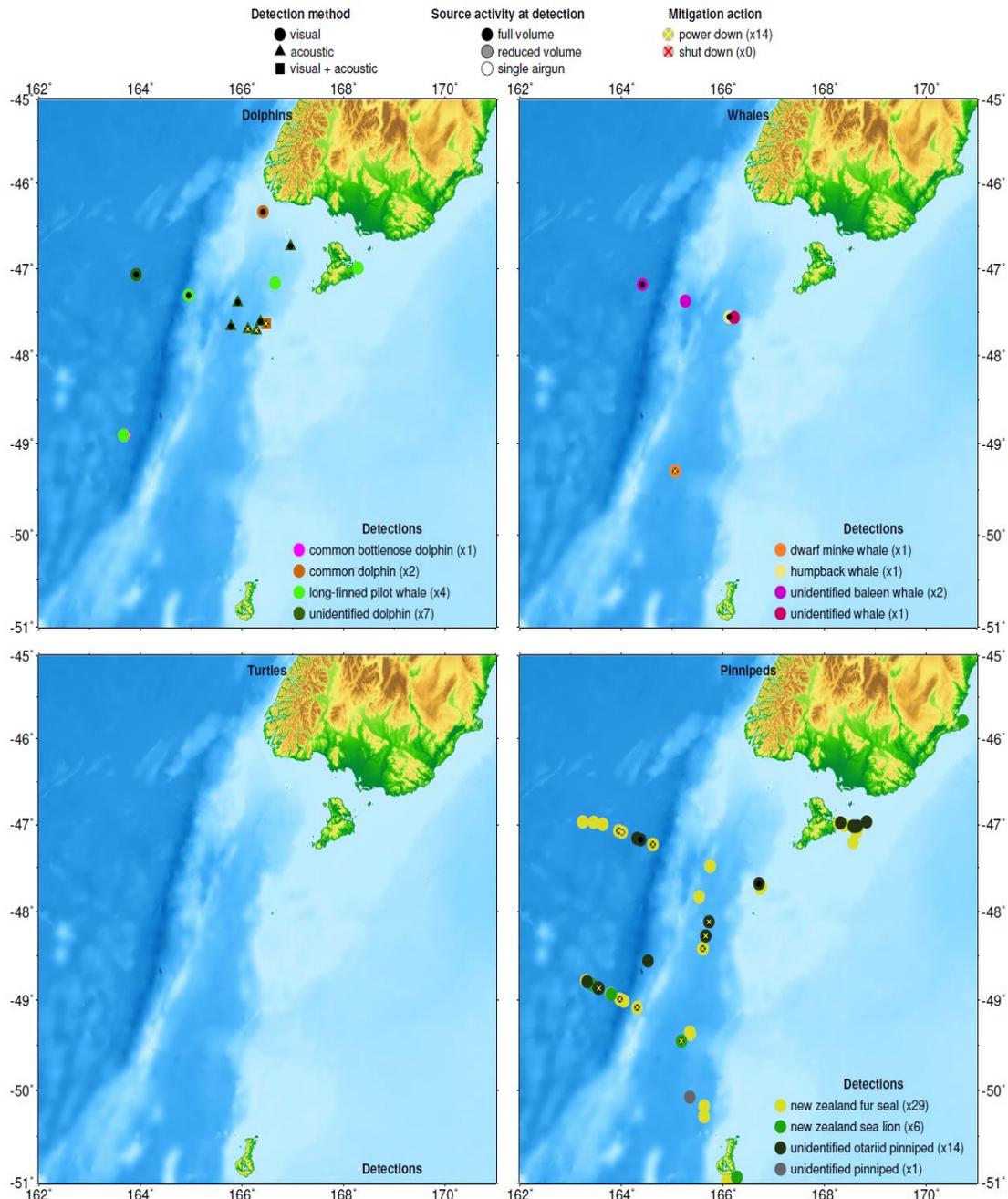


Figure 17: All Protected Species Observed during the South Island 2-D Survey.

There was a large variability in weather conditions throughout the Southwest Pacific Ocean New Zealand survey program, especially during the South Island 2-D survey. However, in general, days with high numbers of visual detections corresponded with days with high visibility, small swells, and calm seas (Figure 18).

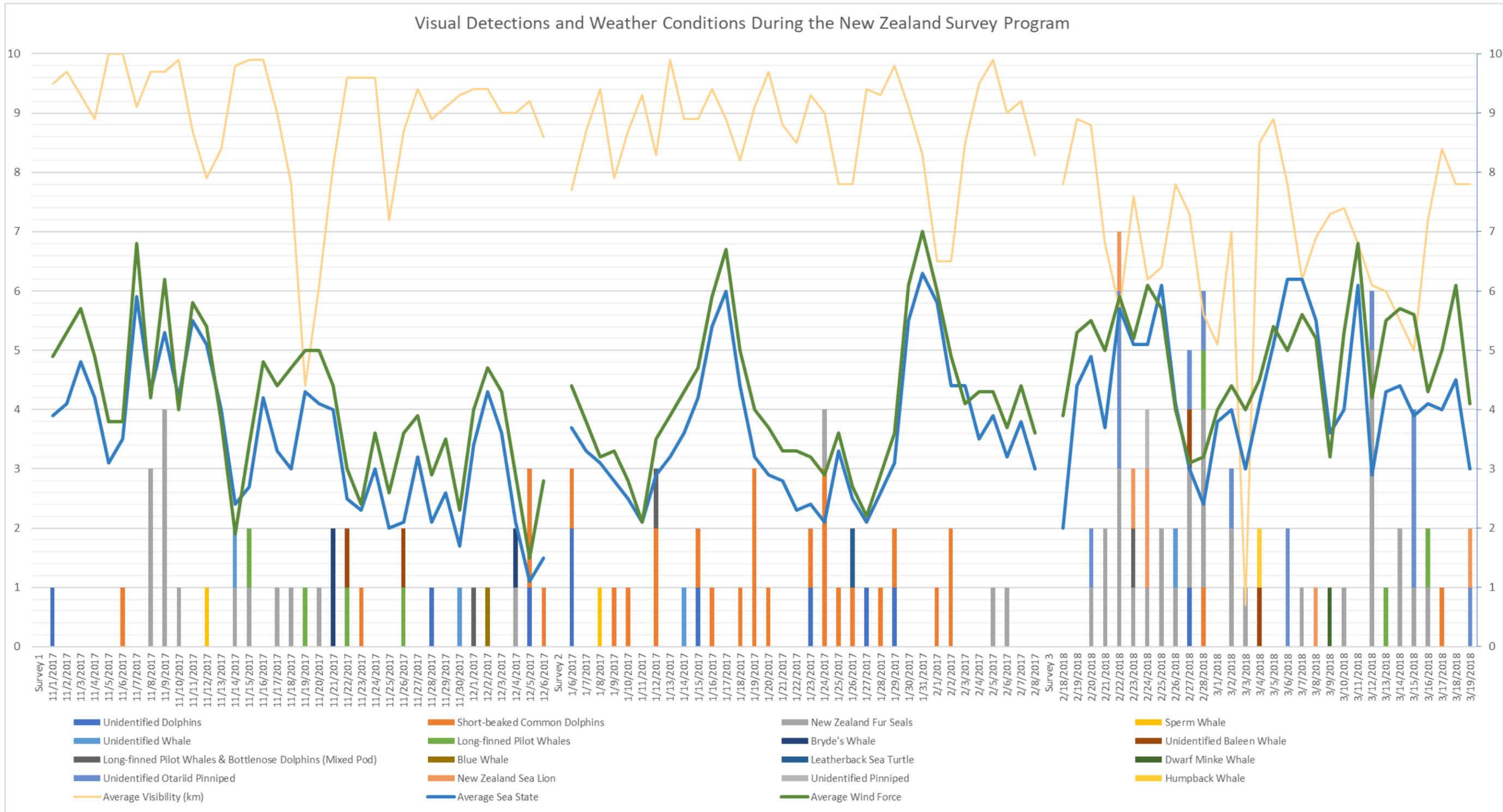


Figure 18: Number of Protected Species Detections each day of the Southwest Pacific Ocean New Zealand Seismic Survey Program and Corresponding Weather Data for each day.

Of the 135 visual detections of protected species during the Southwest Pacific Ocean New Zealand seismic survey program, 62 detections (46%) occurred/began while the acoustic source was at full or reduced volume on a survey line, 17 detections (13%) occurred/began while the acoustic source was at full or reduced volume not on a survey line, one detection (<1%) occurred/began while only a single 40 in3 source element was active, 53 detections (39%) occurred/began while the acoustic source was silent, and two detections (1%) occurred/began during ramp-up (Table 25).

During full or reduced volume operations not on a survey line, there were 17 visual detections of protected species, including: one detection of a blue whale, one detection of a sperm whale, 10 detections of short-beaked common dolphins, one detection of unidentified dolphins, and four detections of New Zealand fur seals.

New Zealand sea lions and leatherback sea turtles had the closest approach to the source during full or reduced volume on a survey line, with an average distance of 178 and 278 meters respectively.

New Zealand fur seals had the closest approach to the source during full or reduced volume while not on a line change, ramp-up, and source silence, with average closest approaches to the source at the various levels of 274 meters, 335 meters, and 218 meters, respectively.

The only detection during source activity of a single 40in3 element was an unidentified baleen whale, with a closest approach to the source of 1,551 meters.

Table 25. Average Closest Approach of Protected Species to the Acoustic Source at Various Volumes during the Southwest Pacific Ocean New Zealand Seismic Survey Program.

Species Detected	Full or Reduced Volume on a Survey Line		Full or Reduced Volume Not on a Survey Line		Single 40 in ³ Element		Silent Source		Ramp-Up	
	Number of detections	Average closest approach to source (meters)	Number of detections	Average closest approach to source (meters)	Number of detections	Average closest approach to source (meters)	Number of detections	Average closest approach to source (meters)	Number of detections	Average closest approach to source (meters)
Blue Whale	-	-	1	740	-	-	-	-	-	-
Bryde's Whale	3	748	-	-	-	-	-	-	-	-
Common "Dwarf" Minke Whale	1	500	-	-	-	-	1	525	-	-
Humpback Whale	1	2376	-	-	-	-	-	-	-	-
Sperm Whale	-	-	1	1300	-	-	2	2343	-	-
Unidentified Baleen Whale	2	2324	-	-	1	1551	2	433	-	-
Unidentified Whale	3	4012	-	-	-	-	1	3158	-	-
All Whale Species	10	1487	2	1020	1	1551	6	1614	-	-
Long-finned Pilot Whales	5	605	-	-	-	-	2	343	-	-
Short-beaked Common Dolphins	15	736	10	622	-	-	6	250	-	-
Mixed pod of Long-finned Pilot Whales & Bottlenose Dolphins	2	860	-	-	-	-	1	244	-	-
Unidentified Dolphins	7	2391	1	1339	-	-	2	365	-	-
All Dolphin Species	29	1148	11	980	-	-	11	300	-	-
New Zealand Fur Seals	16	332	4	274	-	-	32	218	2	335
New Zealand Sea lion	1	178	-	-	-	-	5	235	-	-
Unidentified Otariid Pinniped	5	387	-	-	-	-	9	306	-	-
Unidentified Pinniped	-	-	-	-	-	-	1	259	-	-
All Pinniped Species	22	299	4	274	-	-	47	254	2	335
Leatherback Sea Turtle	1	278	-	-	-	-	-	-	-	-
All Sea Turtle Species	1	278	-	-	-	-	-	-	-	-
All Species	62	976	17	855	1	1551	64	723	2	335

5.1.1. Other Wildlife

Observations of other wildlife during the New Zealand survey program included 71 species of birds, 10 species of fish, and seven species of marine invertebrates. A complete list of birds and other marine wildlife observed and identified, in addition to the approximate number of individuals observed and the number of days on which they were observed, can be found in Appendix L. No impacts to any other wildlife species as a result of research activities were observed during the survey program.

There were three detections of protected bird species during the New Zealand survey program, all of which occurred during the South Island 2-D survey. These sightings included one erect-crested penguin, one unidentified yellow crested penguin, and one rockhopper penguin.

On 22 February 2018, one erect-crested penguin was sighted approximately 40 meters off the starboard side of the vessel. The penguin was observed travelling at a sedate pace away from the vessel for approximately four minutes, then it dove out of sight approximately 260 meters from the vessel. At the time of the detection, the acoustic source was silent and on board while the vessel was conducting OBS retrieval operations. No mitigation actions were required for the sighting of this protected sea bird.

On 09 March 2018, one unidentified yellow crested penguin was sighted approximately 15 meters off the starboard bow of the vessel. The penguin was only observed for a few seconds before it dove out of sight, and visual observers were only able to clearly discern a dark back and head along with the yellow crests. Although the exact species of the penguin could not be determined, there were three species of yellow crested penguins that required mitigation actions for the survey; therefore, as the detection occurred while the source was active at full volume on a survey line, a power-down was implemented as a precaution.

On 10 March 2018, one rockhopper penguin was sighted approximately 80 meters off the port bow of the vessel. The sighting totaled 15 minutes in duration, and the penguin was observed crossing ahead of the vessel at a range of 15 meters from the bow, and then travelling away from the vessel while occasionally diving out of sight off the starboard bow. Throughout the sighting, the acoustic source was silent and on board during streamer retrieval operations, and no mitigation actions were required.

5.2. ACOUSTIC DETECTIONS

There were 40 acoustic detections of protected species during the Southwest Pacific Ocean New Zealand seismic survey program, including three detections during the North Island 2-D survey, 30 detections during the North Island 3-D survey, and seven detections during the South Island 2-D survey. This total included one detection of long-finned pilot whales, 10 detections of short-beaked common dolphins, and 29 detections of unidentified dolphins. All acoustic detections of positively identified dolphins occurred concurrently with visual sighting of the dolphins, and the species identification resulted from the visual detections. A summary of the acoustic detections can be found in Appendix I, and screenshots taken of acoustic detections can be found in Appendix K.

There were 11 concurrent visual and acoustic detections of protected species during the Southwest Pacific Ocean New Zealand seismic survey program, including two detections during the North Island 2-D survey, eight detections during the North Island 3-D survey, and one detections during the South Island 2-D survey. This total included one detection of long-finned pilot whales and 10 detections of short-beaked common dolphins.

Table 26. Number of Acoustic Detection Records Collected for each Protected Species during the Southwest Pacific Ocean New Zealand Seismic Survey Program.

Species	North Island 2-D		North Island 3-D		South Island 2-D		Overall	
	Total Number Detection Records	Total Number Animals Recorded	Total Number Detection Records	Total Number Animals Recorded	Total Number Detection Records	Total Number Animals Recorded	Total Number Detection Records	Total Number Animals Recorded
Concurrent Visual and Acoustic Detections								
Long-finned Pilot Whales	1	2	0	0	0	0	1	2
Short-beaked Common Dolphins	1	11	8	46	1	15	10	72
Acoustic-Only Detections								
Unidentified Dolphins	1	1	22	83	6	16	29	100
TOTAL	3	14	30	129	7	31	40	174

*Three of the detections occurred simultaneously with a detection of another species as a mixed pod and were not counted as separate

6. MITIGATION ACTION SUMMARY

There were 36 mitigation actions implemented during the Southwest Pacific Ocean New Zealand seismic survey program due to protected species being observed approaching, entering, or within the 500 meter and 100 meter exclusion zones. This total included 17 mitigation actions implemented during the North Island 2-D survey, three mitigation actions implemented during the North Island 3-D survey, and 16 mitigation actions implemented during the South Island 2-D survey. Overall, mitigation actions implemented during the survey program totaled 21 hours 47 minutes (Table 27). Thirty-four of the mitigation actions were implemented during acquisition of a survey line, which resulted in a total production loss of 20 hours 11 minutes during the survey program.

Table 27. Number and Duration of Mitigation Actions Implemented during the Southwest Pacific Ocean New Zealand Seismic Survey Program.

Mitigation Action	Whales		Dolphins		Pinnipeds		Sea Turtles		Sea Birds	
	Number	Duration (hh:mm)	Number	Duration (hh:mm)	Number	Duration (hh:mm)	Number	Duration (hh:mm)	Number	Duration (hh:mm)
North Island 2D Survey										
Delayed Source Initiation	0	00:00	0	00:00	0	00:00	0	00:00	0	00:00
Power-down	2	01:07	3	01:50	12	07:25	0	00:00	0	00:00
Shut-down	0	00:00	0	00:00	0	00:00	0	00:00	0	00:00
North Island 3D Survey										
Delayed Operation	0	00:00	0	00:00	0	00:00	0	00:00	0	00:00
Power-down	0	00:00	0	00:00	2	00:37	0	00:00	0	00:00
Shut-down	0	00:00	0	00:00	1	00:27	0	00:00	0	00:00
South Island 2D Survey										
Delayed Operation	0	00:00	0	00:00	0	00:00	0	00:00	0	00:00
Power-down	1	00:54	4	02:58	10	05:54	0	00:00	1	00:35
Shut-down	0	00:00	0	00:00	0	00:00	0	00:00	0	00:00
Total Delayed Source Initiations	0	0:00	0	0:00	0	0:00	0	0:00	0	0:00
Total Power-downs	3	2:01	7	4:48	24	13:56	0	0:00	1	0:35
Total Shut-downs	0	0:00	0	0:00	1	00:27	0	0:00	0	0:00
All Actions	3	2:01	7	4:48	25	14:23	0	0:00	1	00:35

Of the total mitigation actions implemented during the survey program, the majority (69%) were implemented for pinnipeds, with 25 mitigation actions totaling 14 hours 23 minutes.

New Zealand fur seal detections resulted in the greatest number and duration of mitigation actions of all protected species detected, with 24 mitigation actions totaling 13 hours 43 minutes (67% of all mitigation actions) (Table 28).

Table 28: Mitigation Actions and Downtime Duration by Species during the Southwest Pacific Ocean New Zealand Seismic Survey Program.

Species	Number of Delayed Operations	Number of Power-downs	Number of Shut-downs	Duration of Mitigation action (h:mm)	Percentage of Mitigation Downtime
Bryde’s Whale	0	2	0	01:07	5%
Common “Dwarf” Minke Whale	0	1	0	00:54	3%
Short-beaked Common Dolphins	0	1	0	00:55	3%
Long-finned Pilot Whale	0	2	0	01:23	5%
Mixed Pod of Long-finned Pilot Whales & Bottlenose Dolphins	0	1	0	00:27	3%
New Zealand Fur Seal	0	23	1	13:43	67%
New Zealand Sea Lion	0	1	0	00:40	3%
Unidentified Dolphin	0	3	0	02:03	8%
Unidentified Penguin	0	1	0	00:35	3%

Mitigation actions implemented during the Southwest Pacific Ocean New Zealand seismic survey program are summarized in

Table 29.

During the North Island 2-D survey, there were 17 mitigation actions totaling 10 hours 22 minutes implemented for protected species detections. This total included two power-downs totaling one hour seven minutes for whales, three power-downs totaling one hour 50 minutes for dolphins, and 12 power-downs totaling seven hours 25 minutes for pinnipeds. There were no shut-downs or delayed operations implemented during the North Island 2-D survey. No detections resulted in the implementation of more than one mitigation action.

During the North Island 3-D survey, there were three mitigation actions totaling one hour four minutes implemented for protected species detections. This total included two power-downs totaling 37 minutes and one shut-down totaling 27 minutes for pinnipeds. There were no delayed operations implemented during the North Island 3-D survey. One detection resulted in the implementation of more than one mitigation action.

During the South Island 2-D survey, there were 16 mitigation actions totaling 10 hours 21 minutes implemented for protected species detections. This total included one power-down for whales totaling 54 minutes, four power-downs for dolphins totaling two hours 58 minutes, 10 power-downs for pinnipeds totaling five hours 54 minutes, and one power-down for protected sea birds totaling 35 minutes. One detection resulted in the implementation of more than one mitigation action.

Table 29. Summary of each Mitigation Action Implemented during the Southwest Pacific Ocean New Zealand Seismic Survey Program.

Date	Visual or Acoustic Detection Number	Species	Group Size	Source Activity (initial detection)	Closest Approach to Active Source (m)	Mitigation Action	Total Duration of Mitigation Event	Total Duration of Production Loss
North Island 2-D Survey Mitigation Actions								
2017-11-08	VD-3	New Zealand Fur Seal	1	Full volume on a survey line	200	Power Down	00:39	00:39
2017-11-08	VD-4	New Zealand Fur Seal	1	Full volume on a survey line	268	Power Down	00:42	00:42
2017-11-08	VD-5	New Zealand Fur Seal	1	Full volume on a survey line	300	Power Down	00:39	00:39

Date	Visual or Acoustic Detection Number	Species	Group Size	Source Activity (initial detection)	Closest Approach to Active Source (m)	Mitigation Action	Total Duration of Mitigation Event	Total Duration of Production Loss
2017-11-09	VD-6	New Zealand Fur Seal	1	Full volume on a survey line	424	Power Down	00:26	00:26
2017-11-09	VD-7	New Zealand Fur Seal	2	Ramp-up	296	Power Down	00:38	00:38
2017-11-09	VD-8	New Zealand Fur Seal	1	Full volume on a survey line	263	Power Down	00:36	00:36
2017-11-10	VD-10	New Zealand Fur Seal	1	Full volume not on a survey line	224	Power Down	00:37	00:00
2017-11-15	VD-14	New Zealand Fur Seal	4	Full volume on a survey line	458	Power Down	00:39	00:39
2017-11-15	VD-15	Long-finned Pilot Whale	5	Full volume on a survey line	250	Power Down	00:46	00:46
2017-11-17	VD-16	New Zealand Fur Seal	1	Full volume on a survey line	288	Power Down	00:36	00:36
2017-11-18	VD-17	New Zealand Fur Seal	1	Full volume on a survey line	267	Power Down	00:41	00:41
2017-11-20	VD-19	New Zealand Fur Seal	1	Full volume on a survey line	240	Power Down	00:37	00:37
2017-11-21	VD-20	Bryde's Whale	3	Full volume on a survey line	453	Power Down	00:39	00:39
2017-11-21	VD-21	Bryde's Whale	1	Full volume on a survey line	240	Power Down	00:38	00:38
2017-11-22	VD-22	Long-finned Pilot Whale	12	Full volume on a survey line	475	Power Down	00:37	00:37
2017-12-01	VD-29	Mixed pod of Long-finned Pilot whales and Bottlenose Dolphins	12 LFPW & 3 BND	Full volume on a survey line	520	Power Down	00:37	00:37
2017-12-04	VD-32	New Zealand Fur Seal	1	Full volume on a survey line	300	Power Down	00:36	00:36
North Island 3-D Survey Mitigation Actions								
2018-02-05	VD-71	New Zealand Fur Seal	1	Full volume not on a survey line	200	Power Down	00:33	00:00
2018-02-16	VD-72	New Zealand Fur Seal	2	Full volume not on a survey line	100 & 200	Power Down & Shut Down	00:31	00:05
South Island 2-D Survey Mitigation Actions								
2018-02-22	VD-88	New Zealand Fur Seal	1	Full volume on a survey line	240	Power Down	00:37	00:37
2018-02-22	VD-89	New Zealand Fur Seal	1	Full volume on a survey line	369	Power Down	00:26	00:26
2018-02-22	VD-90	Unidentified Otariid Pinniped	1	Full volume on a survey line	219	Power Down	00:35	00:35
2018-02-	VD-108	New	1	Full volume on	309	Power	00:39	00:39

Date	Visual or Acoustic Detection Number	Species	Group Size	Source Activity (initial detection)	Closest Approach to Active Source (m)	Mitigation Action	Total Duration of Mitigation Event	Total Duration of Production Loss
27		Zealand Fur Seal		a survey line		Down		
2018-02-27	VD-109	New Zealand Fur Seal	1	Full volume on a survey line	347	Power Down	00:27	00:27
2018-02-28	VD-111	New Zealand Fur Seal	1	Full volume on a survey line	291	Power Down	00:37	00:37
2018-02-28	VD-113	Short-beaked Common Dolphins	50	Full volume on a survey line	18	Power Down	00:55	00:55
2018-03-05	AD-36	Unidentified Dolphins	4	Full volume on a survey line	220	Power Down (2 times)	01:17	01:17
2018-03-05	AD-37	Unidentified Dolphins	2	Full volume on a survey line	220	Power Down	00:46	00:46
2018-03-06	VD-123	Unidentified Otariid Pinniped	1	Full volume on a survey line	269	Power Down	00:37	00:37
2018-03-06	VD-124	Unidentified Otariid Pinniped	1	Full volume on a survey line	333	Power Down	00:36	00:36
2018-03-07	VD-125	New Zealand Fur Seal	3	Full volume on a survey line	304	Power Down	00:40	00:40
2018-03-08	VD-126	New Zealand Fur Seal	2	Full volume on a survey line	178	Power Down	00:40	00:40
2018-03-09	VD-127	Dwarf Minke Whale	1	Full volume on a survey line	500	Power Down	00:54	00:54
2018-03-09	-	Unidentified Yellow-crested Penguin	1	Full volume on a survey line	239	Power Down	00:35	00:35

6.1. MARINE MAMMALS KNOWN TO HAVE BEEN EXPOSED TO 160 DB OF RECEIVED SOUND LEVELS

NMFS granted an IHA and ITS for the marine seismic survey allowing Level A harassment takes (exposure to sound pressure levels where there is a potential for auditory injury based upon each species hearing range) for 27 marine mammal species, and Level B harassment takes (exposure to sound pressure levels equal to or greater than 160 dB re: 1 μ Pa (rms) where there is a potential for behavioural changes) for 38 marine mammal species. Although NMFS authorized takes for sea turtles, no specific number of takes was authorized for sea turtle species. For sea turtles, behavioral harassment was expected to occur in the 175 dB zone and PTS was expected to occur in the 195 dB zone.

A total of 23,714 individual marine mammals (including six whale species and one dolphin species listed as endangered species) were authorized for takes. Of this total, 23,584 individuals from all 38 species were authorized for Level B takes. The remaining 130 individuals, from only 27 of these species, were authorized for Level A takes. During the Southwest Pacific Ocean New Zealand seismic survey program, 559 protected species were observed within the Level B harassment zone and one protected species was observed within the Level A harassment zone while the acoustic source was active (Table 30).

In addition, there were 386 protected species observed within the predicted harassment zones while the acoustic source was active that were not considered to be potential takes as the vessel was within New Zealand territorial waters at the time of the detections. This total included one Bryde's whale, 347 short-beaked common dolphins, 33 unidentified dolphins, and five New Zealand fur seals.

Table 30. Number of Authorized and Potential Level A and B Harassment Takes During the Southwest Pacific Ocean New Zealand Seismic Survey Program.

Species	IHA Authorized Level A Takes	Potential Level A Takes / PTS During the Program	IHA Authorized Level B Takes	Potential Level B Takes / TTS During the Program	Total IHA Authorized Takes	Total Potential Takes During the Program
ESA Listed Species						
Southern Right Whale	3	0	51	0	54	0
Humpback Whale	3	0	48	1	51	1
Sei Whale	2	0	31	0	33	0
Fin Whale	3	0	52	0	55	0
Blue Whale	0	0	8	1	8	1
Sperm Whale	2	0	654	1	656	1
South Island Hector's Dolphin	0	0	2	0	2	0
Non-Listed Species						
Pygmy Right Whale	1	0	20	0	21	0
Bryde's Whale	1	1	22	3	21	4
Common Minke Whale	2	0	31	1	33	1
Antarctic Minke Whale	2	0	31	0	33	0
Cuvier's Beaked Whale	2	0	591	0	593	0
Arnoux's Beaked Whale	2	0	591	0	593	0
Southern Bottlenose Whale	0	0	394	0	394	0
Shepard's Beaked Whale	0	0	394	0	394	0
Hector's Beaked Whale	0	0	394	0	394	0
True's Beaked Whale	0	0	197	0	197	0
Gray's Beaked Whale	2	0	788	0	790	0
Andrew's Beaked Whale	0	0	394	0	394	0
Strap-toothed Beaked Whale	2	0	591	0	593	0
Blainville's Beaked Whale	0	0	197	0	197	0

Species	IHA Authorized Level A Takes	Potential Level A Takes / PTS During the Program	IHA Authorized Level B Takes	Potential Level B Takes / TTS During the Program	Total IHA Authorized Takes	Total Potential Takes During the Program
Spade-toothed Beaked Whale	0	0	197	0	197	0
Pygmy Sperm Whale	15	0	377	0	392	0
Bottlenose Dolphin	3	0	1,135	7	1,138	7
Short-beaked Common Dolphin	5	0	1,956	319	1,961	319
Dusky Dolphin	3	0	1,323	0	1,326	0
Southern Right Whale Dolphin	2	0	680	0	683	0
Risso's Dolphin	0	0	454	0	454	0
False Killer Whale	3	0	680	0	680	0
Killer Whale	0	0	433	0	433	0
Long-finned Pilot Whale	5	0	1,869	82	1,869	82
Short-finned Pilot Whale	2	0	783	0	783	0
Hourglass Dolphin	37	0	904	0	904	0
Spectacled Porpoise	6	0	120	0	126	0
New Zealand Fur Seal	11	0	5,084	25	5,095	25
New Zealand Sea Lion	1	0	591	2	592	2
Southern Elephant Seal	7	0	1,011	0	1,018	0
Leopard Seal	3	0	506	0	509	0
Sea turtles						
Leatherback Sea Turtle	-	0	-	1	-	1
Hawksbill Sea Turtle	-	0	-	0	-	0
Loggerhead Sea Turtle	-	0	-	0	-	0
Olive Ridley Sea Turtle	-	0	-	0	-	0
Green Sea Turtle	-	0	-	0	-	0
Unidentified species						
Unidentified Whale	-	0	-	5	-	5
Unidentified Dolphin	-	0	-	106	-	106
Unidentified Pinniped	-	0	-	5	-	5
Unidentified Sea Turtle	-	0	-	0	-	0

During the three surveys, 11 identified species (humpback whales, blue whales, sperm whales, Bryde's whales, common "dwarf" minke whales, bottlenose dolphins, short-beaked common dolphins, long-finned pilot whales, New Zealand fur seals, and New Zealand sea lions), along with a number of whales, dolphins, and pinnipeds which were not identifiable to species level, were observed within the Level B harassment zone and one protected species (Bryde's whales) was observed within the Level A harassment zone while the acoustic source was active (Table 31).

Table 31. Number of Potential Level A and B Harassment Takes by Species During the North Island 2D, North Island 3D, and South Island 2D Surveys.

Species	Potential Level A Takes			Potential Level B Takes		
Program	North Island 2D	North Island 3D	South Island 2D	North Island 2D	North Island 3D	South Island 2D
ESA Listed Species						
Humpback Whale						1
Blue Whale				1		
Sperm Whale					1	
Non-Listed Species						
Bryde's Whale	1			3		
Common Minke Whale						1
Bottlenose Dolphin				3	4	
Short-beaked Common Dolphin				82	184	53
Long-finned Pilot Whale				46	6	30
New Zealand Fur Seal				16		9
New Zealand Sea Lion						2
Sea turtles						
Leatherback Sea Turtle					1	
Unidentified species						
Unidentified Whale				4		1
Unidentified Dolphin				7	83	16
Unidentified Pinniped						5

The number of potential takes may be an underestimation and, therefore, may be a minimum estimate of the actual number of protected species potentially exposed to received sound levels within the predicted Level A and Level B harassment zones. It is possible that the estimated numbers of animals recorded were underestimates due to some animals not being seen or having moved away before they were observed. This is most likely to have occurred with sea turtles that were not close enough to the surface to be sighted from the vessel, and large pods of dolphins where exact number of individuals is difficult to determine. The Beaufort Sea state has a large impact on the ability to visibly detect many smaller or unobtrusive marine species such as beaked whales and sea turtles. During the Southwest Pacific Ocean New Zealand survey program, there were many days where Beaufort Sea states (greater than level 4) may have resulted in some missed protected species detections. Only 50% of all visual monitoring observations throughout the survey program were conducted during Beaufort Sea states of level 3 or less.

Additionally, beyond hours of dawn, dusk and darkness, there were several occasions where the entire predicted 160 dB radii, 1,000 meter buffer zone, 500 meter exclusion zone, and 100 meter exclusion zone were not fully visible, which would have prevented sightings of protected species within those areas around the vessel. In addition, when the vessel was in shallow water, the entire 160 dB radii for the full volume source was never visible due to the large range of the area (22,102 meters for a source volume of 6600 in³ and 10,607 meters for a source volume of 3300 in³), which was not fully visible even with utilizing the provided big eye binoculars. Throughout the New Zealand survey program, the entirety of the 160 decibel radii were not visible for 334 hours 28 minutes during visual monitoring efforts. The entire 1,000 meter buffer zone was not visible for 32 hours 17 minutes, the entire 500 meter exclusion zone was not visible for 11 hours six minutes, and the entire 100 meter exclusion zone was not visible for four hours 36 minutes. The majority of the occasions where these radii were not fully visible occurred during the South Island 2-D survey (212 hours 51 minutes)

Previous analysis of R/V *Langseth* source received levels collected via hydrophone streamers in shallow waters (Crone 2014 and 2017), demonstrated that the measured mitigation zones were substantially smaller than those predicted. Therefore, animals observed within the predicted mitigation zones in shallow water for this survey may

similarly not have experienced received levels at those predicted levels. Furthermore, as described in the PEIS, Lloyd’s mirror and surface release effects ameliorate the effects for animals at or near the sea surface.

Table 32 describes the behavior of all animals, including unidentified species, which were visually observed within the predicted Level A and Level B harassment zones during the survey program. While there were no highly distinctive behavioral reactions observed in relation to the vessel or acoustic source during the seismic survey, the majority of the protected species detected were last observed moving away from the vessel.

Table 32: Behaviour of Species Visually Observed to be Exposed to Sound Pressure Levels of 160 dB or Greater during the Southwest Pacific Ocean New Zealand Seismic Survey Program.

Species	Detection No.	No. of Animals	Highest Observed Sound Pressure Level (dB)	Initial behavior	Initial direction in relation to vessel	Subsequent and Final behavior	Subsequent and Final direction in relation to vessel
Blue Whale	30	1	160	Surface Active	Crossing Ahead of the Vessel	Blowing, Diving, Swimming, Surfacing	Away from the Vessel
Bryde’s Whale	20	3	160	Blowing	Crossing Ahead of the Vessel	Milling, Swimming	Away from the Vessel
	21	1	160	Surfacing	Away from the Vessel	Fast Travel	Away from the Vessel
	31	1	160	Blowing	Crossing Ahead of the Vessel	Fast Travel, Surfacing, Diving	Away from the Vessel
Common “Dwarf” Minke Whale	127	1	160	Blowing	Away from the Vessel	Surfacing, Blowing	Away from the Vessel
Humpback Whale	122	1	160	Blowing	Away from the Vessel	Breaching	Away from the Vessel
Sperm Whale	40	1	160	Blowing	Crossing Ahead of the Vessel	Blowing	Away from the Vessel
Unidentified Baleen Whale	23	1	160	Blowing	Away from the Vessel	Blowing	Away from the Vessel
	26	1	160	Blowing	Away from the Vessel	Blowing	Away from the Vessel
	121	1	160	Blowing	Crossing Ahead of the Vessel	Blowing	Crossing Ahead of the Vessel
Unidentified Whale	12	1	160	Diving	Parallel to the Vessel in the Same Direction	Diving	Parallel to the Vessel in the Same Direction
	28	1	160	Swimming	Crossing Ahead of the Vessel	Blowing	Crossing Ahead of the Vessel
Short-beaked Common Dolphin	2	7	160	Porpoising	Crossing Ahead of the Vessel	Fast Travel	Away from the Vessel
	24	82	160	Surfacing	Crossing Ahead of the Vessel	Swimming, Porpoising, Fast Travel, Bow-riding	Away from the Vessel
	34	28	160	Porpoising	Parallel to the Vessel in the Opposite Direction	Porpoising, Fast travel, Surface Active	Away from the Vessel

Species	Detection No.	No. of Animals	Highest Observed Sound Pressure Level (dB)	Initial behavior	Initial direction in relation to vessel	Subsequent and Final behavior	Subsequent and Final direction in relation to vessel
	41	3	160	Surface Active	Parallel to the Vessel in the Same Direction	Surface Active	Parallel to the Vessel in the Same Direction
Short-beaked Common Dolphin	42	20	160	Fast Travel	Crossing Ahead of the Vessel	Porpoising	Away from the Vessel
	44	40	160	Fast Travel	Towards the Vessel	Breaching, Surface Active, Surfacing, milling	Parallel to the Vessel in the Same Direction
	45	21	160	Fast Travel	Crossing Ahead of the Vessel	Porpoising, Jumping, Swimming, Surfacing	Away from the Vessel
	47	10	160	Fast Travel	Parallel to the Vessel in the Opposite Direction	Porpoising, Fast Travel	Away from the Vessel
	49	3	160	Fast Travel	Towards the Vessel	Fast Travel	Towards the Vessel
	50	4	160	Fast Travel	Parallel to the Vessel in the Opposite Direction	Surfacing	Parallel to the Vessel in the Opposite Direction
	51	50	160	Fast Travel	Parallel to the Vessel in the Same Direction	Porpoising, Breaching, Jumping	Parallel to the Vessel in the Same Direction
	52	30	160	Fast Travel	Other	Porpoising, Breaching, Jumping	Crossing Behind the Vessel
	53	10	160	Milling	Parallel to the Vessel in the Opposite Direction	Porpoising, Breaching, Jumping, Spy Hopping	Crossing Behind the Vessel
	55	8	160	Porpoising	Crossing Ahead of the Vessel	Fast Travel; Porpoising	Away from the Vessel
	57	10	160	Fast Travel	Away from the Vessel	Porpoising	Away from the Vessel
	58	75	160	Fast Travel	Towards the Vessel	Surface Active, Feeding, Bow-riding, Mating	Away from the Vessel
	60	70	160	Porpoising	Parallel to the Vessel in the Opposite Direction	Fast Travel, Surface Active, Feeding	Away from the Vessel
	61	40	160	Porpoising	Parallel to the Vessel in the Same Direction	Fast Travel, Surface Active, Feeding, Bow-riding	Away from the Vessel
	62	45	160	Porpoising	Crossing Ahead of the Vessel	Surface Active, Fast Travel	Away from the Vessel
65	15	160	Porpoising	Parallel to the Vessel in the Opposite Direction	Porpoising	Parallel to the Vessel in the Opposite Direction	

Species	Detection No.	No. of Animals	Highest Observed Sound Pressure Level (dB)	Initial behavior	Initial direction in relation to vessel	Subsequent and Final behavior	Subsequent and Final direction in relation to vessel
Short-beaked Common Dolphin	67	40	160	Fast Travel	Towards the Vessel	Porpoising, Surface Active, Feeding Bow riding	Away from the Vessel
	70	2	160	Surface Active	Crossing Ahead of the Vessel	Normal Swimming, Swimming under the Surface	Away from the Vessel
	113	50	160	Swimming	Crossing Ahead of the Vessel	Bow-riding, Swimming under the surface	Away from the Vessel
Long-Finned Pilot Whale	15	5	160	Surfacing	Towards the Vessel	Blowing, Swimming	Away from the Vessel
	18	7	160	Surfacing	Parallel to the Vessel in the Same Direction	Swimming, Porpoising	Parallel to the Vessel in the Same Direction
	22	12	160	Porpoising	Towards the Vessel	Blowing, Milling, Swimming, Surfacing, Feeding, Diving, Fluking, Spy-hopping	Away from the Vessel
	25	10	160	Surfacing	Away from the Vessel	Swimming, Blowing, Milling, Porpoising, Breaching	Away from the Vessel
	43	6	160	Splashing	Variable	Feeding, Swimming, Surfacing, Diving, Fluking	Variable
	112	30	160	Surfacing	Parallel to the Vessel in the Same Direction	Blowing, Milling	Away from the Vessel
Mixed Species Dolphin Pod – Long-finned Pilot Whale and Bottlenose Dolphin	29	12 LFPW & 3 BND	160	Surface Active	Parallel to the Vessel in the Same Direction	Blowing, Porpoising, Fast Travel, Surfacing, Diving	Away from the Vessel
	43	6 LFPW & 4 BND	160	Splashing	Variable	Feeding, Swimming, Surfacing, Diving, Fluking	Variable
Unidentified Dolphin	1	2	160	Porpoising	Away from the Vessel	Fast Travel	Away from the Vessel
	27	6	160	Porpoising	Parallel to the Vessel in the Opposite Direction	Porpoising, Blowing, Fast Travel	Away from the Vessel

Species	Detection No.	No. of Animals	Highest Observed Sound Pressure Level (dB)	Initial behavior	Initial direction in relation to vessel	Subsequent and Final behavior	Subsequent and Final direction in relation to vessel
	33	6	160	Fast Travel	Towards the Vessel	Surface Active, Porpoising, Swimming	Away from the Vessel
	48	4	160	Fast Travel	Crossing Ahead of the Vessel	Fast Travel	Crossing Ahead of the Vessel
	64	15	160	Porpoising	Parallel to the Vessel in the Opposite Direction	Fast Travel	Parallel to the Vessel in the Opposite Direction
	66	10	160	Surfacing	Crossing Ahead of the Vessel	Surface Active, Porpoising, Feeding, Swimming under the surface	Crossing Ahead of the Vessel
	107	3	160	Surfacing	Crossing Ahead of the Vessel	Surfacing	Crossing Ahead of the Vessel
New Zealand Fur Seal	3	1	160	Porpoising	Towards the Vessel	Porpoising, Swimming	Parallel to the Vessel in the Same Direction
	4	1	160	Swimming	Crossing Ahead of the Vessel	Swimming, Porpoising, Fast Travel	Away from the Vessel
	5	1	160	Resting at the Surface	Parallel to the Vessel in the Opposite Direction	Swimming, Diving, Porpoising, Fast Travel	Away from the Vessel
	6	1	160	Spy-hopping	Parallel to the Vessel in the Opposite Direction	Surfacing, Diving, Porpoising, Fast Travel	Away from the Vessel
	7	2	160	Surfacing	Parallel to the Vessel in the Same Direction	Swimming, Porpoising	Away from the Vessel
	8	1	160	Surfacing	Parallel to the Vessel in the Same Direction	Swimming Diving	Away from the Vessel
	10	1	160	Surfacing	Towards the Vessel	Swimming, Fast travel, Porpoising	Parallel to the Vessel in the Opposite Direction
	13	1	160	Resting at the Surface	Stationary	Resting at the Surface	Stationary
New Zealand Fur Seal	14	4	160	Resting at the Surface	Milling	Swimming, Milling, Porpoising	Away from the Vessel
	16	1	160	Surfacing	Unknown	Diving	Unknown
	17	1	160	Surfacing	Parallel to the Vessel in the Opposite Direction	Swimming, Diving	Parallel to the Vessel in the Opposite Direction
	19	1	160	Diving	Crossing Ahead of the Vessel	Fast Travel, Diving, Swimming,	Away from the Vessel

Species	Detection No.	No. of Animals	Highest Observed Sound Pressure Level (dB)	Initial behavior	Initial direction in relation to vessel	Subsequent and Final behavior	Subsequent and Final direction in relation to vessel
						Porpoising	
	32	1	160	Surfacing	Parallel to the Vessel in the Opposite Direction	Swimming, Diving	Parallel to the Vessel in the Opposite Direction
	59	1	160	Surfacing	Away from the Vessel	Swimming, Diving	Away from the Vessel
	71	1	160	Resting at the Surface	Stationary	Swimming, Diving, Feeding, Porpoising	Away from the Vessel
	72	2	160	Resting at the Surface	Stationary	Swimming, Diving	Away from the Vessel
	88	1	160	Surfacing	Parallel to the Vessel in the Same Direction	Diving, Porpoising, Fast Travel	Away from the Vessel
	89	1	160	Spy-hopping	Stationary	Spy-hopping	Stationary
	108	2	160	Spy-hopping	Stationary	Diving, Porpoising	Parallel to the Vessel in the Opposite Direction
	109	1	160	Porpoising	Away from the Vessel	Fast Travel	Away from the Vessel
	111	1	160	Surfacing	Parallel to the Vessel in the Same Direction	Diving, Porpoising, Resting at the Surface	Away from the Vessel
	125	3	160	Surfacing	Parallel to the Vessel in the Same Direction	Diving, Porpoising	Away from the Vessel
	128	1	160	Porpoising	Variable	Swimming under the Surface, Diving, Fast Travel, Spy-hopping	Away from the Vessel
New Zealand Sea Lions	126	2	160	Porpoising	Parallel to the Vessel in the Same Direction	Spy-hopping, Porpoising	Away from the Vessel
Unidentified Otariid Pinniped	90	1	160	Resting at the Surface	Stationary	Porpoising	Away from the Vessel
	110	1	160	Resting at the Surface	Stationary	Resting at the Surface	Stationary
	114	1	160	Porpoising	Away from the Vessel	Porpoising	Away from the Vessel
	123	1	160	Surfacing	Parallel to the Vessel in the Same Direction	Resting at the Surface, Diving	Parallel to the Vessel in the Same Direction
	124	1	160	Surfacing	Parallel to the Vessel in the Same Direction	Porpoising, Diving	Away from the Vessel

Species	Detection No.	No. of Animals	Highest Observed Sound Pressure Level (dB)	Initial behavior	Initial direction in relation to vessel	Subsequent and Final behavior	Subsequent and Final direction in relation to vessel
Leatherback Sea Turtle	63	1	175	Floating/Resurfacing at Surface	Towards the Vessel	Diving, Fast Travel	Towards the Vessel

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

In order to minimize the potential impacts to marine mammals and sea turtles during the Southwest Pacific Ocean New Zealand survey program, LDEO and PSOs were prepared to implement mitigation measures whenever these protected species were detected approaching, entering, or within the exclusion zones designated in the IHA and ITS. There were 36 mitigation actions implemented for protected species during the survey program, including 35 power-downs, and one shut-down, totaling 21 hours 47 minutes. The confirmation of the implementation of each Term and Condition of the Biological Opinion's Incidental Take Statement are described within this report.

Additional mitigation measures in the IHA and ITS required that:

- (1) The acoustic source would be shut-down if a Hector's or Maui's dolphin was visually or acoustically detected at any distance from the source;
- (2) The acoustic source would be shut-down if a beaked whale was visually or acoustically detected at any distance from the source;
- (3) The acoustic source would be shut-down if a *Kogia* spp. was visually or acoustically detected at any distance from the source;
- (4) The acoustic source would be shut-down if a large whale with a calf (defined as two-thirds the body size of the adult) was visually detected at any distance from the source;
- (5) The acoustic source would be shut-down if a large group of whales (six individuals or more) was visually detected at any distance from the source;
- (6) The acoustic source would be shut-down for an acoustic only detection of a sperm whale that could not be definitively located outside of the designated EZ; and
- (7) The acoustic source would be powered down for acoustic only detections where there existed a possibility that the vocalizations could be from a beak whale, *Kogia* sp., or sperm whale and the distance to the source was uncertain.

Throughout the New Zealand seismic survey program, none of these additional mitigation measures were required to be implemented.

The IHA and ITS also outlined mitigation exceptions for three dolphin species, including short-beaked common dolphins, dusky dolphins, and southern right-whale dolphins. If observers could positively identify these species upon initial detection, a mitigation action would not be required if they were observed approaching, entering, or within the 500 meter and 100 meter EZ. However, if there was any uncertainty to the species identification, a mitigation action would be implemented per normal procedures. During the North Island 2-D survey, this exception was utilized during two detections of short-beaked common dolphins. Each detection occurred while the acoustic source was active at full volume during survey line acquisition. The pods consisted of seven and 82 individuals respectively, and the closest observed distance of any of these dolphins to the active source was 95 meters. During the North Island 3-D survey, this exception was utilized during 10 detections of short-beaked common dolphins. Each detection occurred while the acoustic source was at full volume, with five occurring during survey line acquisition operations and five occurring during line change operations. The pod size ranged between two and 75 individuals, and the closest observed distance of any of these dolphins to the active source was 121 meters. During the South Island 2-D survey, a power-down was implemented for one visual detection of short-beaked common dolphins as the species could not be determined for the first few minutes of the sighting before

the dolphins entered the 500 meter exclusion zone due to reduced lighting at dawn and the presence of fog and rain. However, the exception was utilized later in the detection as the dolphins then entered the 100 meter exclusion zone, and as the species was positively identified before that time, a shut-down was not required per the exception. The detection included at least 50 individuals, of which 30 individuals entered the exclusion zone. The closest observed distance of the dolphins to the single active 40 in³ element was 18 meters.

In the event that an injured or dead protected species was discovered during the course of the survey program, and the lead visual observer determined that the cause of death was unknown or unrelated to the activities of the vessel, the incident was to be immediately reported. The report would include a detailed description of the incident, including pictures when possible, and information about the vessel's activities within the 24 hours prior to the discovery of the injured/dead protected species. Throughout the New Zealand seismic survey program, there was one sighting of a dead protected species. On 12 March 2018, the carcass of an unidentified marine mammal was sighted as the vessel was transiting outside of the survey area near Stewart Island, where the vessel was heading to shelter from an approaching storm system. Due to the briefness of the sighting as the vessel transited, the distance of the carcass from the vessel (750 meters), and the reduced visibility due to the presence of rain and fog, the species of the carcass and the cause of the death were unable to be determined. A report dated 12 March 2018 was provided to NMFS detailing this sighting.

Passive acoustic monitoring was conducted throughout the survey and the majority of acoustic monitoring was undertaken while the source was active. High levels of background noise on the hydrophone cable were experienced when the vessel traveled at higher speeds (greater than six knots), which made it impractical to conduct monitoring for baseline acoustic data collection while the vessel was in transit to and from the survey site. This prevented baseline acoustic data from being collected on the survey site and during transit while visual monitoring was ongoing for baseline data collection purposes. There were 40 acoustic detections of protected species during this survey program, including one detection of long-finned pilot whales, 10 detections of short-beaked common dolphins, and 29 detections of unidentified dolphins. All detections of positively identified dolphins were concurrent with visual detections of the animals where the species was determined by the visual observers.

A total of 23,714 individual marine mammals from 38 species (including six whale species and one dolphin species listed as endangered species) were authorized for takes in the IHA and ITS issued by NMFS. Of this total, 23,584 individuals from all 38 species were authorized for Level B takes. The remaining 130 individuals, from only 27 of these species, were authorized for Level A takes. Takes for endangered sea turtles were authorized; however, there were no specific number of Level A or Level B takes issued for sea turtle species. During the survey program, a total of 559 protected species were observed within the predicted Level B harassment radius. This total represents 2% of the authorized Level B takes, or less than 2% of the authorized takes for the survey. The species composition of this total, in relation to total allowed takes and separated by survey, is shown in Table 30 and Table 31, respectively. A total of one protected species was observed within the predicted Level A harassment zone, including one Bryde's whale. This total represents 1% of the authorized Level A takes for the survey, and 1% of the total of the authorized total takes for the survey program.

New Zealand considers its territorial seas to extend out 12 nautical miles. NMFS' jurisdiction under the ESA and MMPA only applied to the portions of the seismic survey which occurred outside of the 12 nautical mile boundary. Therefore, they did not have the authority to authorize takes within the sovereign territory of New Zealand. During the survey program, there were 386 protected species observed within the predicted Level B harassment zone (and none within the predicted Level A harassment zone) but were not considered to be potential takes due to the detections occurring within New Zealand territorial waters. This total included: one Bryde's whale, 347 short-beaked common dolphins, 33 unidentified dolphins, and five New Zealand fur seals.

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

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

7. LITERATURE CITED

NOAA, 2017. Endangered Species Act Section 7 Consultation Biological Opinion for a marine seismic survey by Lamont-Doherty Earth Observatory in the Southwest Pacific Ocean and NFMS IHA issuance.

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

Crone, T.J., M. Tolstoy, and H. Carton. 2017. Utilizing the R/V Marcus G. Langseth's streamer to measure the acoustic radiation of its seismic source in the shallow waters of New Jersey's continental shelf. *PloS ONE* 12(8):e0183096. <http://doi.org/10.1371/journal.pone.0183096>

APPENDIX A: Incidental Harassment Authorization for the Southwest Pacific Ocean New Zealand Marine Geophysical Survey.



INCIDENTAL HARASSMENT AUTHORIZATION

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

1. This incidental harassment authorization (IHA) is valid for a period of one year from the date of issuance.
2. This IHA is valid only for marine geophysical survey activity, as specified in L-DEO's IHA application and using an array aboard the R/V *Langseth* with characteristics specified in the IHA application, in the Pacific Ocean within waters of New Zealand's Exclusive Economic Zone.
3. General Conditions
 - (a) A copy of this IHA must be in the possession of L-DEO, the vessel operator and other relevant personnel, the lead protected species observer (PSO), and any other relevant designees of L-DEO operating under the authority of this IHA.
 - (b) The species authorized for taking are listed in Table 1. The taking, by Level A and Level B harassment only, is limited to the species and numbers listed in Table 1. Any taking exceeding the authorized amounts listed in Table 1 is prohibited and may result in the modification, suspension, or revocation of this IHA.
 - (c) The taking by serious injury or death of any species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this IHA.
 - (d) During use of the airgun(s), if marine mammal species other than those listed in Table 1 are detected by PSOs, the acoustic source must be shut down to avoid unauthorized take.
 - (e) L-DEO shall ensure that the vessel operator and other relevant vessel personnel are briefed on all responsibilities, communication procedures, marine mammal monitoring protocol, operational procedures, and IHA requirements prior to the start of survey activity, and when relevant new personnel join the survey operations.
4. Mitigation Requirements

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

 - (a) L-DEO must use at least five dedicated, trained, National Marine Fisheries Service (NMFS) approved Protected Species Observers (PSOs), including at least four visual PSOs and one acoustic PSO. The PSOs must have no tasks other than to conduct



observational effort, record observational data, and communicate with and instruct relevant vessel crew with regard to the presence of marine mammals and mitigation requirements. PSO resumes shall be provided to NMFS for approval.

- (b) At least two PSOs must have a minimum of 90 days at-sea experience working as PSOs during a high energy seismic survey, with no more than eighteen months elapsed since the conclusion of the at-sea experience. At least one of these must have relevant experience as a visual PSO and at least one must have relevant experience as an acoustic PSO. One “experienced” visual PSO shall be designated as the lead for the entire protected species observation team. The lead PSO shall coordinate duty schedules and roles for the PSO team and serve as primary point of contact for the vessel operator. The lead PSO shall devise the duty schedule such that “experienced” PSOs are on duty with those PSOs with appropriate training but who have not yet gained relevant experience, to the maximum extent practical.
- (c) Visual Observation
 - (i) During survey operations (*e.g.*, any day on which use of the acoustic source is planned to occur; whenever the acoustic source is in the water, whether activated or not), two PSOs must be on duty and conducting visual observations at all times during daylight hours (*i.e.*, from 30 minutes prior to sunrise through 30 minutes following sunset) with the limited exception of meal times during which one PSO may be on duty. PSOs shall monitor the entire extent of the estimated Level B harassment zone (or, as far as they can see, if they cannot see to the extent of the estimated Level B harassment zone).
 - (ii) Visual monitoring must begin not less than 30 minutes prior to ramp-up, including for nighttime ramp-ups of the airgun array, and must continue until one hour after use of the acoustic source ceases or until 30 minutes past sunset.
 - (iii) Visual PSOs shall coordinate to ensure 360° visual coverage around the vessel from the most appropriate observation posts and shall conduct visual observations using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner.
 - (iv) Visual PSOs shall communicate all observations to the acoustic PSO, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.
 - (v) Visual PSOs may be on watch for a maximum of four consecutive hours followed by a break of at least one hour between watches.
 - (vi) During good conditions (*e.g.*, daylight hours; Beaufort sea state 3 or less), visual PSOs shall conduct observations when the acoustic source is not operating for comparison of sighting rates and behavior with and without use of the acoustic source and between acquisition periods, to the maximum extent practicable.
- (d) Acoustic Observation – The *R/V Langseth* must use a towed passive acoustic monitoring (PAM) system, which must be monitored beginning at least 30 minutes prior to ramp-up and at all times during use of the acoustic source.

- (i) One acoustic PSO (in addition to the four visual PSOs) must be on board to operate and oversee PAM operations. Either the acoustic PSO or a visual PSO with training in the PAM system must monitor the PAM system at all times while airguns are operating, and when possible during periods when the airguns are not operating, in shifts lasting no longer than six hours.
- (ii) Acoustic PSOs shall communicate all detections to visual PSOs, when visual PSOs are on duty, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.
- (iii) Survey activity may continue for brief periods of time if the PAM system malfunctions or is damaged. Activity may continue for 30 minutes without PAM while the PAM operator diagnoses the issue. If the diagnosis indicates that the PAM system must be repaired to solve the problem, operations may continue for an additional five hours without acoustic monitoring under the following conditions:
 - (A) No marine mammals (excluding delphinids) detected solely by PAM in the exclusion zone in the previous two hours;
 - (B) NMFS is notified via email as soon as practicable with the time and location in which operations began without an active PAM system; and
 - (C) Operations with an active acoustic source, but without an operating PAM system, do not exceed a cumulative total of five hours in any 24 hour period.
- (e) Exclusion Zone and buffer zone – PSOs shall establish and monitor a 500 m exclusion zone (EZ) with a 500 m buffer. The zones shall be based upon radial distance from any element of the airgun array (rather than being based on the center of the array or around the vessel itself). During use of the acoustic source, occurrence of marine mammals within the EZ, or on a course to enter the EZ, shall trigger further mitigation measures as described below.
 - (i) Ramp-up – A ramp-up procedure, involving a step-wise increase in the number of airguns firing and total array volume until all operational airguns are activated and the full volume is achieved, is required at all times as part of the activation of the acoustic source, including following a power down or shutdown of the array, except as described under 4(e)(vi). Ramp-up shall begin by activating a single airgun of the smallest volume in the array and shall continue in stages by doubling the number of active elements at the commencement of each stage, with each stage of approximately the same duration.
 - (ii) If the airgun array has been powered down or shut down due to a marine mammal detection, ramp-up shall not occur until all marine mammals have cleared the EZ. A marine mammal is considered to have cleared the EZ if:
 - (A) It has been visually observed to have left the EZ; or
 - (B) It has not been observed within the EZ, for 15 minutes (in the case of small odontocetes and pinnipeds) or for 30 minutes (in the case of mysticetes and large odontocetes including sperm, pygmy sperm, and beaked whales).

- (iii) Thirty minutes of pre-clearance observation of the 500 m EZ and 500 m buffer zone are required prior to ramp-up following any extended deactivation of the array (i.e. deactivation of longer than 30 minutes). This pre-clearance period may occur during any vessel activity. If any marine mammal (including delphinids) is observed within or approaching the 500 m EZ during the 30 minute pre-clearance period, ramp-up may not begin until the animal(s) has been observed exiting the buffer zone or until an additional time period has elapsed with no further sightings (i.e., 15 minutes for small odontocetes and pinnipeds, and 30 minutes for mysticetes and large odontocetes including sperm, pygmy sperm, and beaked whales).
 - (iv) During ramp-up, PSOs shall monitor the 500 m EZ and 500 m buffer zone. Ramp-up may not be initiated if any marine mammal (including delphinids) is observed within or approaching the 500 m EZ. If a marine mammal is observed within or approaching the 500 m EZ during ramp-up, a power down or shutdown shall be implemented as though the full array were operational. Ramp-up may not begin again until the animal(s) has been observed exiting the 500 m EZ or until an additional time period has elapsed with no further sightings (i.e., 15 minutes for small odontocetes and pinnipeds, and 30 minutes for mysticetes and large odontocetes including sperm, pygmy sperm, and beaked whales).
 - (v) Ramp-up shall only occur at night and at times of poor visibility where operational planning cannot reasonably avoid such circumstances. Ramp-up may occur at night and during poor visibility if the 500 m EZ and 500 m buffer zone have been continually monitored by visual PSOs for 30 minutes prior to ramp-up with no marine mammal detections and if acoustic monitoring has occurred for 30 minutes prior to ramp-up with no acoustic detections during that period.
 - (vi) Ramp-up of the array must not occur at night or at times of poor visibility if the PAM system is not operational.
 - (vii) If the airgun array has been shut down for reasons other than mitigation (e.g., mechanical difficulty) for a period of less than 30 minutes, it may be activated again without ramp-up if PSOs have maintained constant visual and acoustic observation and no visual detections of any marine mammal have occurred within the buffer zone and no acoustic detections have occurred.
 - (viii) The vessel operator must notify a designated PSO of the planned start of ramp-up as agreed-upon with the lead PSO; A designated PSO must be notified again immediately prior to initiating ramp-up procedures and the operator must receive confirmation from the PSO to proceed.
- (f) Power Down Requirements – L-DEO shall power down the airgun array to a single 40-in³ airgun if a PSO detects a marine mammal within, approaching, or entering the 500 m EZ.
- (i) Any PSO on duty has the authority to call for power down of the airgun array (visual PSOs on duty should be in agreement on the need for power down before requiring such action). When there is certainty regarding the need for mitigation action on the basis of either visual or acoustic detection alone, the relevant PSO(s)

must call for such action immediately.

- (ii) When both visual and acoustic PSOs are on duty, all detections must be immediately communicated to the remainder of the on-duty PSO team for potential verification of visual observations by the acoustic PSO or of acoustic detections by visual PSOs and initiation of dialogue as necessary.
- (iii) The operator must establish and maintain clear lines of communication directly between PSOs on duty and crew controlling the airgun array to ensure that power down commands are conveyed swiftly while allowing PSOs to maintain watch.
- (iv) When power down is called for by a PSO, the power down must occur and any dispute resolved only following power down.
- (v) The power down requirement is waived for dolphins of the following species: short-beaked common dolphin, dusky dolphin and southern right whale dolphin. If there is uncertainty regarding identification (*i.e.*, whether the observed animal(s) belongs to the species described above), power down must be implemented.
- (vi) Upon implementation of a power down, the source may be reactivated under the conditions described at 4(e). Where there is no relevant zone (*e.g.*, power down due to observation of a calf), a 30-minute clearance period must be observed following the last observation of the animal(s).
- (vii) When only the acoustic PSO is on duty and a detection is made, if there is uncertainty regarding distance to the vocalizing animal(s) or regarding species identification, such that the acoustic detection may originate from a sperm whale, beaked whale, or *Kogia* spp., the airgun array must be powered down as a precaution.
- (viii) Power down shall occur for no more than a maximum of 30 minutes at any given time. If, after 30 minutes of the array being powered down, marine mammals have not cleared the 500 m Exclusion Zone as described under 4(e)(ii), the array shall be shut down. Operation of the single 40-in³ airgun (*i.e.*, a power-down state) shall not occur for any purpose other than in response to a marine mammal in the exclusion zone (pursuant to relevant requirements herein).
- (g) Shutdown requirements – An exclusion zone of 100 m for the single 40-in³ airgun shall be established and monitored by PSOs. If a marine mammal is observed within, entering, or approaching the 100 m exclusion zone for the single 40-in³ airgun, whether during implementation of a power down or during operation of the full airgun array, all airguns including the 40-in³ airgun shall be shut down.
- (h) If, after 30 minutes of the array being powered down, marine mammals have not cleared the 500 m Exclusion Zone as described under 4(e)(ii), the full array shall be shut down.
 - (i) Upon implementation of a shutdown, the source may be reactivated under the conditions described at 4(e).
 - (ii) Measures described for power downs under 4(f)(i-v) shall also apply in the case of a shutdown.

- (iii) Shutdown of the acoustic source shall occur upon observation of a large whale (*i.e.*, sperm whale or any baleen whale) with calf at any distance, with “calf” defined as an animal less than two-thirds the body size of an adult observed to be in close association with an adult. Ramp up shall not begin until the whale with calf has not been observed for at least 30 minutes at any distance.
- (iv) Shutdown of the acoustic source shall occur upon observation of an aggregation (*i.e.*, six or more animals) of large whales of any species (*i.e.*, sperm whale or any baleen whale) at any distance. Ramp up shall not begin until the aggregation of whales has not been observed for at least 30 minutes at any distance.
- (v) Shutdown of the acoustic source shall occur upon any observation (visual or acoustic) of a beaked whale or *Kogia* spp., at any distance. Ramp up shall not begin until the beaked whale or *Kogia* spp. has not been observed (visually or acoustically) for at least 30 minutes at any distance.
- (vi) Shutdown of the acoustic source shall occur upon acoustic detection of a sperm whale, unless the location of the sperm whale can be definitively localized and the location is beyond 500 m from the airgun array. If there is any uncertainty regarding the distance or location of an acoustically detected sperm whale, shutdown of the acoustic source shall occur. Ramp up shall not begin until the sperm whale has not been acoustically detected for at least 30 minutes.
- (vii) Shutdown of the acoustic source shall occur upon visual observation of a Hector’s or Maui dolphin, at any distance. Shutdown of the acoustic source shall occur upon acoustic observation of a Hector’s or Maui dolphin, if the acoustic detection can be definitively identified as originating from a Hector’s or Maui dolphin. Ramp up shall not begin until the Hector’s or Maui dolphin has not been observed (visually or acoustically) for at least 15 minutes at any distance.
- (i) Vessel Strike Avoidance – Vessel operator and crew must maintain a vigilant watch for all marine mammals and slow down or stop the vessel or alter course to avoid striking any marine mammal. These requirements apply when the vessel is in transit and do not apply in any case where compliance would create an imminent and serious threat to a person or vessel or to the extent that a vessel is restricted in its ability to maneuver and, because of the restriction, cannot comply. A visual observer aboard the vessel must monitor a vessel strike avoidance zone around the vessel according to the parameters stated below. Visual observers monitoring the vessel strike avoidance zone can be either third-party observers or crew members, but crew members responsible for these duties must be provided sufficient training to distinguish marine mammals from other phenomena. Vessel strike avoidance measures shall be followed during surveys and while in transit.
 - (i) The vessel must maintain a minimum separation distance of 100 m from large whales (*i.e.*, baleen whales and sperm whales). The following avoidance measures must be taken if a large whale is within 100 m of the vessel:
 - (A) The vessel must reduce speed and shift the engine to neutral, and must not engage the engines until the whale has moved outside of the vessel’s path and the minimum separation distance has been established.

- (B) If the vessel is stationary, the vessel must not engage engines until the whale(s) has moved out of the vessel's path and beyond 100 m.
- (ii) The vessel must maintain a minimum separation distance of 50 m from all other marine mammals, with an exception made for animals described in 4(f)(v) that approach the vessel. If an animal is encountered during transit, the vessel shall attempt to remain parallel to the animal's course, avoiding excessive speed or abrupt changes in course.
- (iii) Vessel speeds must be reduced to 10 knots or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near the vessel.
- (j) Miscellaneous Protocols
 - (i) The airgun array must be deactivated when not acquiring data or preparing to acquire data, except as necessary for testing. Unnecessary use of the acoustic source shall be avoided. Notified operational capacity (not including redundant backup airguns) must not be exceeded during the survey, except where unavoidable for source testing and calibration purposes. All occasions where activated source volume exceeds notified operational capacity must be noticed to the PSO(s) on duty and fully documented. The lead PSO must be granted access to relevant instrumentation documenting acoustic source power and/or operational volume.
 - (ii) Testing of the acoustic source involving all elements requires normal mitigation protocols (*e.g.*, ramp-up). Testing limited to individual source elements or strings does not require ramp-up but does require pre-clearance.

5. Monitoring Requirements

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

- (a) The operator must provide bigeye binoculars (*e.g.*, 25 x 150; 2.7 view angle; individual ocular focus; height control) of appropriate quality (*i.e.*, Fujinon or equivalent) solely for PSO use. These shall be pedestal-mounted on the deck at the most appropriate vantage point that provides for optimal sea surface observation, PSO safety, and safe operation of the vessel. The operator must also provide a night-vision device suited for the marine environment for use during nighttime ramp-up pre-clearance, at the discretion of the PSOs. At minimum, the device should feature automatic brightness and gain control, bright light protection, infrared illumination, and optics suited for low-light situations.
- (b) PSOs must also be equipped with reticle binoculars (*e.g.*, 7 x 50) of appropriate quality (*i.e.*, Fujinon or equivalent), GPS, digital single-lens reflex camera of appropriate quality (*i.e.*, Canon or equivalent), compass, and any other tools necessary to adequately perform necessary tasks, including accurate determination of distance and bearing to observed marine mammals.
- (c) PSO Qualifications
 - (i) PSOs must have successfully completed relevant training, including completion of all required coursework and passing a written and/or oral examination

developed for the training program.

- (ii) PSOs must have successfully attained a bachelor's degree from an accredited college or university with a major in one of the natural sciences and a minimum of 30 semester hours or equivalent in the biological sciences and at least one undergraduate course in math or statistics. The educational requirements may be waived if the PSO has acquired the relevant skills through alternate experience. Requests for such a waiver must include written justification. Alternate experience that may be considered includes, but is not limited to (1) secondary education and/or experience comparable to PSO duties; (2) previous work experience conducting academic, commercial, or government-sponsored marine mammal surveys; or (3) previous work experience as a PSO. The PSO should demonstrate good standing and consistently good performance of PSO duties.
- (d) Data Collection – PSOs must use standardized data forms, whether hard copy or electronic. PSOs shall record detailed information about any implementation of mitigation requirements, including the distance of animals to the acoustic source and description of specific actions that ensued, the behavior of the animal(s), any observed changes in behavior before and after implementation of mitigation, and if shutdown was implemented, the length of time before any subsequent ramp-up of the acoustic source to resume survey. If required mitigation was not implemented, PSOs should submit a description of the circumstances. NMFS requires that, at a minimum, the following information be reported:
 - (i) PSO names and affiliations
 - (ii) Dates of departures and returns to port with port name
 - (iii) Dates and times (Greenwich Mean Time) of survey effort and times corresponding with PSO effort
 - (iv) Vessel location (latitude/longitude) when survey effort begins and ends; vessel location at beginning and end of visual PSO duty shifts
 - (v) Vessel heading and speed at beginning and end of visual PSO duty shifts and upon any line change
 - (vi) Environmental conditions while on visual survey (at beginning and end of PSO shift and whenever conditions change significantly), including wind speed and direction, Beaufort sea state, Beaufort wind force, swell height, weather conditions, cloud cover, sun glare, and overall visibility to the horizon
 - (vii) Factors that may be contributing to impaired observations during each PSO shift change or as needed as environmental conditions change (*e.g.*, vessel traffic, equipment malfunctions)
 - (viii) Survey activity information, such as acoustic source power output while in operation, number and volume of airguns operating in the array, tow depth of the array, and any other notes of significance (*i.e.*, pre-ramp-up survey, ramp-up, shutdown, testing, shooting, ramp-up completion, end of operations, streamers, etc.)
 - (ix) If a marine mammal is sighted, the following information should be recorded:

- (A) Watch status (sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform)
 - (B) PSO who sighted the animal
 - (C) Time of sighting
 - (D) Vessel location at time of sighting
 - (E) Water depth
 - (F) Direction of vessel's travel (compass direction)
 - (G) Direction of animal's travel relative to the vessel
 - (H) Pace of the animal
 - (I) Estimated distance to the animal and its heading relative to vessel at initial sighting
 - (J) Identification of the animal (*e.g.*, genus/species, lowest possible taxonomic level, or unidentified); also note the composition of the group if there is a mix of species
 - (K) Estimated number of animals (high/low/best)
 - (L) Estimated number of animals by cohort (adults, yearlings, juveniles, calves, group composition, etc.)
 - (M) Description (as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics)
 - (N) Detailed behavior observations (*e.g.*, number of blows, number of surfaces, breaching, spyhopping, diving, feeding, traveling; as explicit and detailed as possible; note any observed changes in behavior)
 - (O) Animal's closest point of approach and/or closest distance from the center point of the acoustic source;
 - (P) Platform activity at time of sighting (*e.g.*, deploying, recovering, testing, shooting, data acquisition, other)
 - (Q) Description of any actions implemented in response to the sighting (*e.g.*, delays, shutdown, ramp-up, speed or course alteration, etc.); time and location of the action should also be recorded
- (x) If a marine mammal is detected while using the PAM system, the following information should be recorded:
- (A) An acoustic encounter identification number, and whether the detection was linked with a visual sighting
 - (B) Time when first and last heard
 - (C) Types and nature of sounds heard (*e.g.*, clicks, whistles, creaks, burst pulses, continuous, sporadic, strength of signal, etc.)

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

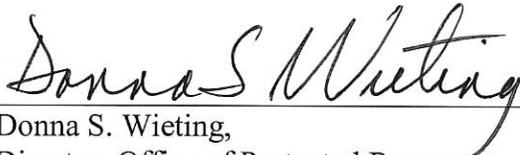
6. Reporting

- (a) L-DEO shall submit a draft comprehensive report on all activities and monitoring results within 90 days of the completion of the survey or expiration of the IHA, whichever comes sooner. The report must describe all activities conducted and sightings of marine mammals near the activities, must provide full documentation of methods, results, and interpretation pertaining to all monitoring, and must summarize the dates and locations of survey operations and all marine mammal sightings (dates, times, locations, activities, associated survey activities). Geospatial data regarding locations where the acoustic source was used must be provided. In addition to the report, all raw observational data shall be made available to NMFS. The report must summarize the data collected as required under condition 5(d) of this IHA. The report must also provide an estimate of the number (by species) of marine mammals with known exposures to seismic survey activity at received levels greater than or equal to thresholds for Level A and Level B harassment (based on visual observation) including an estimate of those on the trackline but not detected. The draft report must be accompanied by a certification from the lead PSO as to the accuracy of the report, and the lead PSO may submit directly to NMFS a statement concerning implementation and effectiveness of the required mitigation and monitoring. A final report must be submitted within 30 days following resolution of any comments from NMFS on the draft report.
- (b) Reporting injured or dead marine mammals:
 - (i) In the event that the specified activity clearly causes the take of a marine mammal in a manner not permitted by this IHA, such as serious injury or mortality, L-DEO shall immediately cease the specified activities and immediately report the incident to the NMFS Office of Protected Resources (301-427-8401) and the New Zealand Department of Conservation (0800-362-468). The report must include the following information:
 - (A) Time, date, and location (latitude/longitude) of the incident;
 - (B) Vessel's speed during and leading up to the incident;
 - (C) Description of the incident;
 - (D) Status of all sound source use in the 24 hours preceding the incident;
 - (E) Water depth;
 - (F) Environmental conditions (*e.g.*, wind speed and direction, Beaufort sea state, cloud cover, and visibility);
 - (G) Description of all marine mammal observations in the 24 hours preceding the incident;
 - (H) Species identification or description of the animal(s) involved;
 - (I) Fate of the animal(s); and

(J) Photographs or video footage of the animal(s).

Activities shall not resume until NMFS is able to review the circumstances of the prohibited take. NMFS will work with L-DEO to determine what measures are necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. L-DEO may not resume their activities until notified by NMFS.

- (ii) In the event that L-DEO discovers an injured or dead marine mammal, and the lead observer determines that the cause of the injury or death is unknown and the death is relatively recent (*e.g.*, in less than a moderate state of decomposition), L-DEO shall immediately report the incident to the NMFS Office of Protected Resources (301-427-8401) and the New Zealand Department of Conservation (0800-362-468). The report must include the same information identified in condition 6(b)(i) of this IHA. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with L-DEO to determine whether additional mitigation measures or modifications to the activities are appropriate.
- (iii) In the event that L-DEO discovers an injured or dead marine mammal, and the lead observer determines that the injury or death is not associated with or related to the specified activities (*e.g.*, previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), L-DEO shall report the incident to the NMFS Office of Protected Resources (301-427-8401) and the New Zealand Department of Conservation (0800-362-468) within 24 hours of the discovery. L-DEO shall provide photographs or video footage or other documentation of the sighting to NMFS.
7. This Authorization may be modified, suspended or withdrawn if the holder fails to abide by the conditions prescribed herein, or if NMFS determines the authorized taking is having more than a negligible impact on the species or stock of affected marine mammals.



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

OCT 27 2017

Date

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

Species	Authorized Level A Takes	Authorized Level B Takes	Total Authorized Takes
Southern right whale	3	51	54
Pygmy right whale	1	20	21
Humpback whale	3	48	51
Bryde's whale	1	22	23
Common minke whale	2	31	33
Antarctic minke whale	2	31	33
Sei whale	2	31	33
Fin whale	3	52	55
Blue whale	0	8	8
Sperm whale	2	654	656
Cuvier's beaked whale	2	591	593
Arnoux's beaked whale	2	591	593
Southern bottlenose whale	0	394	394
Shepard's beaked whale	0	394	394
Hector's beaked whale	0	394	394
True's beaked whale	0	197	197
Gray's beaked whale	2	788	790
Andrew's beaked whale	0	394	394

Strap-toothed whale	2	591	593
Blainville's beaked whale	0	197	197
Spade-toothed whale	0	197	197
Bottlenose dolphin	3	1135	1138
Short-beaked common dolphin	5	1956	1961
Dusky dolphin	3	1323	1326
Southern right-whale dolphin	2	680	682
Risso's dolphin	0	454	454
False killer whale	3	680	683
Killer whale	0	433	433
Long-finned pilot whale	5	1869	1874
Short-finned pilot whale	2	783	785
Pygmy sperm whale	15	377	392
Hourglass dolphin	37	904	941
Hector's dolphin	0	2	2
Spectacled porpoise	6	120	126
New Zealand fur seal	11	5084	5095
New Zealand sea lion	1	591	592
Southern elephant seal	7	1011	1018
Leopard seal	3	506	509

APPENDIX B: Basic Data Summary Form

BASIC DATA FORM				
LDEO Project Number		MGL1708, MGL1801, MGL1802, MGL1803		
Seismic Contractor		Lamont-Doherty Earth Observatory of Columbia University		
Area Surveyed During Reporting Period		NI2D – 37-43°S; 180°E to the east coast of the NI NI3D – 38-29.5°S; 18-179.5°E SI2D – 163-169°E; 50°S to the south coast of the SI		
Survey Type		2-D and 3-D; OBS and MCS		
Vessel and/or Rig Name		R/V <i>Marcus G. Langseth</i>		
Permit Number		IHA issued on 27 October 2017		
Location / Distance of Airgun Deployment		Aft of PSO tower: 235 meters (NI2-D survey); 265-290 meters (NI3-D survey); 235 meters (SI2-D survey)		
Water Depth		Min	30	
		Max	5,000	
Dates of project	North Island 2-D Survey	01 November 2017	THROUGH	06 December 2017
	North Island 3-D Survey	06 January 2018	THROUGH	08 February 2018
	Transit North to South Islands	11 February 2018	THROUGH	14 February 2018
	South Island 2-D Survey	18 February 2018	THROUGH	19 March 2018
Total time airguns operating – all power levels:		1601:23		
Time airguns operating on survey lines:		1301:28		
Time airguns operating not on a survey line:		272:22		
Amount of time mitigation gun (40 in³) operations:		09:48		
Amount of time in ramp-up:		17:43		
Number daytime ramp-ups:		46		
Number of night time ramp-ups:		8		
Number of ramp-ups from mitigation source:		35		
Amount of time conducted in airgun testing:		00:02		
Duration of visual observations:		1507:35		
Duration of observations while source active:		1018:10		
Duration of observation during source silence:		489:25		
Duration of acoustic monitoring:		1641:06		
Duration of acoustic monitoring while source active:		1596:09		
Duration of acoustic monitoring during source silence:		44:57		
Duration of simultaneous acoustic and visual monitoring:		1047:50		
Lead Protected Species Observer:		Amanda Dubuque		
Protected Species Observers:		NI-2D Survey	Sara Davis, Mary-Jane Waru, Luis Goncalves	
		NI-3D Survey	Brooke Stanford, Rebecca Lindsay, Mark Johnston	
		Transit North to South Islands	Brooke Stanford, Sara Davis	
		SI-2D Survey	Brooke Stanford, Gail Begbie, Aletta Bussenschutt	
Lead Acoustic Observer:		Jim Wills (NI 2-D), Sara Davis (NI 3-D and SI 2-D)		
Number of Marine Mammals Visually Detected:		145		
Number of Marine Mammals Acoustically Detected:		40		
Number of Simultaneous Visual and Acoustic Detections:		11		
Number of Sea Turtles detected:		1		
Total Number of Protected Species Detections:		175		
List Mitigation Actions		35 power-downs (21:20) and one shut-down (00:27)		
Duration of operational downtime due to mitigation:		21:47 (20:11 of production loss)		

APPENDIX C: Passive Acoustic Monitoring System Specifications

1.1 Conventional Hydrophone Cable

Cable serial number SM 5178 (replaced on 1 November 2017)

Mechanical Information

Length = 250m

Diameter = 14mm cable, 32mm at moldings, 45mm at male connector, 65mm at female connector

Weight = 100kg

Connectors = ITT 19 pin

Hydrophone elements

Hydrophone 0/Sphere 1/Broadband 200Hz to 200 kHz (3dB points)

Hydrophone 1/ Sphere 2/ Broadband 200Hz to 200 kHz (3dB points)

Hydrophone 2/ Sphere 3/ Standard 2 kHz to 200 kHz (3dB points)

Hydrophone 3/Sphere 4 /Standard 2 kHz to 200 kHz

Depth Capability 100m

Spacing between elements 0 & 1 (for LF detection) 2.0m, 1.28mSecs

Spacing between elements 1 & 2 (for LF detection) 13.0m, 8.32mSecs

Spacing between elements 2 & 3 (for HF detection) 0.25m, 0.16mSecs

Interface unit Array 1 outputs

Broadband channel sensitivity -166dB re 1V/uPa

Standard channel sensitivity -166dB re 1V/uPa

1.2 Heavy Tow Cable with separate hydrophone array

Tow Cable serial number SM 5948 (replaced on 4 January 2018), SM 4299 (Replaced on 17 January 2018). and SM 5491

Mechanical Information

Length = 230 m

Outer diameter = 16.5 mm (+/- 0.5 mm)

Ship-side connector: ITT 19-way, male

Wet-end connector: Seiche, with 36-way Lemo insert, female.

Weight = approximately 94 kg (in air)

1.3 Hydrophone array cable

Cable serial number SM 3761 (replace on 17 January 2018) and SM 4233

Mechanical Information

Type = Detachable 20 m, 4-ch Array

Length = 20 m

Diameter = 17 mm (over cable), 32 mm (over mouldings), 65 mm (over connector)

Connector = Seiche connector with 36-way Lemo insert, male.

Weight = approximately 10 kg (in air)

Hydrophone elements

Array elements = four spherical hydrophones / preamplifiers, one depth sensor

Hydrophone 1 = 200-200,000 Hz (-3 dB), sensitivity -166dB re 1V/uPa; 0.00 m

Hydrophone 2 = 200-200,000 Hz (-3 dB), sensitivity -166dB re 1V/uPa; at 2.00 m

Hydrophone 3 = 2,000-200,000 Hz (-3 dB), sensitivity -166dB re 1V/uPa; at 15.00 m
Hydrophone 4 = 2,000-200,000 Hz (-3 dB), sensitivity -166dB re 1V/uPa; at 15.25 m
Depth sensor = 10-bar pressure rating.

1.4 Deck cable

Deck serial number SM 4952

Mechanical Information

Length 100m

Diameter 14mm cable, 45mm at male connector, 65mm at female connector

Weight 25kg

Connectors ITT 19 pin

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

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

Overview

Two types of hydrophone cables have been supplied for the Langseth. One version of the cable consists of a 250 meter conventional-towed linear hydrophone cable which has the hydrophones embedded within the tow cable. The second version consists of a 230 meter steel reinforced tow cable with a detachable 20 meter hydrophone array. The arrays consist of two low-frequency hydrophones (200 Hz to 200 kHz), two high-frequency hydrophone elements (2 kHz to 200 kHz) and a depth gauge (100m capacity) potted directly into the cable. The four hydrophones have been positioned in two pairs, with the first pair positioned roughly 13m ahead of the second pair. On the 250 meter conventional cable, a two kilogram linked chain was taped onto the cable two meters forward of the innermost hydrophone element (Hyd 1) (Figure 1). On the two part cable, the chain is taped two meters ahead of the hydrophone array connector on the steel reinforced tow cable (Figure 2).

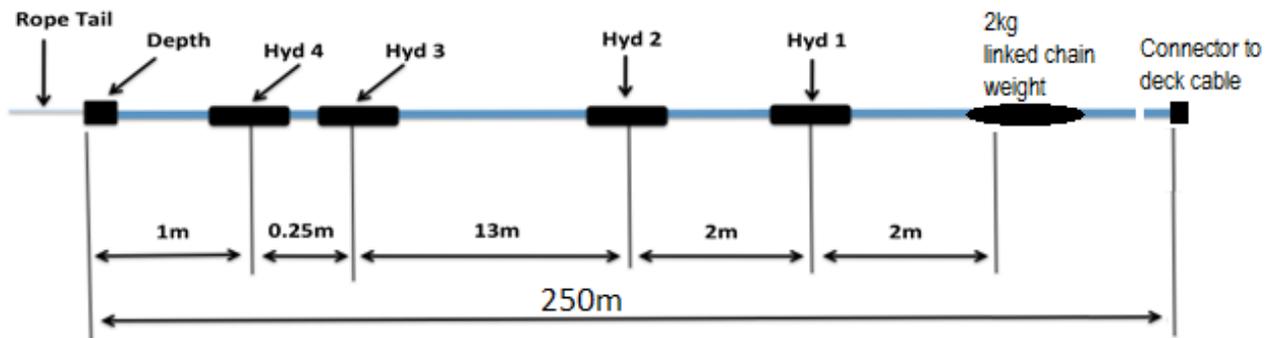


Figure 1: Conventional embedded 250 meter hydrophone array cable.

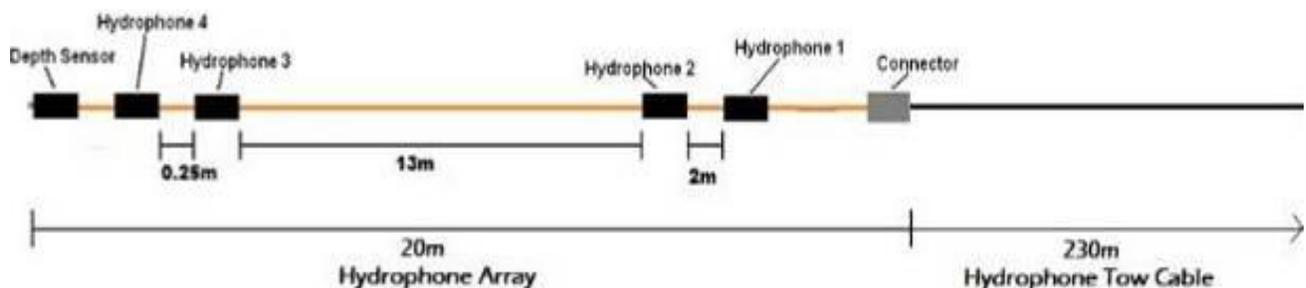


Figure 2: Two part hydrophone cable with a 230 meter tow cable and detachable 20 meter hydrophone array.

The hydrophone cable was spooled onto a hydraulic winch located on the port side of the gun deck (Figure 3). A 100 meter deck cable connects the hydrophone cable on the gun deck to the PAM station in the main science lab (Figure 4). Due to the structural design of the vessel, two 100 meter deck cables were installed in port, prior to the project. One of the deck cables was designated as the main cable and the other acted as a spare. The main deck cable was connected to an electronic processing unit (EPU) located, along with two monitors and other monitoring equipment, at the PAM station in the main science lab. The rack-mounted EPU was secured in the event of rough weather (Figure 5). A GPS feed (GNGGA string) was supplied to the system by the ships navigation Seapath 200.



Figure 3: PAM cable spooled onto the winch.

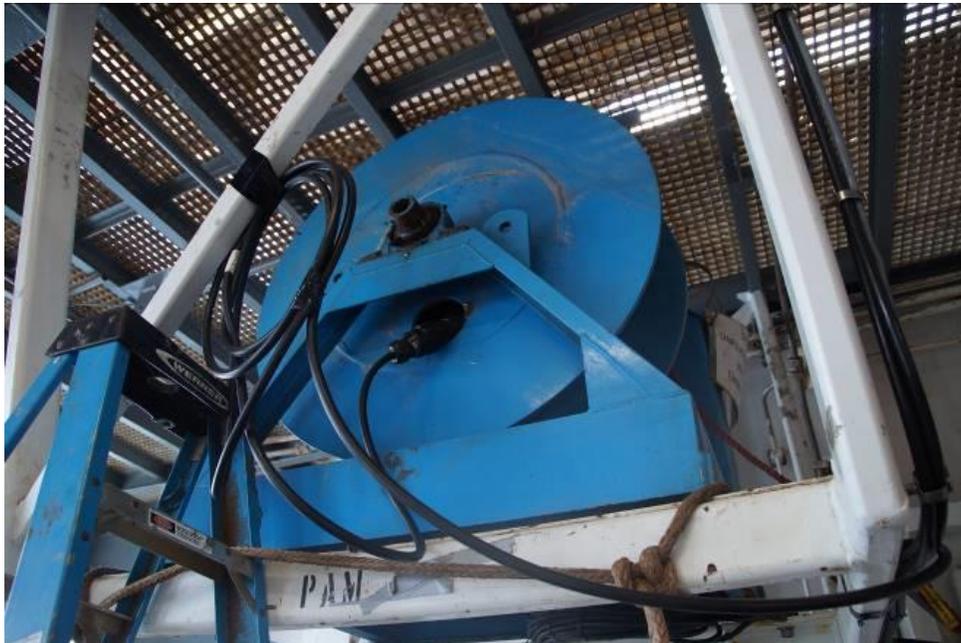


Figure 4: Hydrophone cable on the winch connected to the main deck cable.

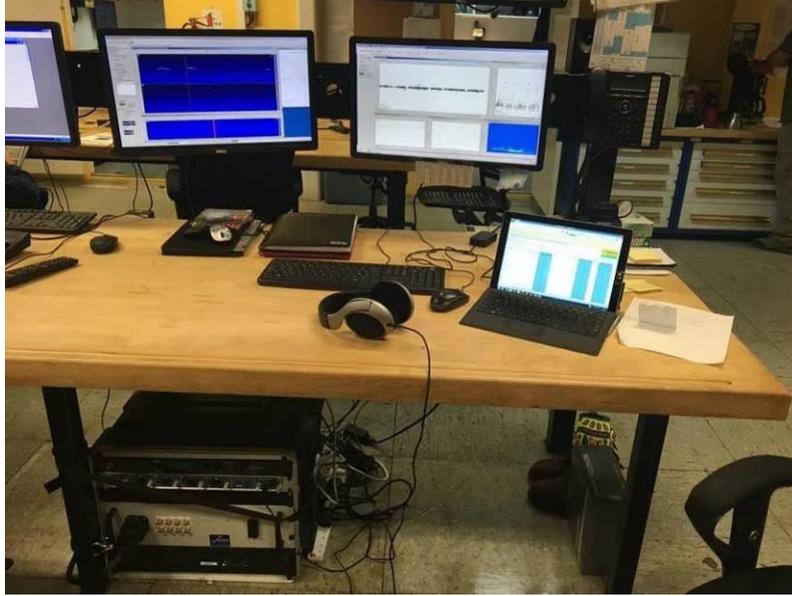


Figure 5: Passive Acoustic Monitoring Station in the Main Science Lab.

Three different deployment methods of the hydrophone cable were used throughout the New Zealand survey program due to the differing deployment methods of the seismic gear during each of the surveys.

For the North Island 2-D survey and the South Island 2-D survey, the hydrophone cable was deployed directly off the stern of the vessel, just aft of the winch. To minimize the risk of entanglement with the seismic gear, the cable was attached, via a Yales grip, to a lifting rope, which offset the towing point of the cable approximately two meters to port (Figure 6). A Chinese finger was attached to the hydrophone cable approximately 120 meters ahead of the depth gauge as a tow point to reduce the tension on the cable that remained spooled on the winch when deployed.



Figure 6: The PAM cable connecting to the offset rope via shackle.

For the North Island 3-D survey, two different deployment methods were utilized. The initial deployment method had the hydrophone cable deployed off the winch to the center of the stern of the vessel, and then into the water between the port and starboard array umbilicals (Figure 7). This was done to minimize entanglement risks with the arrays which were deployed with a wide separation for the survey. Extra cable was paid out off the winch to allow

the hydrophone cable to be moved by hand to either the port or starboard side when either of the source arrays required retrieval for source maintenance. This allowed acoustic monitoring to continue without interruption due to the required moving of the PAM cable. However, this deployment method placed the hydrophones directly within the prop wash from the vessel's engines, which caused excessive movement of the cable and interfered with monitoring for protected species. Several adjustments were made in attempt to stabilize the hydrophones, including adding two pieces of nine link chain to the tow cable. The first chain weighed 3.8 kilograms and was attached one and a half meters ahead of the hydrophone array connector on the yellow tow cable (Figure 8). The second chain weighed six kilograms and was placed approximately 80 meters ahead of the connector, approximately 10 meters in front of the Chinese finger located at 120 meters from the depth gauge (Figure 9). All attempts to help stabilize the hydrophone cable were unsuccessful, and the excessive movement of the cable in the prop wash and the frequent movement of the cable by hand to either to port or starboard side cause the hydrophones to come into contact with the seismic gear with increasing frequency, which resulted in the hydrophone array becoming damaged and unusable.



Figure 7: PAM cable secured to the center offset rope via Chinese finger for towing between the array umbilicals.



Figure 8: First chain weighing 3.8 kg added onto the tow cable approximately 1.5 meters ahead of the hydrophone array connector.

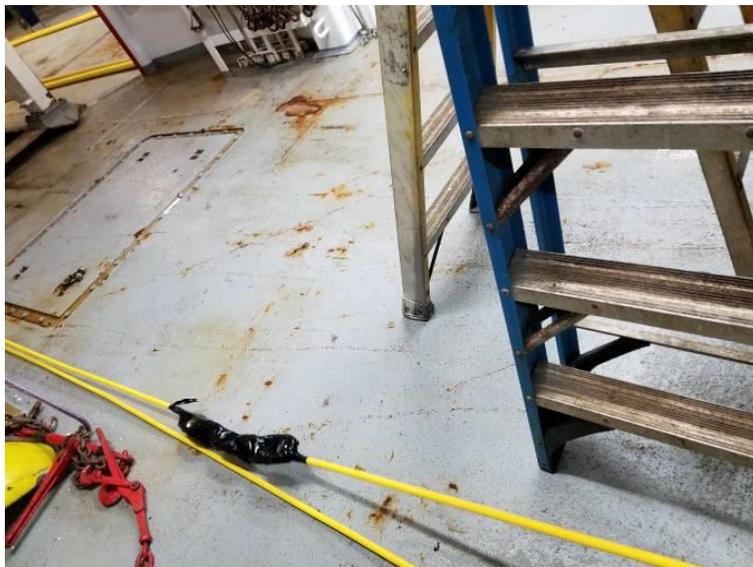


Figure 9: Second chain weighing 6 kg added onto the tow cable approximately 80 meters ahead of the hydrophone array connector.

The second deployment method for the 3-D survey was used to prevent any further damage of the PAM hydrophone cables. With the second deployment method, the hydrophone cable was deployed from lead-in for streamer four off the port stern of the vessel. When fully deployed, the 20 meter hydrophone array along with six meters of tow cable were towed between the lead-ins for streamers three and four. A Chinese finger attached on the tow cable approximately 10 meters ahead of the connector to the hydrophone array were connected to a D-ring, which was then attached to a one meter section of 12 kilogram chain that hangs from a sliding collar (Figure 10 and Figure 11). The chain added extra weight to the sliding collar to pull the hydrophone array down the streamer four lead-in and into the water. From the sliding collar, an additional 65 meters of tow cable was deployed off the winch to ensure that the cable is towed fully in the water. A second Chinese finger was attached onto the tow cable where it went over the stern of the vessel, which was attached as a secondary tow point to relieve extra tension from the cable remaining on the winch (Figure 12). On 2 February 2018 a fabricated sheave

block roller was added to eliminate the sliding collar and help with less resistance during recovery and retrieval of the PAM cable (Figure 13).



Figure 10: Chinese finger attached to D-ring that is attached to a one meter 12 kg chain.



Figure 11: Sliding collar with hydrophone cable and weight attached.



Figure 12: Secondary Chinese finger at the port stern of the vessel.



Figure 13: PAM cable being deployed using the fabricated sheave block roller

Deployment Tasks

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

Retrieval Tasks

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

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

Health Safety and Environment (HSE) Requirements

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

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

APPENDIX E: Survey Lines Acquired

Survey Line	Date Acquisition Commenced	Time Acquisition Commenced (UTC)	Date Acquisition Completed	Time Acquisition Completed (UTC)
North Island 2-D Survey Lines				
MGL1708OB02	2017-11-01	17:23	2017-11-02	04:16
MGL1708OB07	2017-11-02	18:19	2017-11-03	05:55
MGL1708OB09	2017-11-03	06:47	2017-11-04	01:34
MGL1708MC10	2017-11-04	21:18	2017-11-05	19:00
MGL1708MC11	2017-11-05	19:24	2017-11-05	21:28
MGL1708MC12	2017-11-05	23:32	2017-11-08	09:21
MGL1708MC14	2017-11-08	12:17	2017-11-08	12:17
MGL1708MC15	2017-11-08	12:31	2017-11-08	16:49
MGL1708OB16	2017-11-08	16:54	2017-11-09	13:56
MGL1708OB18	2017-11-10	07:12	2017-11-12	19:24
MGL1708MC40	2017-11-13	07:30	2017-11-15	13:13
MGL1708MC41	2017-11-15	14:39	2017-11-16	04:20
MGL1708MC44	2017-11-16	05:28	2017-11-16	20:40
MGL1708MC43	2017-11-16	20:57	2017-11-17	00:45
MGL1708MC42	2017-11-17	01:23	2017-11-17	19:50
MGL1708MC45	2017-11-17	20:02	2017-11-18	00:18
MGL1708MC46	2017-11-18	01:32	2017-11-18	20:08
MGL1708MC47	2017-11-18	20:24	2017-11-19	00:50
MGL1708MC60	2017-11-19	02:03	2017-11-19	22:23
MGL1708MC59	2017-11-19	23:35	2017-11-20	02:51
MGL1708MC48	2017-11-20	03:59	2017-11-21	00:54
MGL1708MC57	2017-11-21	01:36	2017-11-21	03:29
MGL1708MC58	2017-11-21	04:33	2017-11-22	01:56
MGL1708MC49	2017-11-22	03:01	2017-11-22	05:55
MGL1708MC50	2017-11-22	07:06	2017-11-23	05:41
MGL1708MC52	2017-11-23	06:44	2017-11-23	08:01
MGL1708MC53	2017-11-23	09:15	2017-11-24	07:05
MGL1708MC54	2017-11-24	08:11	2017-11-24	10:22
MGL1708MC55	2017-11-24	11:22	2017-11-25	02:58
MGL1708MC56	2017-11-25	04:03	2017-11-25	07:03
MGL1708MH63	2017-11-25	07:21	2017-11-25	18:24
MGL1708MH64	2017-11-25	20:29	2017-11-26	05:46
MGL1708MH36	2017-11-26	09:07	2017-11-26	15:30
MGL1708MH26	2017-11-26	19:17	2017-11-26	23:55
MGL1708MC27	2017-11-27	01:39	2017-11-27	03:37
MGL1708MH24	2017-11-27	05:23	2017-11-27	21:03
MGL1708MH38	2017-11-28	00:32	2017-11-28	18:07
MGL1708MC37	2017-11-28	18:51	2017-11-28	21:37
MGL1708MH28	2017-11-28	21:47	2017-11-29	07:43
MGL1708MH30	2017-11-29	10:39	2017-11-29	18:17
MGL1708MH62	2017-11-29	22:34	2017-11-30	06:58
MGL1708MH61	2017-11-30	11:11	2017-11-30	20:04
MGL1708MH34	2017-12-01	00:10	2017-12-01	12:19
MGL1708MC33	2017-12-01	14:19	2017-12-01	15:34
MGL1708MH32	2017-12-01	16:38	2017-12-02	06:46

Survey Line	Date Acquisition Commenced	Time Acquisition Commenced (UTC)	Date Acquisition Completed	Time Acquisition Completed (UTC)
MGL1708MC07	2017-12-02	07:19	2017-12-02	18:34
MGL1708MC20	2017-12-02	21:42	2017-12-03	06:57
MGL1708MC19	2017-12-03	07:11	2017-12-03	09:32
MGL1708MC22	2017-12-03	11:04	2017-12-03	21:09
MGL1708MC06	2017-12-04	02:00	2017-12-04	08:30
MGL1708MC05	2017-12-04	08:37	2017-12-04	16:20
MGL1708MC04	2017-12-04	16:27	2017-12-05	02:58
MGL1708MC03	2017-12-05	05:59	2017-12-05	15:50
North Island 3-D Survey Lines				
MGL1801M1196	2018-01-09	18:23	2018-01-10	02:32
MGL1801M1020	2018-01-10	04:42	2018-01-10	12:19
MGL1801M1204	2018-01-10	14:21	2018-01-10	21:52
MGL1801M1028	2018-01-11	00:05	2018-01-11	07:46
MGL1801M1212	2018-01-11	10:02	2018-01-11	17:25
MGL1801M1036	2018-01-11	19:31	2018-01-12	03:15
MGL1801M1220	2018-01-12	05:13	2018-01-12	12:46
MGL1801M1044	2018-01-12	14:41	2018-01-12	22:50
MGL1801M1228	2018-01-13	00:58	2018-01-13	08:34
MGL1801M1052	2018-01-13	10:47	2018-01-13	18:21
MGL1801M1236	2018-01-13	20:07	2018-01-14	04:03
MGL1801M1052	2018-01-14	06:40	2018-01-14	14:17
MGL1801M1244	2018-01-14	16:05	2018-01-14	23:59
MGL1801M1060	2018-01-15	02:20	2018-01-15	10:00
MGL1801M1252	2018-01-15	11:49	2018-01-15	19:39
MGL1801M1068	2018-01-15	22:18	2018-01-16	06:09
MGL1801M1260	2018-01-16	08:13	2018-01-16	15:47
MGL1801M1076	2018-01-16	17:52	2018-01-17	01:49
MGL1801M1268 (aborted)	2018-01-17	04:02	2018-01-17	04:26
MGL1801M1268A	2018-01-18	04:53	2018-01-18	12:25
MGL1801M1084	2018-01-18	14:35	2018-01-18	22:10
MGL1801M1276	2018-01-19	00:22	2018-01-19	07:44
MGL1801M1092	2018-01-19	10:03	2018-01-19	17:38
MGL1801M1284	2018-01-19	19:43	2018-01-20	03:08
MGL1801M1100	2018-01-20	05:26	2018-01-20	13:06
MGL1801M1292	2018-01-20	15:03	2018-01-20	22:45
MGL1801M1108	2018-01-21	02:08	2018-01-21	09:49
MGL1801M1300	2018-01-21	12:06	2018-01-21	19:26
MGL1801M1116	2018-01-21	21:54	2018-01-22	05:43
MGL1801M1308	2018-01-22	07:58	2018-01-22	15:21
MGL1801M1012	2018-01-22	18:30	2018-01-23	02:12
MGL1801M1188	2018-01-23	04:19	2018-01-23	11:47
MGL1801M1004	2018-01-23	13:46	2018-01-23	21:57
MGL1801M1316	2018-01-24	00:45	2018-01-24	08:05
MGL1801M1124	2018-01-24	10:41	2018-01-24	18:17
MGL1801M1324	2018-01-24	20:43	2018-01-25	04:02
MGL1801M1132	2018-01-25	06:39	2018-01-25	14:13
MGL1801M1332 (aborted)	2018-01-25	16:40	2018-01-25	16:42
MGL1801A1332	2018-01-25	20:55	2018-01-26	04:46

Survey Line	Date Acquisition Commenced	Time Acquisition Commenced (UTC)	Date Acquisition Completed	Time Acquisition Completed (UTC)
MGL1801M1140	2018-01-26	07:25	2018-01-26	14:57
MGL1801M1340	2018-01-26	17:22	2018-01-27	00:56
MGL1801M1148	2018-01-27	03:50	2018-01-27	11:20
MGL1801M1348	2018-01-27	13:48	2018-01-27	21:15
MGL1801M1348	2018-01-27	23:56	2018-01-28	07:30
MGL1801M1156	2018-01-27	23:56	2018-01-28	07:30
MGL1801M1356	2018-01-28	09:59	2018-01-28	17:22
MGL1801M1164	2018-01-28	19:55	2018-01-29	03:40
MGL1801M1364	2018-01-29	06:05	2018-01-29	13:20
MGL1801M1172	2018-01-29	15:57	2018-01-30	00:24
MGL1801M1372	2018-01-30	02:53	2018-01-30	10:08
MGL1801M1180	2018-01-30	12:46	2018-01-30	21:10
MGL1801R1268 (aborted)	2018-01-30	23:38	2018-01-31	01:01
MGL1801T1084	2018-02-02	18:57	2018-02-02	19:21
MGL1801I1276	2018-02-03	14:34	2018-02-03	18:11
MGL1801A1276	2018-02-03	18:25	2018-02-03	23:08
MGL1801R1076	2018-02-04	01:57	2018-02-04	09:24
MGL1801B1268	2018-02-04	10:45	2018-02-04	18:34
MGL1801I1116	2018-02-04	20:54	2018-02-05	04:16
MGL1801I1244	2018-02-05	06:11	2018-02-05	12:52
MGL1801I1004	2018-02-05	15:33	2018-02-05	22:55
MGL1801I1188	2018-02-06	00:42	2018-02-06	08:18
MGL1801A1004	2018-02-06	10:42	2018-02-06	18:02
MGL1801B1276	2018-02-06	19:56	2018-02-06	20:50
South Island 2-D Survey Lines				
MGL1803OBS01	2018-02-21	10:41	2018-02-22	12:27
MGL1803OBS02	2018-02-27	13:19	2018-02-28	20:48
MGL1803MCS01	2018-03-03	18:58	2018-03-05	05:10
MGL1803MCS03a	2018-03-05	08:31	2018-03-06	00:18
MGL1803T01	2018-03-06	02:34	2018-03-06	10:29
MGL1803MCS23a	2018-03-06	11:52	2018-03-07	09:49
MGL1803MCS23b	2018-03-07	20:11	2018-03-08	08:42
MGL1803T02	2018-03-08	10:38	2018-03-08	11:48
MGL1803MCS14	2018-03-08	19:23	2018-03-09	22:35
MGL1803MCS17a (aborted)	2018-03-11	00:20	2018-03-11	01:21
MGL1803MCS17b (aborted)	2018-03-11	03:07	2018-03-11	12:11
MGL1803MCS17c	2018-03-17	02:12	2018-03-17	12:09
MGL1803MCST03	2018-03-17	12:16	2018-03-17	13:49
MGL1803MCS19a	2018-03-17	13:54	2018-03-18	03:00

APPENDIX F: Reductions in Acoustic Source Volume During Survey Operations

Date	Time (UTC)	Start Volume (in ³)	End Volume (in ³)	Active Elements	Comments
North Island 2-D Survey					
06 Nov 2017	21:36	6660	6420	36	Main element switched with spare
08 Nov 2017	05:32	6420	6440	32	Problem with element
08 Nov 2017	09:33	6440	6520	36	
08 Nov 2017	12:19	6520	3260	18	Array 3&4 disabled for maintenance
08 Nov 2017	14:10	3260	6560	36	
08 Nov 2017	14:13	6560	3300	18	Array 1&2 disabled for maintenance
08 Nov 2017	15:49	3300	6600	36	
08 Nov 2017	17:08	6600	6560	36	Main element switched with spare
08 Nov 2017	19:29	6560	6570	35	
08 Nov 2017	22:57	6570	6600	36	
10 Nov 2017	14:00	6600	6560	36	Main element switched with spare
13 Nov 2017	07:24	6560	4950	27	Adjustments to one array
13 Nov 2017	07:30	4950	6600	36	
15 Nov 2017	13:17	6600	4950	27	Array 3 retrieved
15 Nov 2017	14:08	4950	6600	36	
18 Nov 2017	22:04	6600	3660	20	Array 1&2 retrieved for maintenance
18 Nov 2017	22:40	3660	5950	30	
18 Nov 2017	23:43	5950	6600	36	
19 Nov 2017	15:47	6600	6520	36	Problem with element
19 Nov 2017	22:23	6520	3220	18	Array 1&2 retrieved for maintenance
20 Nov 2017	00:24	3220	5050	28	
20 Nov 2017	00:41	5050	3660	20	Arrays 3&4 disabled for maintenance
20 Nov 2017	03:37	3660	4950	27	
20 Nov 2017	03:54	4950	6600	36	
26 Nov 2017	05:46	6600	3300	18	Arrays 3&4 disabled for maintenance
26 Nov 2017	07:53	3300	6600	36	
27 Nov 2017	21:03	6600	3300	18	Arrays 1&2 disabled for maintenance
27 Nov 2017	22:52	3300	6600	36	
29 Nov 2017	19:27	6600	4950	27	Array 2 disabled for maintenance
29 Nov 2017	20:39	4950	6600		
30 Nov 2017	20:04	6600	3300	18	Arrays 3&4 disabled for maintenance
01 Dec 2017	00:02	3300	6600	36	
01 Dec 2017	12:23	6600	4950	27	Array 3 disabled for maintenance
01 Dec 2017	14:16		6600	36	
North Island 3-D					
10 Jan 2018	02:32	3300 / 3300	3260 / 3300	18 / 18	Port array reduced volume from 3300 to 3260. Remainder of survey, full volume for port array is 3260. (Flip-flop source firing)
10 Jan 2018	21:52	3260 / 3300	3260 / 0	18 / 0	Starboard array disabled. Port array still active.
10 Jan 2018	23:49	3260	3260 / 3300	18 / 18	Starboard array resumes firing.
20 Jan 2018	22:45	3260 / 3300	1650 / 0	9 / 0	Arrays 1,2&3 disabled. Full starboard array disabled.

Date	Time (UTC)	Start Volume (in ³)	End Volume (in ³)	Active Elements	Comments
21 Jan 2018	01:04	1650 / 0	3260 / 0	18 / 0	Port array active. Starboard array still disabled.
21 Jan 2018	01:22	3260 / 0	3260 / 3300	18 / 18	
21 Jan 2018	09:49	3260 / 3300	1650 / 3300	9 / 18	Array 3 disabled for maintenance
21 Jan 2018	12:06	1650 / 3300	3260 / 3300	18 / 18	
22 Jan 2018	15:21	3260 / 3300	3260 / 0	18 / 0	Starboard arrays disabled
22 Jan 2018	17:56	3260 / 0	3260 / 440	18 / 2	
22 Jan 2018	18:00	3260 / 440	3260 / 3300	18 / 18	
25 Jan 2018	16:42	3260 / 3300	1650 / 3300	9 / 18	
25 Jan 2018	17:45	1650 / 3300	0 / 3300	0 / 18	
25 Jan 2018	19:29	0 / 3300	3260 / 3300	18 / 18	
26 Jan 2018	18:58	3260 / 3300	3120 / 3300	18 / 18	
27 Jan 2018	00:56	3120 / 3300	0 / 3300	0 / 18	
27 Jan 2018	02:01	0 / 3300	3260 / 3300	18 / 18	
South Island 2-D					
07 Mar 2018	09:21	6600	6240	35	Single element disabled
11 Mar 2018	01:21	6600	3300	18	PAM cable entanglement with array; array silenced
11 Mar 2018	03:03	3300	6600	36	
11 Mar 2018	10:24	6600	6420	36	Main element switched with spare
11 Mar 2018	10:52	6420	3120	18	Subarrays 1&2 disabled
17 Mar 2018	06:26	6600	4950	27	Subarrays 3&4 disabled
17 Mar 2018	06:50	4950	6600	36	

APPENDIX G: Acoustic Monitoring Downtime

Acoustic Monitoring Stopped		Acoustic Monitoring Resumed		Comments
Date	Time (UTC)	Date	Time (UTC)	
North Island 2-D				
02 Nov 2017	06:10	02 Nov 2017	17:00	Retrieval of seismic gear to transit to new location. Hydrophone cable swap
04 Nov 2017	02:39	04 Nov 2017	17:00	Retrieval of arrays to deploy streamer cable.
09 Nov 2017	14:15	10 Nov 2017	03:41	Retrieval of streamer
12 Nov 2017	19:27	13 Nov 2017	04:57	Deployment of streamer
28 Nov 2017	04:55	28 Nov 2017	05:36	Signal loss detected on one hydrophone, cable retrieved for inspection
North Island 3-D				
08 Jan 2018	16:36	08 Jan 2018	16:56	Adjustment to deployment configuration of cable
17 Jan 2018	04:46	18 Jan 2018	02:00	Severe weather conditions
25 Jan 2018	17:35	25 Jan 2018	20:00	Retrieval of source array
31 Jan 2018	01:10	01 Feb 2018	23:38	Severe weather conditions
02 Feb 2018	02:02	02 Feb 2012	07:30	Retrieval of streamer
02 Feb 2018	11:48	02 Feb 2012	18:00	Retrieval of streamer
South Island 2-D				
22 Feb 2018	12:44	27 Feb 2018	10:33	OBS retrieval followed by severe weather
28 Feb 2018	21:10	03 Mar 2018	12:58	Severe weather
07 Mar 2018	10:20	07 Mar 2018	19:12	Seismic equipment maintenance
09 Mar 2018	23:16	10 Mar 2018	10:48	Retrieval of all seismic equipment for transit inside survey area
11 Mar 2018	01:35	11 Mar 2018	03:33	PAM cable entanglement due to severe weather
11 Mar 2018	12:16	16 Mar 2018	21:05	Sever weather

APPENDIX H: Summary of Visual Detections of Protected Species during the Southwest Pacific Ocean New Zealand Seismic 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

Behavioural Codes:

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

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
1	2017-11-01	23:26	Unidentified Dolphins	2	37.65147°S 176.76719°W	Full Volume on Line	AV	FT, PO	1700/Full Volume on Line	None	Detection occurred within New Zealand territorial waters
2	2017-11-05	05:59	Short-beaked common dolphins	7	38.99977°S 178.16712°E	Full volume on line	PE(AH); AV	PO, FT	497m/Full volume on line	None	No mitigation actions required due to exception in the permit for the species. Dolphins last sighted in the 160 dB radius. Detection occurred within New Zealand territorial waters – no take.
3	2017-11-08	07:02	New Zealand fur seal	1	41.80932°S 175.82503°E	Full volume on line	TV; PV/SD	PO, FT, NS, SS	200m/Single 40 in ³ element	Power down	Pinniped last sighted within 500m EZ. Total mitigation action was 39 minutes (19 minute PD and 20 minute ramp up). Detection occurred outside NZ territorial waters, therefore fur seal was considered to be a Level B take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
4	2017-11-08	20:14	New Zealand fur seal	1	41.63475°S 176.09301°E	Full volume on line	PE(AH)/ AV	BA; NS; PO; DI; FT	268m/Single 40 in ³ element	Power down	Pinniped last sighted within 500m EZ. Total mitigation action was 42 minutes (18 minute PD and 24 minute ramp up). Detection occurred outside NZ territorial waters, therefore fur seal was considered to be a Level B take.
5	2017-11-08	22:17	New Zealand fur seal	1	41.72890°S 176.22883°E	Full volume on line	PV/OD; AV	PO, DI, FT	300m/Single 40 in ³ element	Power down	Pinniped last sighted within 500m EZ. Total mitigation action was 39 minutes (17 minute PD and 22 minute ramp up). Detection occurred outside NZ territorial waters, therefore fur seal was considered to be a Level B take.
6	2017-11-09	01:21	New Zealand fur seal	1	41.85678°S 176.43673°E	Full volume on line	PV/OD; AV	PO, DI, FT	424m/Full volume on line	Power down	Pinniped last sighted within 500m EZ. Total mitigation action was 26 minutes (16 minute PD and 10 minute ramp up). Detection occurred outside NZ territorial waters, therefore fur seal was considered to be a Level B take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
7	2017-11-09	01:47	New Zealand fur seal	2	41.87754°S 176.80388°E	Ramp-up	PV/SD;A V	SS, PO	296m/Ramp-up at 1420 in ³	Power down	Pinnipeds last sighted within 500m EZ. Total mitigation action was 37 minutes (17 minute PD and 20 minute ramp up). Detection occurred outside NZ territorial waters, therefore fur seals were considered to be a Level B take.
8	2017-11-09	06:45	New Zealand fur seal	1	42.12255°S 176.87394°E	Full volume on line	PV/SD;A V	NS, DI	263m/Full volume on line	Power down	Pinniped last sighted within 500m EZ. Total mitigation action was 36 minutes (16 minute PD and 20 minute ramp up). Detection occurred outside NZ territorial waters, therefore fur seal was considered to be a Level B take.
9	2017-11-09	18:23	New Zealand fur seal	2	42.40647°S 177.67121°E	Silent	MI; PV/SD	NS, SS, FT, DI, PO	195m/Silent	None	Source was silent and on board the vessel at the time of the detection. Detection occurred outside NZ territorial waters.
10	2017-11-10	06:32	New Zealand fur seal	1	42.61142°S 176.98999°E	Full volume off line	TV; PV/OD	NS, PO, FT	224m/Single 40 in ³ element	Power down	Pinniped last sighted within 500m EZ. Total mitigation action was 37 minutes (17 minute PD and 20 minute ramp up). Detection occurred outside NZ territorial waters, therefore fur seal was considered to be a Level B take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
11	2017-11-12	23:22	Sperm Whales	4	38.84652°S 179.90218°W	Silent	PE(AH); AV	BV, BA, NS, DI, DF	585m/Silent	None	Source was silent and on board the vessel at the time of the detection. Detection occurred outside NZ territorial waters.
12	2017-11-14	20:50	Unidentified Whale	1	41.53822°S 177.93872°E	Full volume online	PV/AD	DI	1551m/Full volume	None	Detection occurred outside NZ territorial waters. Whale only observed in the 160 dB radius – potential Level B take
13	2017-11-14	22:08	New Zealand fur seal	1	41.61330°S 177.87357°E	Full volume online	SA	BA	792m/Full volume	None	Detection occurred outside NZ territorial waters. Pinniped only observed in the 160 dB radius – potential Level B take
14	2017-11-15	17:43	New Zealand fur seal	4	42.32505°S 177.07391°E	Full volume online	MI; AV; MI	BA, NS, PO, SS	458m/Single 40 in ³ element	Power Down	Pinnipeds last sighted within 500m EZ. Total mitigation action was 39 minutes (18 minute PD and 21 minute ramp up). Detection occurred outside NZ territorial waters. Fur seals were potential Level B takes

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
15	2017-11-15	21:15	Long-finned Pilot Whales	5	42.12713°S 177.21707°E	Full volume online	TV; PV/OD ;AV	NS, SS, BV,	250m/Single 40 in ³ element	Power Down	Dolphins last sighted outside of 500m EZ. Total mitigation action was 46 minutes (12 minute PD and 34 minute ramp up). Detection occurred outside NZ territorial waters. Dolphins were potential Level B takes
16	2017-11-17	18:03	New Zealand fur seal	1	41.49656°S 177.83282°E	Full volume online	UN	DI	288m/Full volume	Power Down	Pinniped last sighted within 500m EZ. Total mitigation action was 36 minutes (15 minute PD and 21 minute ramp up). Detection occurred outside NZ territorial waters. Fur seal was a potential Level B take
17	2017-11-18	06:44	New Zealand fur seal	1	41.07770°S 177.78361°E	Full volume online	PV/OD	NS, ST, DI, SS	267m/Full volume	Power Down	Pinniped last sighted within 500m EZ. Total mitigation action was 41 minutes (20 minute PD and 21 minute ramp up). Detection occurred outside NZ territorial waters. Fur seal was a potential Level B take
18	2017-11-19	05:15	Long-finned Pilot Whales	7	40.40155°S 177.30241°E	Full volume on line	PV/SD	NS, SS, PO	634m/Full volume	None	Detection occurred outside NZ territorial waters. Dolphins only observed in the 160 dB radius – potential Level B takes. Visual observation of the dolphins was greatly hindered by the presence of fog at the time of the detection.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
19	2017-11-20	05:29	New Zealand Fur Seal	1	40.72677°S 178.61058°E	Full volume on line	PE(AH); AV	DI; FT; PO	240m/Single 40 in ³ element	Power Down	Pinniped last sighted within 500m EZ. Total mitigation action was 37 minutes (17 minute PD and 20 minute ramp up). Detection occurred outside NZ territorial waters. Fur seal was a potential Level B take
20	2017-11-21	06:09	Bryde's Whale	3	39.89957°S 177.37068°E	Full volume on line	PE(AH); AV	BV, MI, NS	453m/Single 40 in ³ element	Power Down	Only one whale entered the 500 meter EZ. All three whales were last observed in the 160 dB radius. Total mitigation action was 39 minutes (19 minute PD and 20 minute ramp-up). Detection occurred outside of NZ territorial waters. All 3 whales were potential Level B takes.
21	2017-11-21	07:13	Bryde's Whale	1	39.93956°S 177.45877°E	Full volume on line	AV	BV, FT, DI	240m/Single 40 in ³ element	Power Down	Whale initially surfaced within the 500 meter EZ, and was last sighted in the 160 dB radius. Total mitigation action was 28 minutes (8 minute PD and 20 minute ramp-up). Detection occurred outside of NZ territorial waters. Whale was a potential Level A take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
22	2017-11-22	23:39	Long-finned Pilot Whales	12	39.68567°S 177.74283°E	Full volume on line	TV; MI; AV	PO, FT, MI, SS, SA, DI, DF, FF, DV	475m/Single 40 in ³ element	Power Down	Simultaneous with AD#2. Dolphins last sighted in the 160 dB radius. Total mitigation action was 37 minutes (17 minute PD and 20 minute ramp up). Detection occurred outside NZ territorial waters. Dolphins were potential Level B takes.
23	2017-11-22	23:52	Unidentified Baleen Whale	1	39.67752°S 177.72540°E	Single 40 in ³ element	AV	BV	1551m/Single 40 in ³ element	None	Whale was only sighted within the 160 dB radius. Detection occurred outside of NZ territorial waters. Whale was a potential Level B take. Whale was sighted during VD#22, initially when the source was powered down for the pilot whales and then at last detection after the source had resumed FV.
24	2017-11-23	02:44	Short-beaked Common Dolphins	82	39.56272°S 177.48097°E	Full volume on line	PE(AH); AV	SR, NS, PO, FT, BR	95m/Full volume	None	Simultaneous with AD#3. No mitigation actions required due to permit exceptions for the species. Only 17 of the dolphins were observed in the 500m EZ. Detection occurred outside NZ territorial waters. Dolphins were potential Level B takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
25	2017-11-26	00:33	Long-finned Pilot Whale	10	38.79116°S 178.81149°E	Full volume online	AV	BV, NS, MI, PO, SA	1108m/Full volume	None	Dolphins only sighted in the 160 dB radius. Detection occurred outside of NZ territorial waters. Dolphins were potential Level B takes.
26	2017-11-26	05:43	Unidentified Baleen Whale	1	39.13005°S 178.56114°E	Full volume online	AV	BV	3307m/Full volume	None	Whale only sighted in the 160 dB radius. Detection occurred outside of NZ territorial waters. Whale was a potential Level B take.
27	2017-11-28	06:06	Unidentified Dolphin	6	39.79438°S 179.43615°E	Full volume online	PV.OD; AV	PO, BV, FT	874m/Full volume	None	Dolphins only sighted in the 160 dB radius. Detection occurred outside of NZ territorial waters. Dolphins were potential Level B takes.
28	2017-11-30	03:58	Unidentified Whale	1	38.98459°S 178.86289°E	Full volume online	PE(AH)	BV	4320m/Full volume	None	Whale only sighted in the 160 dB radius. Detection occurred outside of NZ territorial waters. Whale was a potential Level B take.
29	2017-12-01	01:28	Long-finned Pilot Whales & Bottlenose Dolphins	15 (12 LFPW & 3 BD)	38.92050°S 178.35449°E	Full volume online	PV/SD; TV; PV/OD; AV	SA, BV, PO, FT, SR, SS, DI	520m/Full volume	Power Down	Detection was of a mixed pod of 12 long-finned pilot whales and 3 bottlenose dolphins, Dolphins approached, but were not visually observed entering, the 500 meter EZ. Total mitigation action was 27 minutes (7 minute PD and 20 minute ramp-up). Detection occurred outside NZ territorial waters. Dolphins were potential Level B takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
30	2017-12-02	21:34	Blue Whale	1	37.97872°S 178.80712°E	Full volume line change	PE(AH); AV	SA, BV, SS, SR, DI	740m/Full volume	None	Whale only sighted in the 160 dB radius. Detection occurred outside of NZ territorial waters. Whale was a potential Level B take.
31	2017-12-04	05:34	Bryde's Whale	1	37.80491°S 178.75311°E	Full volume online	PE(AH); AV	BV, FT, Di	1,551m/Full volume	None	Whale was only sighted in the 160 dB radius. No mitigation actions required. Detection occurred within New Zealand territorial waters, therefore the whale was not considered a potential take.
32	2017-12-04	23:55	New Zealand Fur Seal	1	37.71534°S 177.52067°E	Full volume online	PV/OD	NS, DI	300m/Full volume	Power Down	Pinniped last sighted within 500m EZ. Total mitigation action was 36 minutes (16 minute PD and 20 minute ramp up). Detection occurred within NZ territorial waters, therefore the fur seal was not considered a potential take.
33	2017-12-05	04:56	Unidentified Dolphins	6	37.87283°S 177.12658°E	Full volume on a line change	TV; AV	FT, SA, PO, NS	680m/Full volume	None	Dolphins only sighted in the 160 dB radius. Detection occurred within New Zealand territorial waters, therefore dolphins were not considered potential takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
34	2017-12-05	06:16	Short-beaked Common Dolphins	28	37.82044°S 177.02693°E	Full volume online	PV/OD;	PO, FT, SA	680m/Full volume	None	Dolphins only sighted in the 160 dB radius. Detection occurred within New Zealand territorial waters, therefore dolphins were not considered potential takes.
35	2017-12-05	18:45	Short-beaked Common Dolphins	10	37.27461°S 176.44145°E	Silent	TV; AV	PO, SA, FT	386m/Silent	None	Detection occurred within New Zealand territorial waters. Acoustic source was silent and on board the vessel during the detection. Dolphins were not considered to be potential takes.
36	2017-12-06	19:50	Short-beaked Common Dolphins	3	37.43424°S 176.24425°E	Silent	TV; UN	PO, FT, BR	257m/Silent	None	Detection occurred within New Zealand territorial waters. Acoustic source was silent and on board the vessel during the detection. Dolphins were not considered to be potential takes.
37	2018-01-06	02:14	Unidentified Dolphins	5	37.43548°S 176.29925°E	Silent	AV	SR	130m/Silent	None	Detection occurred within NZ territorial waters. Source on board and silent during the detection.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
38	2018-01-06	02:38	Short-beaked Common Dolphins	4	37.38400°S 176.33259°E	Silent	TV; PE(BH); AV	FF, FT, SR	292m/Silent	None	Detection occurred within NZ territorial waters. Source on board and silent during the detection.
39	2018-01-06	05:19	Unidentified Dolphins	5	37.35483°S 176.52967°E	Silent	V	FF,SR	600m/Silent	None	Detection occurred within NZ territorial waters. Source on board and silent during the detection.
40	2018-01-08	20:33	Sperm Whale	1	39.11340°S 179.23945°E	Full Volume Offline	PE(AH); AV	BV	1300m/Full Volume	None	Whale only sighted in 160 dB radius. Detection occurred outside of NZ territorial waters. Whale was a potential Level B take.
41	2018-01-09	07:01	Short-beaked Common Dolphins	3	38.78417°S 178.56367°E	Full Volume Offline	PV/SD	SA	750m/Full Volume	None	Dolphins only sighted in 160 dB radius. Simultaneous with AD#4. Detection occurred outside of NZ territorial waters. Dolphins were potential Level B takes.
42	2018-01-10	17:18	Short-beaked Common Dolphins	20	38.77655°S 178.70988°E	Full Volume Online	PE(AH); AV	FT, PO	798m/Full Volume	None	Dolphins only sighted in 160 dB radius. Detection occurred outside of NZ territorial waters. Dolphins were potential Level B takes.
43	2018-01-12	00:51	Long-finned Pilot Whales & Bottlenose Dolphins	6LFPW & 4 BND	38.79550°S 178.60867°E	Full Volume Online	V	FF, NS, SR, DV, DF	1200m/Full Volume	None	Mixed pod. Dolphins only sighted in the 160 dB radius. Detection occurred outside of NZ territorial waters. Dolphins were potential Level B takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
44	2018-01-12	05:35	Short-beaked Common Dolphins	40	38.68067°S 178.48893°E	Full Volume Online	TV; PV/SD	FT, BR, SA, SR, MI	290m/Full Volume	None	Simultaneous with AD#9. No mitigation action required due to IHA exception for the species. Dolphins last sighted in the 500 meter EZ. Detection occurred outside of NZ territorial waters. Dolphins were potential Level B takes.
45	2018-01-12	22:52	Short-beaked Common Dolphins	21	38.69767°S 178.40533°E	Full Volume Offline	PE(AH); AV	FT, PO, SA, NS, SR, SS	225m/Full Volume	None	Simultaneous with AD#10. No mitigation action required due to IHA exception for the species. Dolphins last sighted in the 500 meter EZ. Detection occurred within of NZ territorial waters. Dolphins were not potential takes.
46	2018-01-14	20:39	Unidentified Whale	1	38.81952°S 178.83477°E	Full Volume on a Survey Line	UN	SA	6167m/Full Volume	None	Whale only sighted outside of 160 dB radius. Detection occurred outside of NZ waters. Whale not considered to be a potential take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
47	2018-01-15	05:20	Short-beaked Common Dolphin	10	38.87332°S 178.79590°E	Full Volume on a Survey Line	PV/OD; AV	FT, PO	481m/Full Volume	None	Simultaneous with AD#12. Dolphins detected acoustically first. Only 5 dolphins sighted visually, but at least 10 detected acoustically. Dolphins last visually sighted in 160 dB radius. No mitigation action required due to permit exception for the species. Detection occurred outside of NZ waters. Dolphins were considered to be potential Level B takes.
48	2018-01-15	05:37	Unidentified Dolphin	4	38.86126°S 178.77173°E	Full Volume on a Survey Line	PE(AH)	FT	2247m/Full Volume	None	Dolphins only sighted briefly in 160 dB radius. Detection occurred outside of NZ waters. Dolphins considered potential Level B takes.
49	2018-01-16	05:09	Short-beaked Common Dolphin	3	38.72942°S 178.49603°E	Full Volume on a Survey Line	TV	FT	465m/Full Volume	None	Simultaneous with AD#15. Dolphins detected acoustically first. Only briefly visually sighted in the 500m EZ. No mitigation action required due to permit exception for the species. Detection occurred outside of NZ waters. Dolphins were potential Level B takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
50	2018-01-18	04:15	Short-beaked Common Dolphin	4	38.61750°S 178.41617°E	Full Volume on a Survey Line	PV/OD	FF, SR	460m/Full Volume	None	Dolphins only briefly sighted in the 500m EZ. No mitigation action required due to permit exception for the species. Detection occurred within NZ waters. Dolphins not considered to be potential takes.
51	2018-01-19	18:13	Short-beaked Common Dolphin	50	38.65557°S 178.38006°E	Full Volume Not on a Survey Line	PV/SD	FT, PO, SA	900m/Full Volume	None	Dolphins only sighted in the 160 dB radius. Detection occurred within NZ waters. Dolphins not considered to be potential takes.
52	2018-01-19	19:28	Short-beaked Common Dolphin	30	38.62656°S 178.45522°E	Full Volume Not on a Survey Line	OM; PE(BH)	FT, PO, SA	1500m/Full Volume	None	Dolphins only sighted in the 160 dB radius. Detection occurred within NZ waters. Dolphins not considered to be potential takes.
53	2018-01-19	19:34	Short-beaked Common Dolphin	10	38.62828°S 178.45928°E	Full Volume Not on a Survey Line	PV/OD; PE(BH)	MI, PO, SA, SH	753m/Full Volume	None	Dolphins only sighted in the 160 dB radius. Detection occurred within NZ waters. Dolphins not considered to be potential takes.
54	2018-01-20	21:31	Short-beaked Common Dolphin	25	38.88600°S 179.01787°E	Full Volume on a Survey Line	PV/OD, MI	PO, FT, SA, FF, MI	3845m/Full Volume	None	Dolphins only sighted outside of the 160 dB radius. Detection occurred outside of NZ waters. Dolphins not considered to be potential takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
55	2018-01-23	01:36	Short-beaked Common Dolphins	8	38.73050°S 178.44850°E	Full Volume on a Survey Line	PE(AH) ; AV	PO, FT	576m/Full Volume	None	Dolphins only sighted within the 160 dB radius. Detection occurred outside of NZ waters. Dolphins were considered to be potential Level b takes.
56	2018-01-23	01:42	Unidentified Dolphins	10	38.72683°S 178.44067°E	Full Volume on a Survey Line	PV/SD; V	SV, PO, FT, FF	5400m/Full Volume	None	Dolphins only sighted outside of the 160 dB radius. Detection occurred outside of NZ waters. Dolphins were not considered to be potential takes.
57	2018-01-24	18:09	Short-beaked Common Dolphins	10	38.68099°S 178.43738°E	Full Volume on a Survey Line	AV	FT, PO	1350m/Full Volume	None	Dolphins only sighted within the 160 dB radius. Detection occurred within NZ waters. Dolphins were not considered to be potential takes.
58	2018-01-24	18:28	Short-beaked Common Dolphins	75	38.66906°S 178.41102°E	Full Volume Not on a Survey Line	TV; AV	FT, SA, PO, FF, BR, SS, MT	121m/Full Volume	None	Simultaneous with AD#25. Dolphins detected first and last visually. Dolphins visually observed moving in and out of 500m EZ several times. Last visually sighted in 160 dB radius. No mitigation action required due to permit exception for the species. Detection occurred within NZ waters. Dolphins not considered to be potential takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
59	2018-01-24	19:55	New Zealand Fur Seal	1	38.60182°S 178.43639°E	Full Volume Not on a Survey Line	AV	ST, SS	570m/Full Volume	None	Fur seal only sighting within the 160 dB radius. Detection occurred within NZ waters. Pinniped not considered to be a potential take.
60	2018-01-24	20:37	Short-beaked Common Dolphins	70	38.62997°S 178.49663°E	Full Volume Not on a Survey Line	PV/OD; AV	PO, FT, SA, FF	860m/Full Volume	None	Dolphins only sighted within the 160 dB radius. Detection occurred within NZ waters. Dolphins were not considered to be potential takes.
61	2018-01-25	20:26	Short-beaked Common Dolphins	40	38.61140°S 178.46405°E	Full Volume Not on a Survey Line	PV/SD; PE(AH); TV; AV	PO, FT, SA, FF, BR	324m/Full Volume	None	Simultaneous with AD#27. Dolphins sighted first and last visually. Dolphins visually observed entering and exiting the 500m EZ, and last sighted in the 160 dB radius. No mitigation action required due to permit exception for the species. Detection occurred within NZ waters. Dolphins not considered to be potential takes.
62	2018-01-26	06:40	Short-beaked Common Dolphins	45	38.99150°S 178.11820°E	Full Volume on a Survey Line	PE(AH); PV/OD, AV	PO, SA, FT	370m/Full Volume	None	Only one dolphin sighted entering and then diving out of sight within the 500m EZ. Remaining dolphins only sighted within 160 dB radius. No mitigation action required due to permit exception for the species. Detection occurred outside NZ waters. Dolphins considered to be potential Level B takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
63	2018-01-26	23:07	Leatherback Sea Turtle	1	38.84902°S 187.97975°E	Full and Reduced Volume on a Survey Line	TV	BA, DI	278m/Full and Reduced Volume	None	Detection occurred with the starboard source array operating at full volume (3300 in ³) and the port source array operating at reduced volume (3120 in ³). Turtle was only sighted within the 175 dB radius for less than one minute. Long-line fishing gear using squid as bait passed by vessel and entangled with seismic gear just before sighting occurred. Detection occurred outside of NZ waters. Sea turtle considered to be a potential Level B take.
64	2018-01-27	07:16	Unidentified Dolphins	15	38.82967°S 178.77617°E	Full Volume on a Survey Line	PV/OD	PO, FT	1700m/Full Volume	Non	Dolphins only sighted in the 160 dB radius. Species undetermined due to distance of the dolphins and severe glare from the setting sun. Detection occurred outside of NZ waters. Dolphins considered to be potential Level B takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
65	2018-01-28	06:58	Short-beaked Common Dolphins	15	38.68850°S 178.47900°E	Full Volume on a Survey Line	PV/OD	PO, NS	800m/Full Volume	None	Dolphins only sighted within the 160 dB radius. Detection began outside of NZ waters and ended within. Dolphins were potential Level B takes.
66	2018-01-29	02:09	Unidentified Dolphins	10	38.72500°S 178.56533°E	Full Volume on a Survey Line	PE(AH)	NS, SA, PO, FF, SS	4300m/Full Volume	None	Dolphins only sighted within the 160 dB radius. No species identified due to distance of the dolphins from the vessel and glare from the sun. Detection occurred outside of NZ waters. Dolphins were potential Level B takes.
67	2018-01-29	06:26	Short-beaked Common Dolphins	40	38.63469°S 178.54065°E	Full Volume on a Survey Line	TV; AV	FT, PO, SA, FF, BR	230m/Full Volume	None	Simultaneous with AD#29. Dolphins first and last sighted visually. About 40 dolphins sighted visually, but only about 4 detected acoustically. Only 8 dolphins visually sighted within 500m EZ. Dolphin vocalizations could not be tracked. No mitigation due to permit exception for the species. Detection occurred outside of NZ waters. Dolphins were potential Level B takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
68	2018-02-01	06:19	Short-beaked Common Dolphins	4	38.62617°S 178.51517°E	Not Firing/Silent	PV/SD	PO, FT, SA	246m/Silent	None	Detection occurred while operations were suspended due to rough weather and sea conditions, and the acoustic source was silent and on board the vessel. Distance to the source was determined as if the arrays had been deployed. Detection occurred within NZ waters. Dolphins were not potential takes.
69	2018-02-01	22:23	Short-beaked Common Dolphins	11	38.63069°S 178.49535°E	Not Firing/Silent	TV; PV/SD	BR, PO, NS	174m/Silent	None	Detection occurred while operations were suspended due to rough weather and sea conditions, and the acoustic source was silent and on board the vessel. Distance to the source was determined as if the arrays had been deployed. Detection occurred within NZ waters. Dolphins were not potential takes.
70	2018-02-02	01:15	Short-beaked Common Dolphins	2	38.64086°S 178.47242°E	Full Volume Not on a Survey Line	PE(AH), AV	PO, NS, SS	315m/Full Volume	None	Dolphins only sighted within the 500m EZ for about one minute. No mitigation action required due to permit exception for the species. Detection occurred within NZ waters. Dolphins were not potential takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
71	2018-02-04	23:23	New Zealand Fur Seal	1	38.67150°S 178.37983°E	Full Volume Not on a Survey Line	SA; AV; PV/O D; AV	BA, NS, DI, FF, PO, FT	200m/Single 40 in ³ Element	Power Down	Fur seal observed entering and exiting the 500m EZ, and was last observed in the 160 dB radius. Total mitigation action was 33 minutes (13 minute PD and 20 minute ramp-up). Detection occurred within NZ territorial waters. Fur seal was not considered to be a potential take.
72	2018-02-05	00:04	New Zealand Fur Seal	2	38.66073°S 178.43537°E	Full Volume Not on a Survey Line	SA, PV/O D; AV	BA, NS, DI	100m/Single 40 in ³ Element	Power Down & Shutdown	Fur seals observed entering and exiting the 500 m EZ. Only one observed entering and exiting the 100m EZ. Both last sighted in the 160 dB radius. Total mitigation action was 31 minutes (4 minute PD, 7 minute SD, and 20 minute ramp-up). Detection occurred within NZ territorial waters. Fur seals were not considered to be potential takes.
73	2018-02-12	03:57	Short-beaked Common Dolphin	100	39.87083°S 177.24183°E	Not Firing/Silent	TV; V; AV	PO, FT, SA, SS, BR, DI	150m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Detection included 5 juveniles. A fishing trawler was sighted off the port beam of the vessel during the detection. Dolphins not considered to be potential takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
74	2018-02-13	00:31	Sperm Whale	1	42.86245°S 174.60090°E	Not Firing/Silent	PV/SD; AV	BV; DF	4102m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Whale not considered to be a potential take.
75	2018-02-13	01:27	New Zealand Fur Seal	1	42.99300°S 174.45930°E	Not Firing/Silent	PV/OD; AV	FL, BA	250m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Pinniped not considered to be a potential take.
76	2018-02-13	03:34	New Zealand Fur Seal	1	43.28085°S 174.14370°E	Not Firing/Silent	AV; PV/OD	SR, PO, FT, DI	100m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Pinniped not considered to be a potential take.
77	2018-02-13	03:46	New Zealand Fur Seal	2	43.30889°S 174.11122°E	Not Firing/Silent	AV; UN	PO, FT, MI	200m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Pinnipeds not considered to be potential takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
78	2018-02-13	04:00	New Zealand Fur Seal	2	43.33723°S 174.07761°E	Not Firing/Silent	PV/OD	NS, DI	150m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Pinnipeds not considered to be potential takes.
79	2018-02-13	04:20	New Zealand Fur Seal	1	43.38100°S 174.02493°E	Not Firing/Silent	SA; AV; PV/OD	BA, DI, SR, SS, PO	200m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Pinniped not considered to be a potential take.
80	2018-02-13	05:30	Unidentified Baleen Whale	1	43.53459°S 173.85448°E	Not Firing/Silent	PV/SD	BV, FT	670m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Whale not considered to be a potential take.
81	2018-02-13	05:48	Dwarf Minke Whale	1	43.57643°S 173.81017°E	Not Firing/Silent	PV/SD; AV	FF, BV, NS	525m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Whale not considered to be a potential take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
82	2018-02-13	07:50	New Zealand Fur Seal	2	43.86583°S 173.49317°E	Not Firing/Silent	PE(AH); AV	PO, FT	165m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Pinnipeds not considered to be potential takes.
83	2018-02-13	19:04	New Zealand Fur Seal	2	45.23617°S 171.51783°E	Not Firing/Silent	AV; PV/SD	PO, FT, SS	230m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Pinnipeds not considered to be potential takes
84	2018-02-20	07:49	Unidentified Otariid Pinniped	1	48.56150°S 164.51133°E	Not Firing/Silent	PV/SD	PO	251m/Silent	None	Acoustic source was silent and on board while the vessel was transiting to the first survey site. Detection occurred outside of NZ waters. Pinniped not considered to be a potential take.
85	2018-02-20	18:17	New Zealand Fur Seal	1	48.9300°S 163.78517°E	Not Firing/Silent	SA; TV	BA, MI	287m/Silent	None	Acoustic source was silent and on board while the vessel was deploying OBSs. Detection occurred outside of NZ waters. Pinniped not considered to be a potential take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
86	2018-02-21	03:52	New Zealand Fur Seal	4	49.35933°S 165.34833°E	Not Firing/Silent	SA; PV/OD	BA, PO	271m/Silent	None	Acoustic source was silent and on board while the vessel was deploying OBSs. Detection occurred outside of NZ waters. Pinnipeds not considered to be potential takes.
87	2018-02-21	04:10	New Zealand Fur Seal	1	49.37767°S 165.35267°E	Not Firing/Silent	PV/SD; TV	PO	157m/Silent	None	Acoustic source was silent and on board while the vessel was deploying OBSs. Detection occurred outside of NZ waters. Pinniped not considered to be a potential take.
88	2018-02-22	01:03	New Zealand Fur Seal	1	49.08350°S 164.30167°E	Full Volume on a Survey Line	PV/SD; AV	SR, DI, PO, FT	240m/Full Volume	Power-down	Pinniped last sighted within the 500m EZ. Mitigation action totalled 37 minutes (17 minutes PD and 20 minutes R-Up). Detection occurred outside of NZ waters. Pinniped was a potential Level B take.
89	2018-02-22	04:08	New Zealand Fur Seal	1	48.98779°S 163.97030°E	Full Volume on a Survey Line	SA	SH	369m/Full Volume	Power-down	Pinniped last sighted within the 160 dB radius. Mitigation action totalled 26 minutes (6 minutes PD and 20 minutes R-Up). Detection occurred outside of NZ waters. Pinniped was a potential Level B take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
90	2018-02-22	08:03	Unidentified Otariid Pinniped	1	48.86517°S 163.55233°E	Full Volume on a Survey Line	SA; AV	BA, PO	219m/Full Volume	Power-down	Pinniped last sighted within the 500m EZ. Mitigation action totalled 35 minutes (15 minutes PD and 20 minutes R-Up). Detection occurred outside of NZ waters. Pinniped was a potential Level B take.
91	2018-02-22	18:12	New Zealand Fur Seal	1	48.78533°S 163.29417°E	Not Firing/Silent	V	PO, SS, MI	210m/Silent	None	Acoustic source was silent and on board while the vessel was retrieving OBSs. Detection occurred outside of NZ waters. Pinniped was not considered to be a potential take.
92	2018-02-22	19:03	Unidentified Otariid Pinniped	1	48.79406°S 163.31762°E	Not Firing/Silent	SA, AV	SH, PO	230m/Silent	None	Acoustic source was silent and on board while the vessel was retrieving OBSs. Detection occurred outside of NZ waters. Pinniped was not considered to be a potential take.
93	2018-02-22	19:51	New Zealand Sea Lion	1	48.82562°S 163.41969°E	Not Firing/Silent	PV/SD; AV	PO	239m/Silent	None	Acoustic source was silent and on board while the vessel was retrieving OBSs. Detection occurred outside of NZ waters. Pinniped was not considered to be a potential take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
94	2018-02-22	21:31	Unidentified Otariid Pinniped	2	48.85985°S 163.53338°E	Not Firing/Silent	AV	PO	343m/Silent	None	Acoustic source was silent and on board while the vessel was retrieving OBSs. Detection occurred outside of NZ waters. Pinnipeds were not considered to be potential takes.
95	2018-02-23	00:18	Mixed Pod of Long-finned Pilot Whales and Bottlenose Dolphins	20 LFPW & 7 BND	48.89702°S 163.67054°E	Not Firing/Silent	TV; AV	SR, SS, BV, PO, SH, MI	244m/Silent	None	Acoustic source was silent and on board while the vessel was retrieving OBSs. Detection occurred outside of NZ waters. Dolphins were not considered to be potential takes.
96	2018-02-23	03:20	New Zealand Sea Lion	1	48.93686°S 163.79474°E	Not Firing/Silent	TV; AV	PO, BA	195m/Silent	None	Acoustic source was silent and on board while the vessel was retrieving OBSs. Detection occurred outside of NZ waters. Pinniped was not considered to be a potential take.
97	2018-02-23	07:58	New Zealand Fur Seal	1	49.01133°S 164.03967°E	Not Firing/Silent	TV; AV	PO, SS, SH, FT, BA	246m/Silent	None	Acoustic source was silent and on board while the vessel was retrieving OBSs. Detection occurred outside of NZ waters. Pinniped was not considered to be a potential take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
98	2018-02-24	06:13	Unidentified Pinniped	1	50.07517°S 165.34800°E	Not Firing/Silent	PV/OD	SR	259m/Silent	None	Acoustic source was silent and on board while the vessel transited to shelter behind the Auckland Island from an approaching storm system. Detection occurred outside of NZ waters. Pinniped was not considered to be a potential take.
99	2018-02-24	19:19	New Zealand Sea Lion	1	50.93734°S 166.27200°E	Not Firing/Silent	PV/SD; PE(BH)	SS, SR	195m/Silent	None	Acoustic source silent and on board while the vessel was stationary taking shelter from a storm near Auckland Island. Detection occurred within NZ waters. Pinniped was not considered to be a potential take.
100	2018-02-24	20:06	New Zealand Sea Lion	1	50.93784°S 166.26434°E	Not Firing/Silent	AV; PV/OD	PO	259m/Silent	None	Acoustic source silent and on board while the vessel was stationary taking shelter from a storm near Auckland Island. Detection occurred within NZ waters. Pinniped was not considered to be a potential take.
101	2018-02-24	21:59	New Zealand Fur Seal	1	50.98617°S 166.07579°E	Not Firing/Silent	SA; PV/OD	BA, SH, PO	193m/Silent	None	Acoustic source silent and on board while the vessel was stationary taking shelter from a storm near Auckland Island. Detection occurred within NZ waters. Pinniped was not considered to be a potential take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
102	2018-02-25	03:29	New Zealand Fur Seal	1	50.28176°S 165.62114°E	Not Firing/Silent	SA	BA	272m/Silent	None	Acoustic source silent and on board while the vessel transited back to the survey area after sheltering by Auckland Island from a passing storm system. Detection occurred outside of NZ waters. Pinniped not considered to be a potential take.
103	2018-02-25	04:08	New Zealand Fur Seal	1	50.07653°S 165.62917°E	Not Firing/Silent	PV/SD; AV	PO, SS, FT	287m/Silent	None	Acoustic source silent and on board while the vessel transited back to the survey area after sheltering by Auckland Island from a passing storm system. Detection occurred outside of NZ waters. Pinniped not considered to be a potential take.
104	2018-02-26	18:47	Unidentified Whale	1	47.56407°S 166.21217°E	Not Firing/Silent	PV/SD	SA	3158m/Silent	None	Acoustic source silent and on board during OBS deployment operations. Detection occurred outside of NZ waters. Whale not considered to be a potential take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
105	2018-02-26	21:21	New Zealand Fur Seal	1	47.47985°S 165.74404°E	Not Firing/Silent	TV; AV	SR, PO	287m/Silent	None	Acoustic source silent and on board during OBS deployment operations. Detection occurred outside of NZ waters. Pinniped not considered to be a potential take.
106	2018-02-27	00:34	Unidentified Baleen Whale	1	47.37300°S 165.25517°E	Not Firing/Silent	PV/SD; AV	BV	1196m/Silent	None	Acoustic source silent and on board during OBS deployment operations. Detection occurred outside of NZ waters. Whale not considered to be a potential take.
107	2018-02-27	19:18	Unidentified Dolphin	3	47.07087°S 163.91911°E	Full Volume on a Survey Line	PE(AH)	SR	518m/Full Volume	None	Dolphins only sighted within the 160 dB radius. No mitigation action required. Detection occurred outside of NZ waters. Dolphins were potential Level B takes.
108	2018-02-27	19:30	New Zealand Fur Seal	2	47.07635°S 163.94256°E	Full Volume on a Survey Line	SA; PV/OD	SH, DI, PO	309m/Single 40 in ³ element	Power-Down	Pinniped last observed in the 500m EZ. Mitigation action totalled 39 minutes (23 min PD and 16 min R-up). Detection occurred outside of NZ waters. Pinnipeds were potential Level B takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
109	2018-02-27	20:11	New Zealand Fur Seal	1	47.09283°S 164.01250°E	Ramp-up	AV	PO, FT	374m/Single 40 in ³ element	Power-Down	Detection began during ramp-up from VD#108 PD. Pinniped last sighted in 160 dB radius. Mitigation action totalled 27 minutes (7 min PD and 20 min R-up). Detection occurred outside of NZ waters. Pinniped was a potential Level B takes.
110	2018-02-27	23:34	Unidentified Otariid Pinniped	1	47.17687°S 164.37722°E	Full Volume on a Survey Line	SA	BA	504m/Full Volume	None	Pinniped only observed in the 160 dB radius. Detection occurred outside of NZ waters. Pinniped was a potential Level B take.
111	2018-02-28	01:42	New Zealand Fur Seal	1	47.23112°S 164.61614°E	Full Volume on a Survey Line	PV/SD; AV	SR, DI, PO, BA	291m/Full Volume	Power-Down	Pinniped last sighted in the 500m EZ. Mitigation action totalled 37 minutes (16 min PD and 21 min R-up). Detection occurred outside of NZ waters. Pinniped was a potential Level B take.
112	2018-02-28	04:47	Long-finned Pilot Whales	30	47.30656°S 164.95206°E	Full Volume on a Survey Line	PV/SD; AV	SR, BV, MI, SR	558m/Full Volume	None	Dolphins only observed in the 160 dB radius. Detection occurred outside of NZ waters. Dolphins were potential Level B takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
113	2018-02-28	18:14	Short-beaked Common Dolphins	50	47.63461°S 166.48105°E	Full Volume on a Survey Line	PE(AH); PV/OD; AV	NS, BR, SS, SR	18m/Single 40 in ³ element	Power-Down	Simultaneous with AD#35. Dolphins detected first simultaneously and last visually. About 50 dolphins sighted visually but only about 15 detected acoustically. 20 dolphins visually entered 500m EZ before species ID confirmed, so source was powered down. 18 dolphins then entered the 100m EZ, but no further mitigation actions required due to permit exception for the species. Dolphins last sighted in 100m EZ. Detection occurred outside of NZ waters. All 50 dolphins visually sighted were potential Level B takes.
114	2018-02-28	20:33	Unidentified Otariid Pinniped	1	47.68238°S 166.70398°E	Full Volume on a Survey Line	AV	PO	613m/Full Volume	None	Pinniped only observed in the 160 dB radius. Detection occurred outside of NZ waters. Pinniped was a potential Level B take.
115	2018-02-28	21:13	New Zealand Fur Seal	1	47.71555°S 166.75082°E	Not Firing/Silent	PV/OD; AV	PO, BA, SS, SH	275m/Silent	None	Acoustic source silent and being retrieved for OBS retrieval. Detection occurred outside of NZ waters. Pinniped not considered to be a potential take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
116	2018-02-28	21:38	New Zealand Fur Seal	5	47.73453°S 166.72328°E	Not Firing/Silent	SA	BA	50m/Silent	None	Acoustic source silent and being retrieved for OBS retrieval. Detection occurred outside of NZ waters. Pinnipeds not considered to be potential takes.
117	2018-03-02	07:40	Unidentified Otariid Pinniped	1	47.15903°S 164.30553°E	Not Firing/Silent	PV/OD	SA	257m/Silent	None	Acoustic source silent and on board for OBS retrieval operations. Detection occurred outside of NZ waters. Pinniped not considered to be a potential take.
118	2018-03-02	20:15	New Zealand Fur Seal	2	46.99881°S 163.62102°E	Not Firing/Silent	PE(BH); AV	SA, DI, SR	195m/Silent	None	Acoustic source silent and on board for OBS retrieval operations. Detection occurred outside of NZ waters. Pinnipeds not considered to be potential takes.
119	2018-03-02	23:21	New Zealand Fur Seal	1	46.97281°S 163.44621°E	Not Firing/Silent	PV/OD	PO, FT	168m/Silent	None	Acoustic source on board during streamer deployment. Detection occurred outside of NZ waters. Pinniped not considered to be a potential take.
120	2018-03-03	01:13	New Zealand Fur Seal	2	46.97140°S 163.23311°E	Not Firing/Silent	AV; PV/OD	DI, SR, SH	297m/Silent	None	Acoustic source on board during streamer deployment. Detection occurred outside of NZ waters. Pinniped not considered to be a potential take.
121	2018-03-04	06:28	Unidentified Baleen Whale	1	47.18473°S 164.41117°E	Full Volume on a Survey Line	PE(AH)	BV	1341m/Full Volume	None	Whale only observed within the 160 dB radius. Detection occurred outside of NZ waters. Whale was a potential Level B take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
122	2018-03-04	23:19	Humpback Whale	1	47.56004°S 166.12217°E	Full Volume on a Survey Line	AV	BV, SA	2376m/Full Volume	None	Whale only observed within the 160 dB radius. Detection occurred outside of NZ waters. Whale was a potential Level B take.
123	2018-03-06	21:17	Unidentified Otariid Pinniped	1	48.11878°S 165.72055°E	Full Volume on a Survey Line	PV/SD	SR, BA, DI	269m/Full Volume	Power Down	Pinniped last sighted within 500m EZ. Mitigation action totalled 37 minutes (17 min for PD and 20 min for R-up). Detection occurred outside of NZ waters. Pinniped was a potential Level B take.
124	2018-03-06	23:27	Unidentified Otariid Pinniped	1	48.27880°S 165.65716°E	Full Volume on a Survey Line	PV/SD; AV	SR, PO, DI	333m/Full Volume	Power Down	Pinniped last sighted within 500m EZ. Mitigation action totalled 36 minutes (16 min for PD and 20 min for R-up). Detection occurred outside of NZ waters. Pinniped was a potential Level B take.
125	2018-03-07	01:28	New Zealand Fur Seal	3	48.42390°S 165.59931°E	Full Volume on a Survey Line	PV/SD; AV	SR, DI, PO	304m/Full Volume	Power Down	Pinnipeds last sighted within 500m EZ. Mitigation action totalled 40 minutes (19 min for PD and 21 min for R-up). Detection occurred outside of NZ waters. Pinnipeds were potential Level B takes.
126	2018-03-08	05:33	New Zealand Sea Lions	2	49.45327°S 165.17773°E	Full Volume on a Survey Line	PV/SD; AV	PO, SH, PO	178m/Single 40 in ³ Element	Power Down	Pinnipeds last sighted within 500m EZ. Mitigation action totalled 40 minutes (18 min for PD and 22 min for R-up). Detection occurred outside of NZ waters. Pinnipeds were potential Level B takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
127	2018-03-09	01:46	Dwarf Minke Whale	1	49.29723°S 165.05956°E	Full Volume on a Survey Line	AV	BV, SR	500m/Single 40 in ³ Element	Power Down	Whale initially sighted 537 meters from the full volume active source. PD implemented as a precaution due to Level A take zone being 501 meters for this species. Whale last observed right at 500 meters from the powered-down source. Mitigation action totalled 54 minutes (33 min for PD and 21 min for R-Up). Detection occurred outside of NZ waters. Whale was a potential Level B take.
128	2018-03-10	19:51	New Zealand Fur Seal	1	47.83388°S 165.52941°E	Silent/Not Firing	V; AV	PO, NS, SS, DI, FT, SH	201m/Silent	None	Acoustic source silent and on board during seismic gear deployment. Detection occurred outside of NZ waters. Pinniped was not considered to be a potential take.
129	2018-03-12	03:00	New Zealand Fur Seal	1	47.21265°S 168.56243°E	Not Firing/Silent	PV/OD; AV	NS, SS, SH, PO	108m/Silent	None	Acoustic source silent and on board. Vessel transiting near Stewart Island to shelter from a storm system. Detection occurred outside of NZ waters. Pinniped was not a potential take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
130	2018-03-12	03:43	New Zealand Fur Seal	1	47.09198°S 168.62588°E	Not Firing/Silent	PV/SD; AV	SH, PO	248m/Silent	None	Acoustic source silent and on board. Vessel transiting near Stewart Island to shelter from a storm system. Detection occurred outside of NZ waters. Pinniped was not a potential take.
131	2018-03-12	04:02	New Zealand Fur Seal	1	47.03785°S 168.65225°E	Not Firing/Silent	SA; PV/SD	SH, BA, DI	374m/Silent	None	Acoustic source silent and on board. Vessel transiting near Stewart Island to shelter from a storm system. Detection occurred outside of NZ waters. Pinniped was not a potential take.
132	2018-03-12	04:12	New Zealand Fur Seal	1	47.02914°S 168.61663°E	Not Firing/Silent	PV/OD	NS,	224m/Silent	None	Acoustic source silent and on board. Vessel transiting near Stewart Island to shelter from a storm system. Detection occurred outside of NZ waters. Pinniped was not a potential take.
133	2018-03-12	04:18	Unidentified Otariid Pinniped	1	47.02540°S 168.59078°E	Not Firing/Silent	PV/OD	FF, FT, DI	549m/Silent	None	Acoustic source silent and on board. Vessel transiting near Stewart Island to shelter from a storm system. Detection occurred outside of NZ waters. Pinniped was not a potential take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
134	2018-03-12	20:56	New Zealand Fur Seal	1	46.99185°S 168.30453°E	Not Firing/Silent	PE(AH); AV	PO, FT, SH	289m/Silent	None	Acoustic source silent and on board. Vessel stationary near Stewart Island sheltering from a storm system. Detection occurred within NZ waters. Pinniped was not a potential take.
135	2018-03-13	19:40	Long-Finned Pilot Whales	20	46.98937°S 168.29078°E	Not Firing/Silent	PV/OD; TV; V; AV	BV,SR, PO, SH, MI, SA	20m/Silent	None	Acoustic source silent and on board. Vessel stationary near Stewart Island sheltering from a storm system. Detection occurred within NZ waters. Pinniped was not a potential take.
136	2018-03-14	00:58	New Zealand Fur Seal	1	47.02550°S 168.63700°E	Not Firing/Silent	PE(AH); AV	PO, FT, DI	249m/Silent	None	Acoustic source silent and on board. Vessel transiting near Stewart Island sheltering from a storm system. Detection occurred outside of NZ waters. Pinniped was not a potential take.
137	2018-03-14	19:28	New Zealand Fur Seal	1	46.98171°S 168.27076°E	Not Firing/Silent	PV/SD; AV	PO, FT, DI	205m/Silent	None	Acoustic source silent and on board. Vessel stationary near Stewart Island sheltering from a storm system. Detection occurred within NZ waters. Pinniped was not a potential take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
138	2018-03-15	01:01	Unidentified Otariid Pinniped	1	47.02099°S 168.63940°E	Not Firing/Silent	AV	PO	289m/Silent	None	Acoustic source silent and on board. Vessel transiting near Stewart Island sheltering from a storm system. Detection occurred outside of NZ waters. Pinniped was not a potential take.
139	2018-03-15	01:23	Unidentified Otariid Pinniped	1	47.02050°S 168.55700°E	Not Firing/Silent	PV/OD	PO	289m/Silent	None	Acoustic source silent and on board. Vessel transiting near Stewart Island sheltering from a storm system. Detection occurred outside of NZ waters. Pinniped was not a potential take.
140	2018-03-15	02:42	New Zealand Fur Seal	1	46.97970°S 168.31870°E	Not Firing/Silent	PV/OD	SR, DI	244m/Silent	None	Acoustic source silent and on board. Vessel stationary near Stewart Island sheltering from a storm system. Detection occurred within NZ waters. Pinniped was not a potential take.
141	2018-03-15	02:58	Unidentified Otariid Pinniped	3	46.97860°S 168.30928°E	Not Firing/Silent	AV	PO, FT, DI	307m/Silent	None	Acoustic source silent and on board. Vessel stationary near Stewart Island sheltering from a storm system. Detection occurred within NZ waters. Pinniped was not a potential take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
142	2018-03-16	06:32	New Zealand Fur Seal	1	47.01019°S 168.39198°E	Not Firing/Silent	TV; AV	PO; OB; SH	151m/Silent	None	Acoustic source silent and on board. Vessel transiting back to survey area from sheltering near Stewart Island from a storm system. Detection occurred within NZ waters. Pinniped was not a potential take.
143	2018-03-16	20:41	Long-finned Pilot Whales	4	47.16667°S 166.65289°E	Not Firing/Silent	UN; AV	SA, BV, SR	666m/Silent	None	Acoustic source silent and on board during streamer deployment operations. Detection occurred outside of NZ waters. Dolphins were not potential takes. Sighting of the dolphins was hindered by the large 5-6 meter swells present at that time.
144	2018-03-17	20:34	Short-beaked Common Dolphins	3	46.33739°S 166.41409°E	Full Volume on a Survey Line	PE(AH)	PO, FT, DI	544m/Full Volume	None	Dolphins only sighted within the 160 dB radius. Detection occurred outside of NZ waters. Dolphins were potential Level B takes.
145	2018-03-19	00:07	Unidentified Otariid Pinnipeds	4	46.96790°S 168.82006°E	Not Firing/Silent	PV/OD	PO, FT	241m/Silent	None	Acoustic source was silent and on board while the vessel was transiting back to port at the end of the survey. Detection occurred outside of NZ waters. Pinnipeds were not potential takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
146	2018-03-19	18:19	New Zealand Sea Lion	1	45.79017°S 170.06950°E	Not Firing/Silent	SA	FF, DI	291m/Silent	None	Acoustic source was silent and on board while the vessel was transiting back to port at the end of the survey. Detection occurred within NZ waters. Pinniped was not a potential take.

APPENDIX I: Summary of Acoustic Detections of Protected Species during Southwest Pacific Ocean New Zealand Seismic Survey

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
1	2017-11-18	16:16	Unidentified dolphin	1	40.68807°S	177.04993°E	Scattered high frequency clicks between bearings 77 and 123 degrees to the hydrophones astern of the vessel; frequency 33-110 kilohertz; peak frequency 42-105 kilohertz; amplitude 133-156 decibels	Unknown/Full volume	None	There were no discernible click trains that could be tracked during the detection; therefore, range could not be determined. Detection was not visually confirmed. Per the IHA, acoustic only detection of dolphins do not require mitigation actions; therefore, none were implemented for this detection. Detection occurred outside of New Zealand territorial waters. As the detection did consist of HF vocalizations, it was likely that the dolphin was at least within the 160 dB radius, and was therefore a potential Level B take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
2	2017-11-22	23:39	Long-finned Pilot Whales	12	39.8797°S 177.6142°E	Full volume online	High frequency clicks 27-230 kHz	Not tracked acoustically	Power Down – due to the visual detection of the dolphins	Simultaneous with VD#22. Vocalizations did not register in the Pamguard software during the detection. Analysis of the detection recordings revealed the clicks, which occurred when the dolphins were visually sighted at their closest distance to the vessel, source and hydrophone cable. Acoustic detection totalled 16 minutes. Source was powered down for 37 minutes during full volume source production operations due to the dolphins being visually observed within the 500 meter exclusion zone.
3	2017-11-23	02:44	Short-beaked Common Dolphins	11	39.55895°S 177.47298° E	Full volume online	Broadband high frequency click trains - bearings 39-121 degrees; peak frequencies 24-75 kHz; amplitudes 123-162 dB	78m/Full volume	None	Simultaneous with VD#24. Acoustic detection began five minutes after initial visual detection and concluded simultaneously with the conclusion of the visual detection. Acoustic detection could only confirm 11 individuals vocalizing, and totalled one hour 19 minutes. No mitigation actions were required for the detection due to the permit exception for the species.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
4	2018-01-09	07:02	Short-beaked Common Dolphins	2	38.78462°S 178.56445°E	Full Volume Offline	High frequency clicks 20-250 kHz and 127-142 dB	750m/Full Volume	None	Simultaneous with VD #41. Dolphins detected visually first. Dolphins only observed in 160 dB radius. Detection occurred outside of NZ territorial waters. Dolphins were potential Level B takes.
5	2018-01-09	12:36	Unidentified Dolphins	2	38.44173°S 178.45440°E	Full Volume Offline	High frequency clicks 24-250 kHz and 139-152 dB; Low frequency whistles 7-16 kHz.	Unknown/Full Volume	None	Acoustic only detection during hours of darkness. Dolphin vocalizations could not be tracked; therefore no mitigation actions were required. Detection occurred within NZ territorial waters, thus the dolphins were not considered to be potential takes.
6	2018-01-09	16:03	Unidentified Dolphins	1	38.49695°S 178.46942°E	Full Volume Offline	High frequency clicks 27-157 kHz and 134-150 dB	Unknown/Full Volume	None	Acoustic only detection during hours of darkness. Dolphin vocalizations could not be tracked; therefore no mitigation actions were required. Detection occurred within NZ territorial waters, thus the dolphins were not considered to be potential takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
7	2018-01-10	11:44	Unidentified Dolphins	3	38.72671°S 178.44765°E	Full Volume Online	High frequency clicks 11-250 kHz and 131-143 dB and low frequency whistles 13-16 kHz	Unknown/Full Volume	None	Acoustic only detection during hours of darkness. Dolphin vocalizations could not be tracked; therefore no mitigation actions were required. Detection occurred outside NZ territorial waters, thus the dolphins were considered to be potential takes.
8	2018-01-10	14:46	Unidentified Dolphins	4	38.67578°S 178.49326°E	Full Volume Online	High frequency clicks 11-250 kHz and 137-157 dB and low frequency whistles 7-18 kHz	Unknown/Full Volume	None	Acoustic only detection during hours of darkness. Dolphin vocalizations could not be tracked; therefore no mitigation actions were required. Detection occurred within NZ territorial waters, thus the dolphins were not considered to be potential takes.
9	2018-01-12	05:39	Short-beaked Common Dolphins	8	38.67242°S 178.49883°E	Full Volume Online	Clicks 16-250 kHz and 1320162 dB; burst pulse 29-87 kHz; whistles 5-42 kHz	290m/Full Volume	None	Simultaneous with VD #44. Dolphins detected visually first. Dolphins last sighted in the 500m EZ. No mitigation action required due to the IHA exception for the species. Dolphins vocalization could not be acoustically tracked. Detection occurred outside of NZ territorial waters. Dolphins were potential Level B takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
10	2018-01-12	22:55	Short-beaked Common Dolphins	2	38.69400°S 178.40067° E	Full Volume Offline	High frequency clicks 25-205 kHz and 135-145 dB; whistles 10-18 kHz	225m/Full Volume	None	Simultaneous with VD #45. Dolphins detected visually first. Dolphins last sighted in the 500m EZ. No mitigation action required due to the IHA exception for the species. Dolphin's vocalization could not be acoustically tracked. Detection occurred within NZ territorial waters. Dolphins were not potential takes.
11	2018-01-14	13:55	Unidentified Dolphin	4	38.70567°S 178.43521° E	Full Volume on a Survey Line	High frequency clicks 11-250 kHz and 132-158 dB; whistles 9-24 kHz	Unknown/Full Volume	None	Acoustic only detection during hours of darkness. Dolphin vocalizations could not be tracked. Detection occurred within NZ waters. Dolphins not considered to be potential takes.
12	2018-01-15	05:19	Short-beaked Common Dolphin	10	38.87242°S 178.79687° E	Full Volume on a Survey Line	High frequency clicks 18-250 kHz and 131-165 dB; whistles 6-23 kHz	481m/Full Volume	None	Simultaneous with VD#47. 10 dolphins detected acoustically but only 5 visually sighted. Dolphin vocalizations could not be track. Dolphins visually sighted in 500m EZ and last sighted in 160 dB radius. No mitigation action required due to permit exception for the species. Detection occurred outside of NZ waters. Dolphins were considered potential Level B takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
13	2018-01-15	09:35	Unidentified Dolphin	3	38.70900°S 178.44683°E	Full Volume on a Survey Line	High frequency clicks 10-190 kHz and 117-160 dB; whistles 8-20 kHz	Unknown/Full Volume	None	Acoustic only detection during hours of darkness. Dolphin vocalizations could not be tracked. Detection occurred outside of NZ waters. Dolphins considered to be potential Level B takes.
14	2018-01-15	11:53	Unidentified Dolphin	12	38.64170°S 178.46035°E	Full Volume on a Survey Line	High frequency clicks 27-230 kHz and 125-146 dB; whistles 6-40 kHz	Unknown/Full Volume	None	Acoustic only detection during hours of darkness. Dolphin vocalizations could not be tracked. Detection occurred outside of NZ waters. Dolphins considered to be potential Level B takes.
15	2018-01-16	05:05	Short-beaked Common Dolphin	3	38.73111°S 178.49963°E	Full Volume on a Survey Line	High frequency clicks 17-136 kHz and 134-141 dB	465m/Full Volume	None	Simultaneous with VD#49. Dolphins detected acoustically first. Dolphins only briefly visually observed within 500m EZ. No mitigation action required due to permit exception for the species Detection occurred outside of NZ waters. Dolphins considered to be potential Level B takes.
16	2018-01-16	05:39	Unidentified Dolphin	8	38.70975°S 178.45455°E	Full Volume on a Survey Line	High frequency clicks 270-230 kHz and 125-146 dB; whistles 6-40 kHz	Unknown/Full Volume	None	Acoustic only detection during hours of darkness. Dolphin vocalizations could not be tracked. Detection occurred outside of NZ waters. Dolphins considered to be potential Level B takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
17	2018-01-16	09:07	Unidentified Dolphin	5	38.68317°S 178.55533°E	Full Volume on a Survey Line	High frequency clicks 5-190 kHz and 135-151 dB; whistles 9-20 kHz	Unknown/Full Volume	None	Acoustic only detection during hours of darkness. Dolphin vocalizations could not be tracked. Detection occurred outside of NZ waters. Dolphins considered to be potential Level B takes.
18	2018-01-19	14:47	Unidentified Dolphin	2	38.79943°S 178.66175°E	Full Volume on a Survey Line	High frequency clicks 19-250 kHz and 133-140 dB	Unknown/Full Volume	None	Acoustic only detection during hours of darkness. Dolphin vocalizations could not be tracked. Detection occurred outside of NZ waters. Dolphins considered to be potential Level B takes.
19	2018-01-20	12:25	Unidentified Dolphin	6	38.71119°S 178.48000°E	Full Volume on a Survey Line	High frequency clicks 24-250 kHz and 129-147 dB; whistles 7-16 kHz	Unknown/Full Volume	None	Acoustic only detection during hours of darkness. Dolphin vocalizations could not be tracked. Detection began outside of NZ waters and ended within. Dolphins considered to be potential Level B takes.
20	2018-01-20	14:09	Unidentified Dolphin	3	38.62069°S 178.39356°E	Full Volume Not on a Survey Line	High frequency clicks 23-209 kHz and 133 dB; whistles 7-15 kHz	Unknown/Full Volume	None	Acoustic only detection during hours of darkness. Dolphin vocalizations could not be tracked. Detection occurred within NZ waters. Dolphins not considered to be potential takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
21	2018-01-20	14:41	Unidentified Dolphin	3	38.61481°S 178.43710°E	Full Volume Not on a Survey Line	High frequency clicks 24-250 kHz and 128-136 dB	Unknown/Full Volume	None	Acoustic only detection during hours of darkness. Dolphin vocalizations could not be tracked. Detection occurred within NZ waters. Dolphins not considered to be potential takes.
22	2018-01-20	15:39	Unidentified Dolphin	4	38.65339°S 178.51942°E	Full Volume on a Survey Line	High frequency clicks 25-250 kHz and 132-152 dB; whistles 6-22 kHz	Unknown/Full Volume	None	Acoustic only detection during hours of darkness. Dolphin vocalizations could not be tracked. Detection occurred outside of NZ waters. Dolphins considered to be potential Level B takes.
23	2018-01-21	12:00	Unidentified Dolphin	4	38.63054°S 178.47776°E	Reduced and Full Volume Not on a Survey Line	High frequency clicks 12-250 kHz and 137-147 dB; whistles 7-21 kHz	Unknown/ Reduced and Full Volume	None	Detection began with the starboard source array operating at full volume (3300 in ³) and the port source array operating at reduced volume (1650 in ³). Source resumed FV operations on a survey line at 12:06 UTC. Detection occurred during hours of darkness. Dolphin vocalizations could not be tracked. Detection occurred within NZ waters. Dolphins not considered to be potential takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
24	2018-01-21	13:10	Unidentified Dolphin	3	38.67760°S 178.57771° E	Full Volume on a Survey Line	High frequency clicks 17-250 kHz and 126-143 dB; whistles 8 kHz	Unknown/Full Volume	None	Detection occurred during hours of darkness. Dolphin vocalizations could not be tracked. Detection occurred outside of NZ waters. Dolphins considered to be potential Level B takes.
25	2018-01-24	18:31	Short-beaked Common Dolphin	10	38.66664°S 178.40588° E	Full Volume Not on a Survey Line	High frequency clicks 17-250 kHz and 128-143 dB; whistles 7-20 kHz	121m/Full Volume	None	Simultaneous with VD#58. Dolphins detected first and last visually. At least 75 dolphins sighted visually but only about 10 detected acoustically. Dolphin vocalizations could not be tracked acoustically, but they were visually sight within 500m EZ. No mitigation actions required due to permit exception of the species. Detection occurred within NZ waters. Dolphins not considered to be potential takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
26	2018-01-25	14:22	Unidentified Dolphin	2	38.66785°S 178.41557°E	Full Volume Not on a Survey Line	High frequency clicks 17-207 kHz and 131-140 dB	Unknown/Full Volume	None	Detection occurred during hours of darkness. Dolphin vocalizations could not be tracked. Detection occurred within NZ waters. Dolphins not considered to be potential takes.
27	2018-01-25	20:32	Short-beaked Common Dolphin	6	38.61550°S 178.47267°E	Full Volume Not on a Survey Line	High frequency clicks 10-140 kHz and 127-160 dB; whistles 6-24 kHz	324m/Full Volume	None	Simultaneous with VD#61. Dolphins detected first and last visually. At least 40 dolphins sighted visually, but only about 6 detected acoustically. Dolphin vocalizations could not be tracked acoustically, but they were visually sight within 500m EZ. No mitigation actions required due to permit exception of the species. Detection occurred within NZ waters. Dolphins not considered to be potential takes.
28	2018-01-27	14:29	Unidentified Dolphins	2	38.65122°S 178.56118°E	Full Volume on a Survey Line	High frequency clicks 21-240 kHz and 135-152 dB; whistles 9-21 kHz	542m/Full Volume	None	Detection occurred during hours of darkness. Dolphin vocalizations tracked outside of the 500m EZ. Detection occurred outside of NZ waters. Dolphins considered to be potential Level B takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
29	2018-01-29	06:37	Short-beaked Common Dolphins	4	38.64338°S 178.55885°E	Full Volume on a Survey Line	High frequency clicks 19-250 kHz and 128-146 dB	230m/Full Volume	None	Simultaneous with VD#67. Dolphins sighted first and last visually. About 40 dolphins sighted visually but only about 4 detected acoustically. Dolphin vocalizations could not be tracked acoustically. Only 8 dolphins visually sighted within 500m EZ. No mitigation action due to permit exception for the species. Detection occurred outside of NZ waters. Dolphins were potential Level B takes.
30	2018-01-30	02:01	Unidentified Dolphins	1	38.58466°S 178.43402°E	Full Volume Not on a Survey Line	Whistles 18-20 kHz	Unknown/Full Volume	None	Acoustic only detection during daylight hours. Dolphins not visually sighted. Dolphin vocalizations could not be tracked acoustically. Detection occurred within NZ waters. Dolphins not considered to be potential takes.
31	2018-01-30	04:06	Unidentified Dolphins	6	38.66983°S 178.62100°E	Full Volume on a Survey Line	High frequency clicks 21-248 kHz and 135-148 dB	Unknown/Full Volume	None	Acoustic only detection during daylight hours. Dolphins not visually sighted. Dolphin vocalizations could not be tracked acoustically. Detection occurred outside of NZ waters. Dolphins were potential Level B takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
32	2018-02-02	06:31	Unidentified Dolphins	2	38.07704°S 178.68965°E	Not Firing/Silent	High frequency clicks 15-213 kHz and 123-130 dB	Unknown/Full Volume	None	Acoustic only detection during daylight hours. Dolphins not visually sighted. Dolphin vocalizations could not be tracked acoustically. Acoustic source was silent, but deployed, while operations were suspended due to rough weather and sea conditions. Detection occurred outside of NZ waters. Dolphins were not potential takes.
33	2018-02-04	09:12	Unidentified Dolphin	3	38.69667°S 178.43133°E	Full Volume on a Survey Line	High frequency clicks 5-170 kHz and 135-148 dB	Unknown/Full Volume	None	Acoustic only detection during hours of darkness. Vocalizations only detected for about 10 seconds and could not be tracked. Detection occurred within NZ waters. Dolphins not considered to be potential takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
34	2018-02-28	17:17	Unidentified Dolphin	2	47.61254°S 166.37487°E	Full Volume on a Survey Line	High frequency clicks 28-250 kHz and 127-155 dB; burst pulses 41-86 kHz	Unknown/Full Volume	None	Acoustic only detection at night. Vocalizations were unable to be tracked acoustically. Detection occurred outside of NZ waters. Dolphins were potential Level B takes.
35	2018-02-28	18:14	Short-beaked Common Dolphin	15	47.63461°S 166.48105°E	Full Volume on a Survey Line	High frequency clicks 21-250 kHz and 125-163 dB; whistles 8-19 kHz	18m/Single 40 in ³ element	Power-Down	Simultaneous with VD#113. Dolphins detected first simultaneously and last visually. About 50 dolphins sighted visually but only about 15 detected acoustically. 20 dolphins visually entered 500m EZ before species ID confirmed, so source was powered down. 18 dolphins then entered the 100m EZ, but no further mitigation actions required due to permit exception for the species. Dolphins last sighted in 100m EZ. Detection occurred outside of NZ waters. All 50 dolphins visually sighted were potential Level B takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
36	2018-03-05	11:15	Unidentified Dolphin	4	47.71335°S 166.28440°E	Full Volume on a Survey Line	High frequency clicks 21-250 kHz and 129-151 dB	220m/Full Volume	Power Down Twice	Acoustic only detection at night. Dolphins tracked entering, exiting, and then re-entering the 500m EZ, so two PDs and two R-ups for this detection. Mitigation actions totalled one hour 17 minutes (39 minutes for the two PDs and 38 minutes for the two R-ups). Detection occurred outside of NZ waters. Dolphins were potential Level B takes.
37	2018-03-05	12:58	Unidentified Dolphin	2	47.69690°S 166.28440°E	Full Volume on a Survey Line	High frequency clicks 21-250 kHz and 128-158 dB	220m/Full Volume	Power Down	Acoustic only detection at night. Dolphin vocalizations last tracked within the 500m EZ. Mitigation action totalled 46 minutes (26 minutes of PD and 20 minutes of R-up). Detection occurred outside of NZ waters. Dolphins were potential Level B takes.
38	2018-03-05	16:13	Unidentified Dolphin	3	47.66397°S 165.78042°E	Full Volume on a Survey Line	High frequency clicks 24-250 kHz and 144-150 dB	Unknown/Full Volume	None	Acoustic only detection at night. Dolphin vocalizations could not be tracked. Detection occurred outside of NZ waters. Dolphins were potential Level B takes.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Acoustic Detection Details	CPA Source / Source Activity	Mitigation Action	Comments
39	2018-03-06	09:59	Unidentified Dolphin	2	47.38725°S 165.92346°E	Full Volume on a Survey Line	High frequency clicks 18-214 kHz and 139-144 dB	Unknown/Full Volume	None	Acoustic only detection at night. Dolphin vocalizations could not be tracked. Detection occurred outside of NZ waters. Dolphins were potential Level B takes.
40	2018-03-17	07:57	Unidentified Dolphin	3	46.74078°S 166.96245°E	Full Volume on a Survey Line	Low frequency whistles 5-13 kHz, Pulses 7-12 kHz, High frequency clicks 25-85 kHz; Amplitude 125-169 dB	Unknown/Full Volume	None	Acoustic only detection during hours of darkness. Dolphin vocalizations could not be tracked. Detection occurred within NZ waters. Dolphins were not potential takes.

APPENDIX J: Photographs of Identified Protected Species Visually Detected during the Southwest Pacific Ocean New Zealand Seismic Survey.



Figure 1: Visual Detection #4; New Zealand Fur Seal; 8 November 2017



Figure 2: Visual Detection #5; New Zealand Fur Seal; 8 November 2017



Figure 3: Visual Detection #7; New Zealand Fur Seal; 9 November 2017



Figure 4: Visual Detection #9; New Zealand Fur Seal; 9 November 2017



Figure 5: Visual detection #11; Sperm Whales; 12 November 2017.



Figure 6: Visual detection #14; New Zealand fur seals; 15 November 2017.



Figure 7: Visual detection #15; Long-finned Pilot Whales; 15 November 2017.



Figure 8: Visual detection #18; Long-finned pilot whales; 19 November 2017.



Figure 9: Visual detection #20; Bryde's whale; 21 November 2017.



Figure 10: Visual detection #22; Long-finned pilot whales; 22 November 2017.



Figure 11: Visual detection #24; Short-beaked common dolphins; 23 November 2017.



Figure 12: Visual detection #25; Long-finned pilot whales; 26 November 2017.



Figure 13: Visual detection #29; Long-finned pilot whales and bottlenose dolphins; 01 December 2017.



Figure 14: Visual detection #30; Blue Whale; 02 December 2017



Figure 15: Visual detection #32; New Zealand Fur Seal; 4 December 2017.



Figure 16: Visual detection #35; Short-beaked common dolphins; 5 December 2017.



Figure 17: Visual detection #36; Short-beaked common dolphins; 6 December 2017.



Figure 18: Visual detection #38; Short-beaked common dolphins; 6 January 2017.



Figure 19: Visual detection #40; Sperm whale; 8 January 2018.



Figure 20: Visual detection #44; Short-beaked common dolphins; 12 January 2018.



Figure 21: Visual detection #45; Short-beaked common dolphins; 12 January 2018.



Figure 22: Visual detection #53; Short-beaked Common Dolphins; 19 January 2018.



Figure 23: Visual detection #55; Short-beaked common dolphins; 23 January 2018.



Figure 24: Visual detection #58; Short-beaked common dolphins; 24 January 2018.



Figure 25: Visual Detection #61; Short-beaked Common Dolphins; 25 January 2018.



Figure 26: Visual Detection #62; Short-beaked Common Dolphins; 26 January 2018



Figure 27: Visual Detection #67; Short-beaked Common dolphins; 29 January 2018.



Figure 28: Visual Detection #68; Short-beaked Common Dolphins; 01 February 2018.



Figure 29: Visual Detection #69; Short-beaked Common dolphins; 01 February 2018



Figure 30: Visual detection #71; New Zealand Fur Seal; 05 February 2018.



Figure 31: Visual Detection #72; New Zealand Fur Seals; 6 February 2018.



Figure 32: Visual Detection #73; Short-beak Common Dolphins; 12 February 2018.



Figure 33: Visual Detection #76; New Zealand Fur Seal; 13 February 2018.



Figure 34: Visual Detection #79; New Zealand Fur Seal; 13 February 2018.



Figure 35: Visual Detection #81; Dwarf Minke Whale; 13 February 2018.



Figure 36: Visual Detection #86; New Zealand Fur Seal; 21 February 2018.



Figure 37: Visual Detection #95; Long-finned Pilot Whales and Bottlenose Dolphins; 23 February 2018.



Figure 38: Visual Detection #95; Long-finned Pilot Whales and Bottlenose Dolphins; 23 February 2018.



Figure 39: Visual Detection #97; New Zealand Fur Seal; 23 February 2018.



Figure 40: Visual Detection #99; New Zealand Sea Lion; 24 February 2018.



Figure 41: Visual Detection #100; New Zealand Sea Lion; 24 February 2018.



Figure 42: Visual Detection #101; New Zealand Fur Seal; 24 February 2018.



Figure 43: Visual Detection #106 - Unidentified Baleen Whale - 27 February 2018.



Figure 44: Visual Detection #111; New Zealand Fur Seal; 28 February 2018.



Figure 45: Visual Detection #112; Long-finned Pilot Whales; 28 February 2018.



Figure 46: Visual Detection #113 - Short-beaked Common Dolphins - 28 February 2018.



Figure 47: Visual Detection #127; Dwarf Minke Whale; 9 March 2018.



Figure 48: Visual Detection #128; New Zealand Fur Seal; 10 March 2018.



Figure 49: Visual Detection #134; New Zealand Fur Seal; 12 March 2018.



Figure 50: Visual Detection #135; Long-finned Pilot whales; 13 March 2018.



Figure 51: Visual Detection #135; Long-finned Pilot whales; 13 March 2018.



Figure 52: Visual Detection #135; Long-finned Pilot whales; 13 March 2018.



Figure 53: Visual Detection #142; New Zealand Fur Seal; 16 March 2018.

APPENDIX K: Screenshots Taken during Acoustic Detections of Protected Species during the Southwest Pacific Ocean New Zealand Seismic Survey.

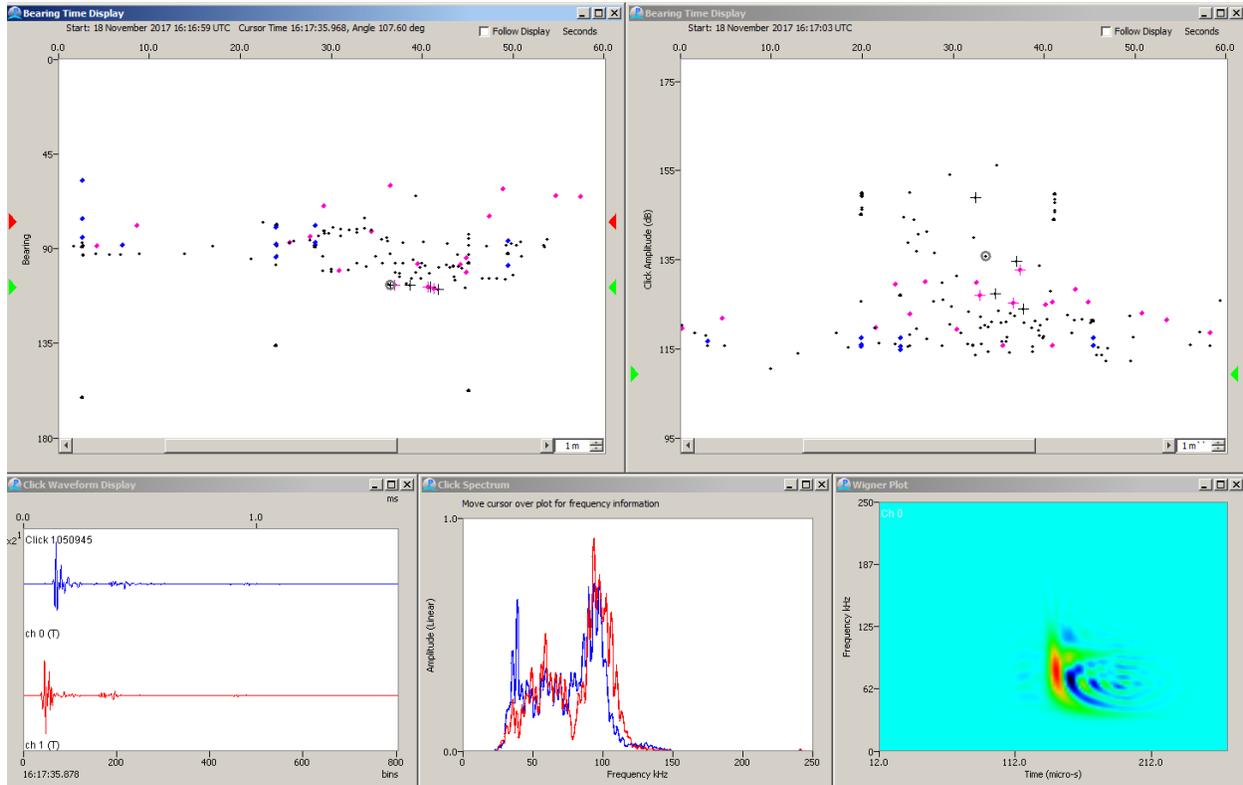


Figure 1: Acoustic detection #1; Unidentified dolphin clicks; Pamguard high frequency click detector; 18 November 2017.

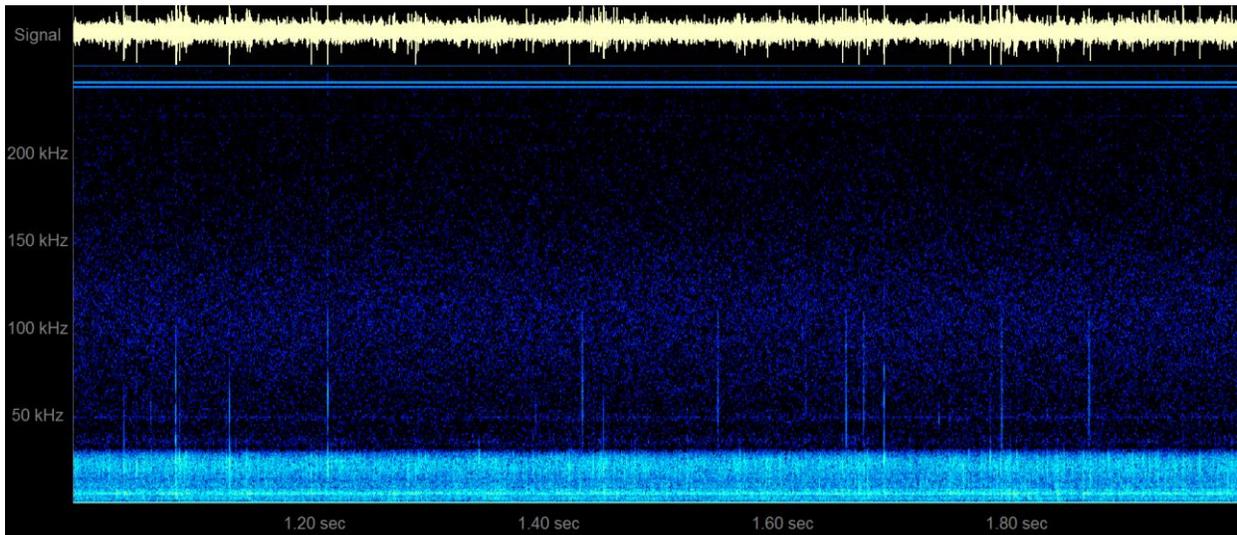


Figure 2: Acoustic detection #1; Unidentified dolphin high frequency clicks; Spectrogram 16; 18 November 2017.

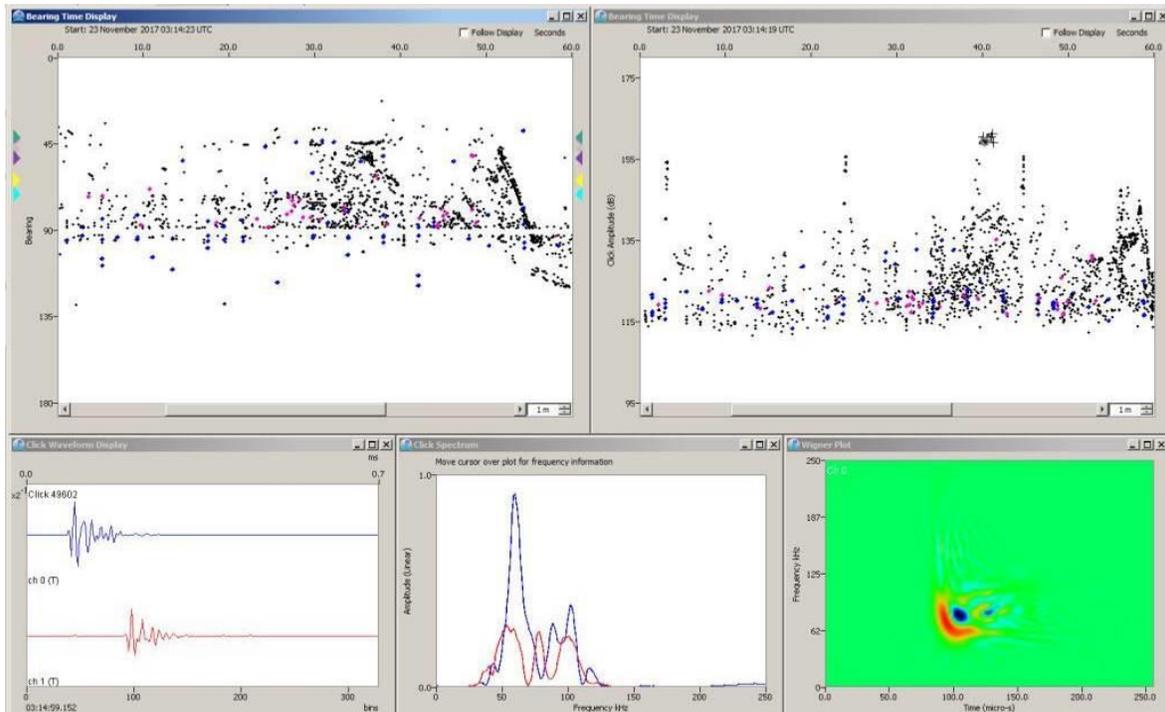


Figure 3: Acoustic detection #3; Short-beaked common dolphins' high frequency clicks; Pamguard high frequency click detector; 23 November 2017.

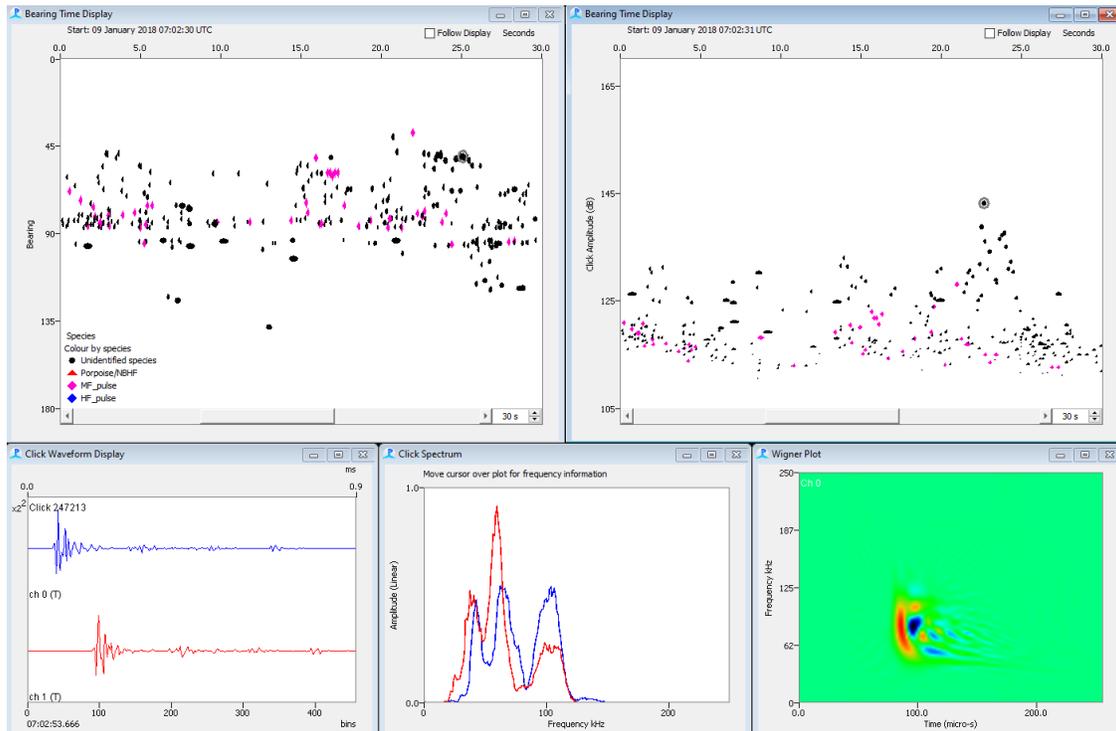


Figure 4: Acoustic detection #4; Short-beaked Common Dolphins; Pamguard high frequency click detector; 9 January 2018

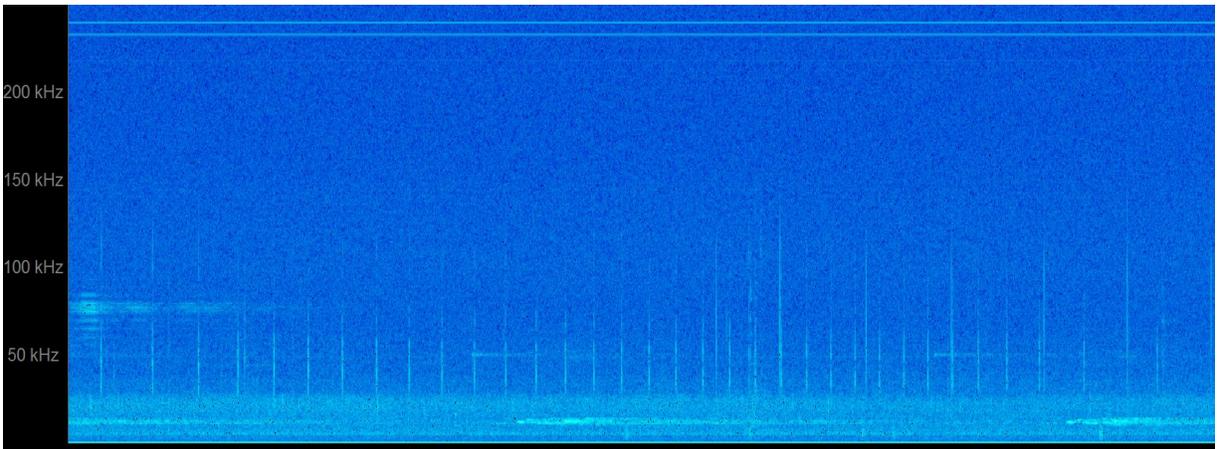


Figure 5: Acoustic detection #6; Unidentified dolphins high frequency clicks; Spectrogram 16; 9 January 2018.

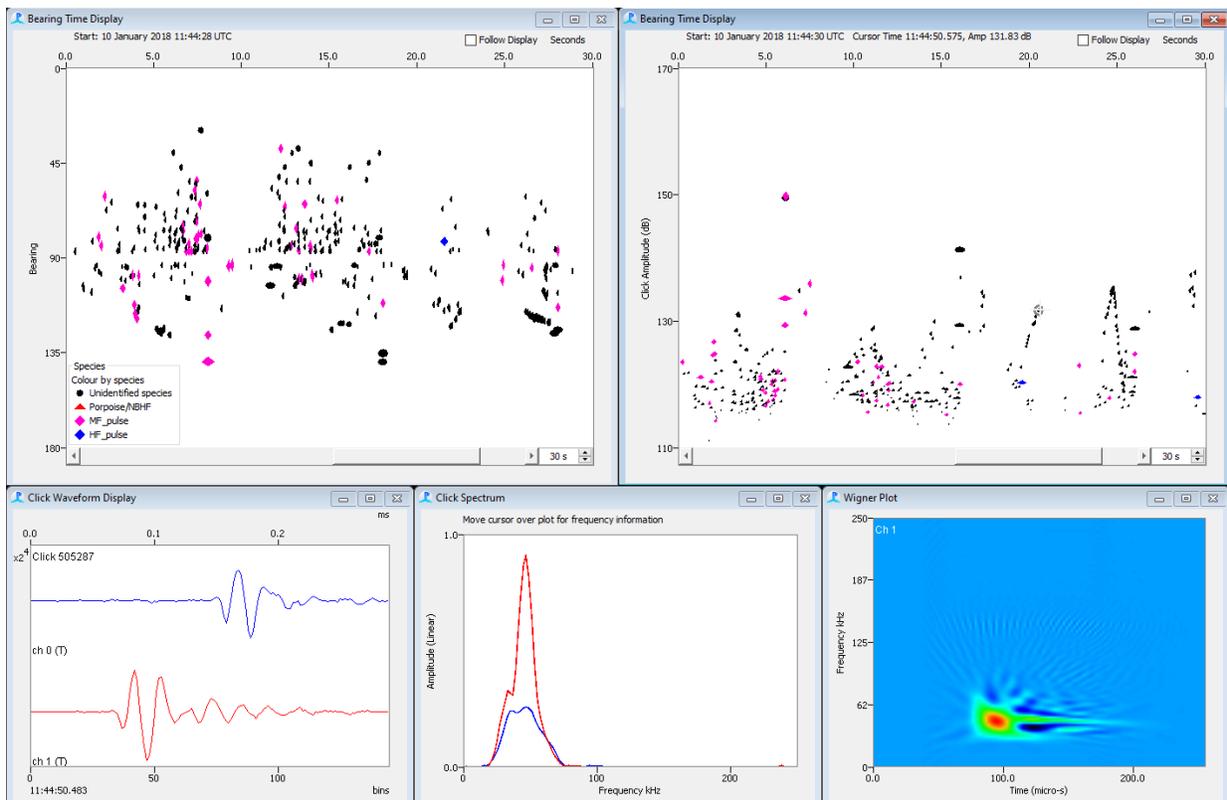


Figure 6: Acoustic detection #7; Unidentified dolphins; Panguard high frequency click detector; 10 January 2018.

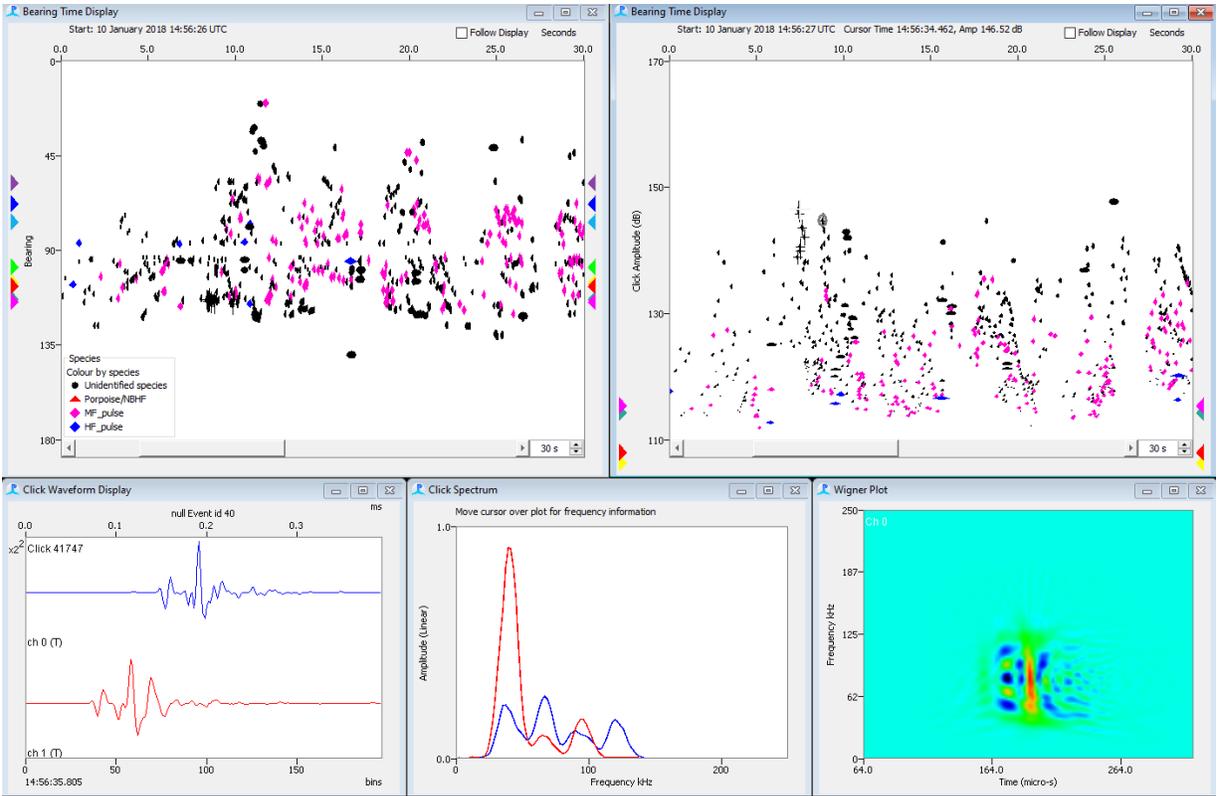


Figure 7: Acoustic detection #8; Unidentified dolphins; Pamguard high frequency click detector; 10 January 2018.

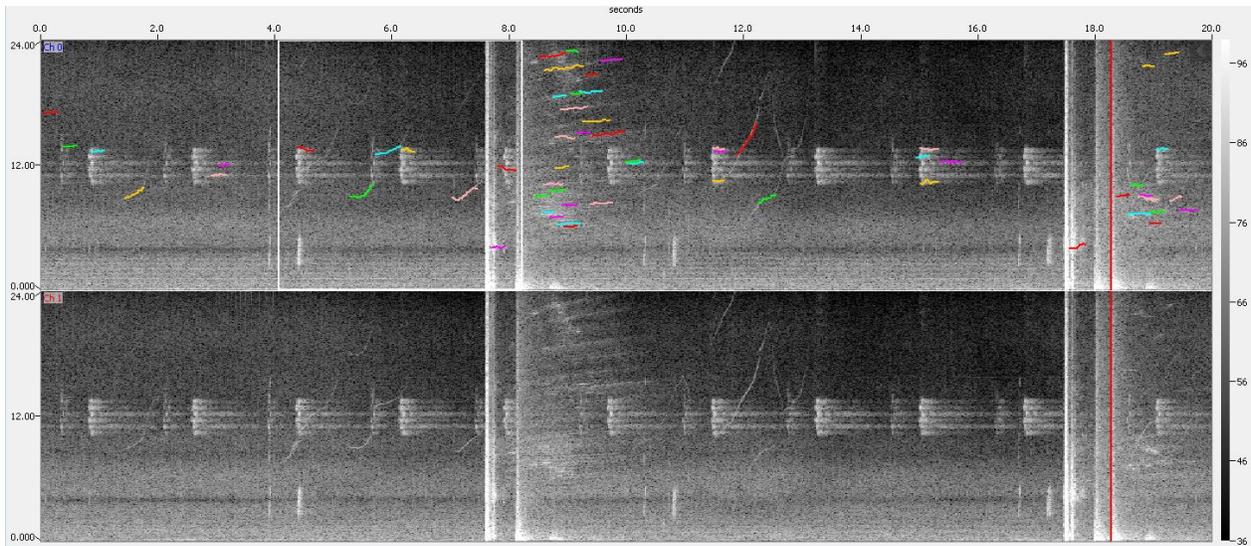


Figure 8: Acoustic detection #8; Unidentified dolphin low frequency whistles; Pamguard spectrogram; 10 January 2018.

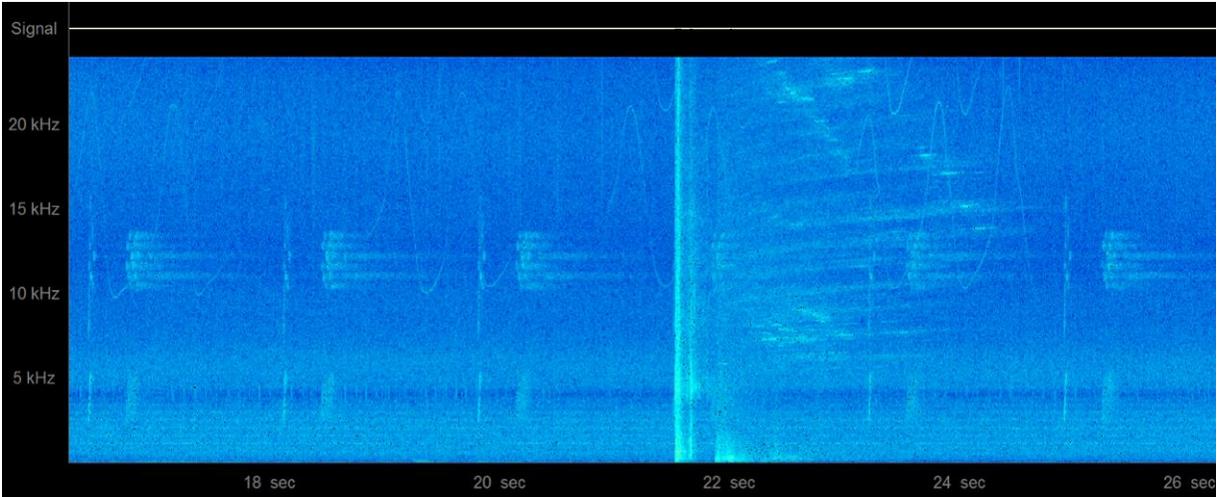


Figure 9: Acoustic detection #9; Short-beaked common dolphins, low frequency whistles; Spectrogram 16; 12 January 2018.

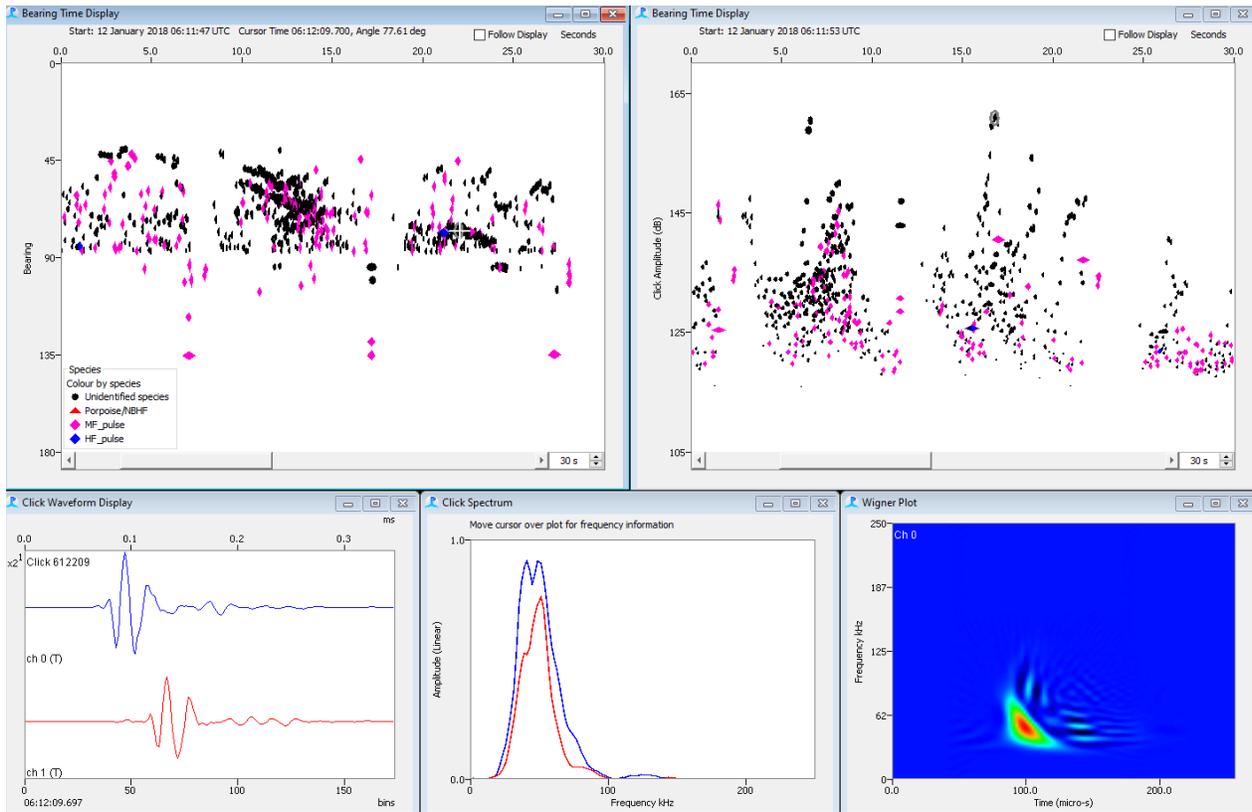


Figure 10: Acoustic detection #9; Short-beaked common dolphins; Panguard high frequency click detector; 12 January 2018.

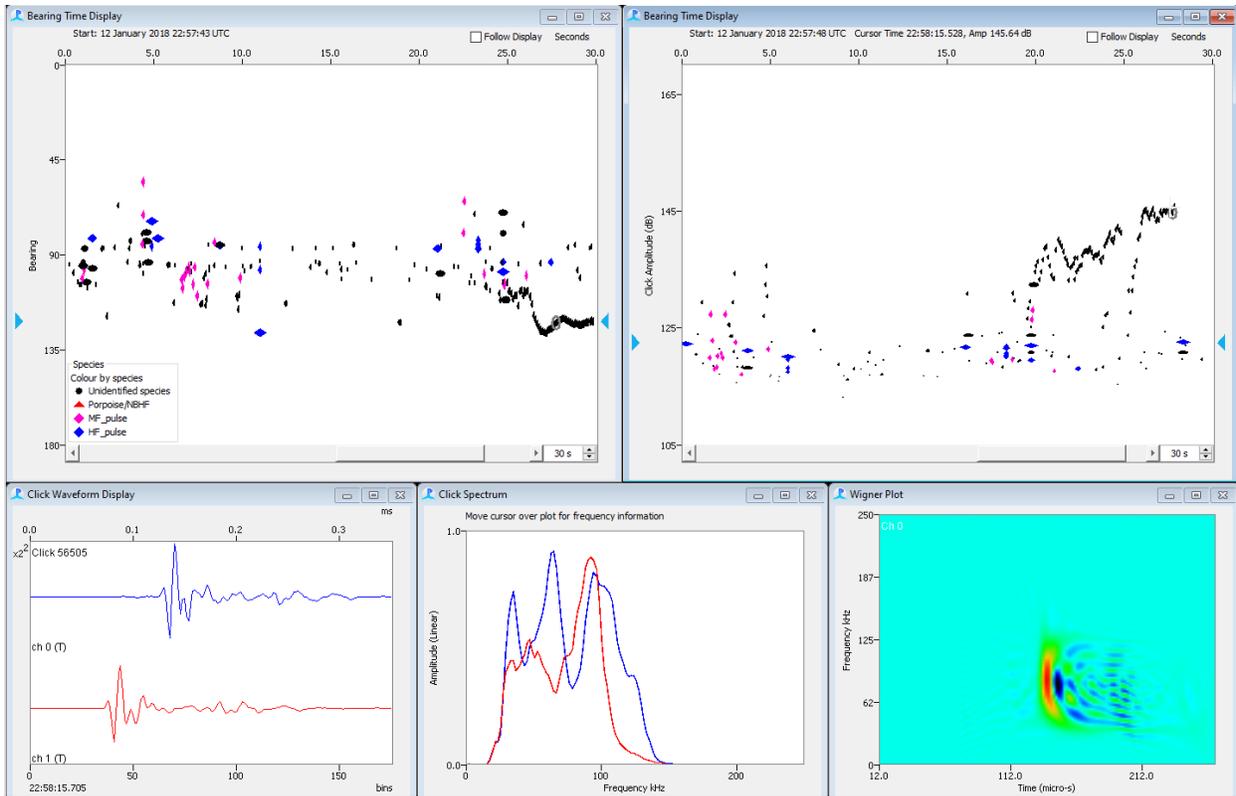


Figure 11: Acoustic detection #10; Short-beaked common dolphins; Pamguard high frequency click detector; 12 January 2018.

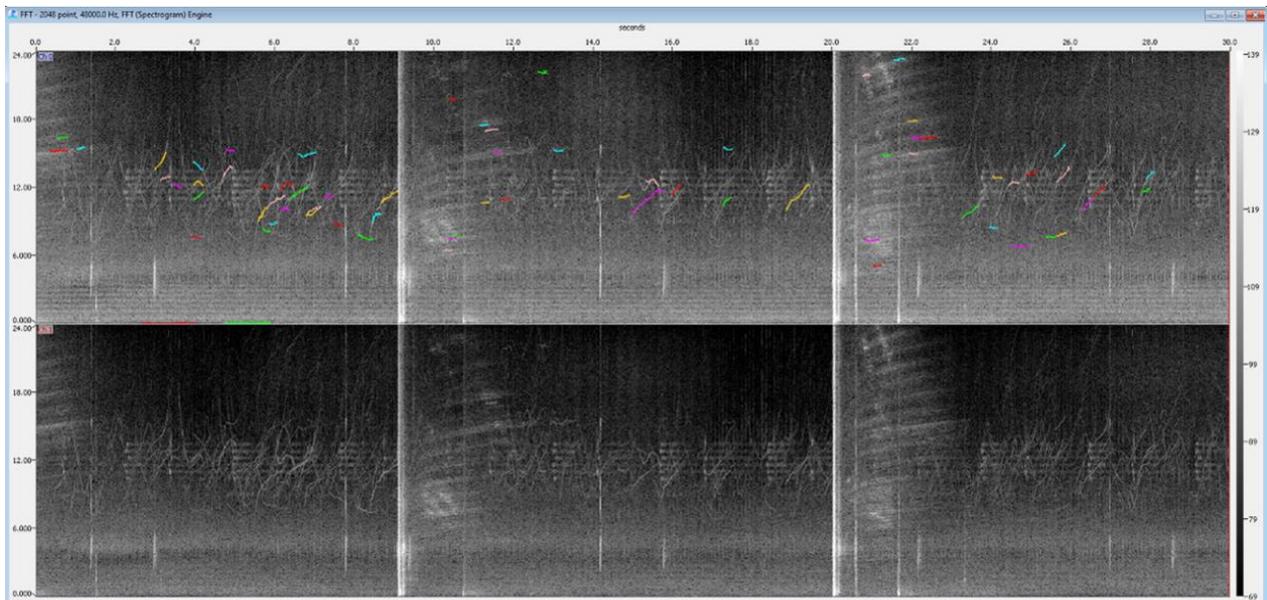


Figure 12: Acoustic Detection #12; Short-beaked common dolphin; Pamguard spectrogram; 15 January 2018.

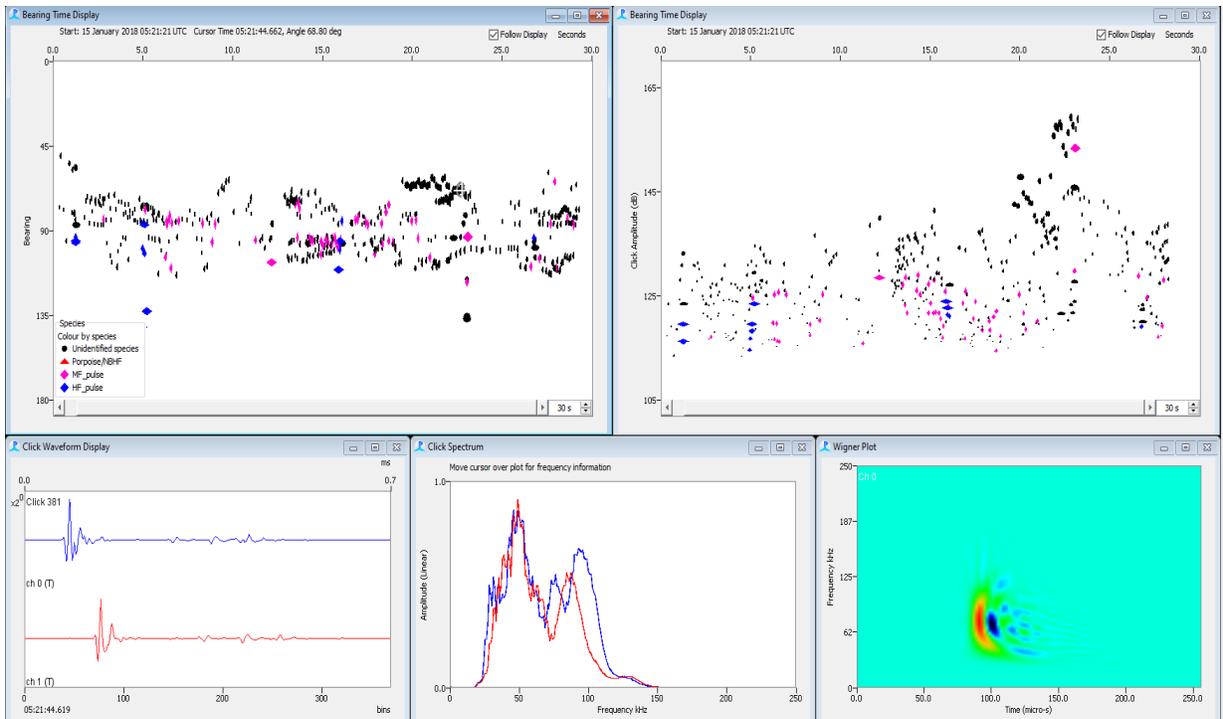


Figure 13: Acoustic Detection #12; Short-beaked common dolphin; Panguard high frequency click detector; 15 January 2018.

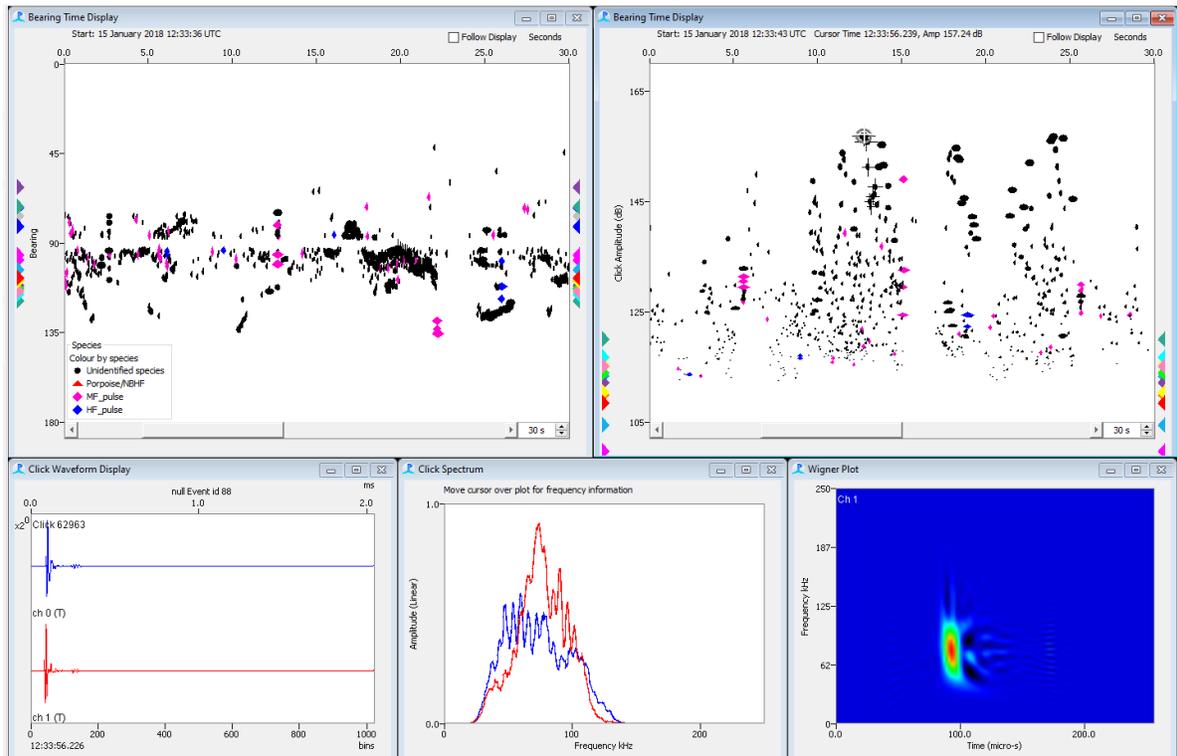


Figure 14: Acoustic detection #14; Unidentified dolphins; Panguard high frequency click detector; 15 January 2018.

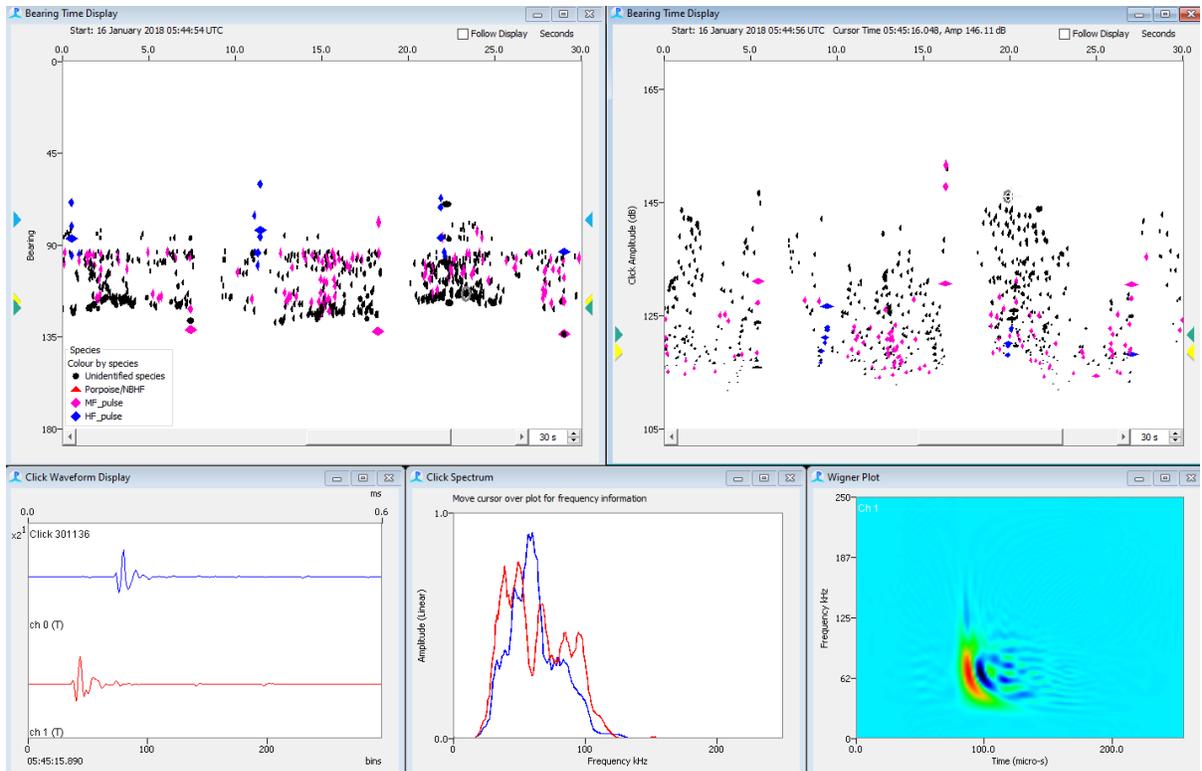


Figure 15: Acoustic detection #16; Unidentified dolphins; Panguard high frequency click detector; 16 January 2018.

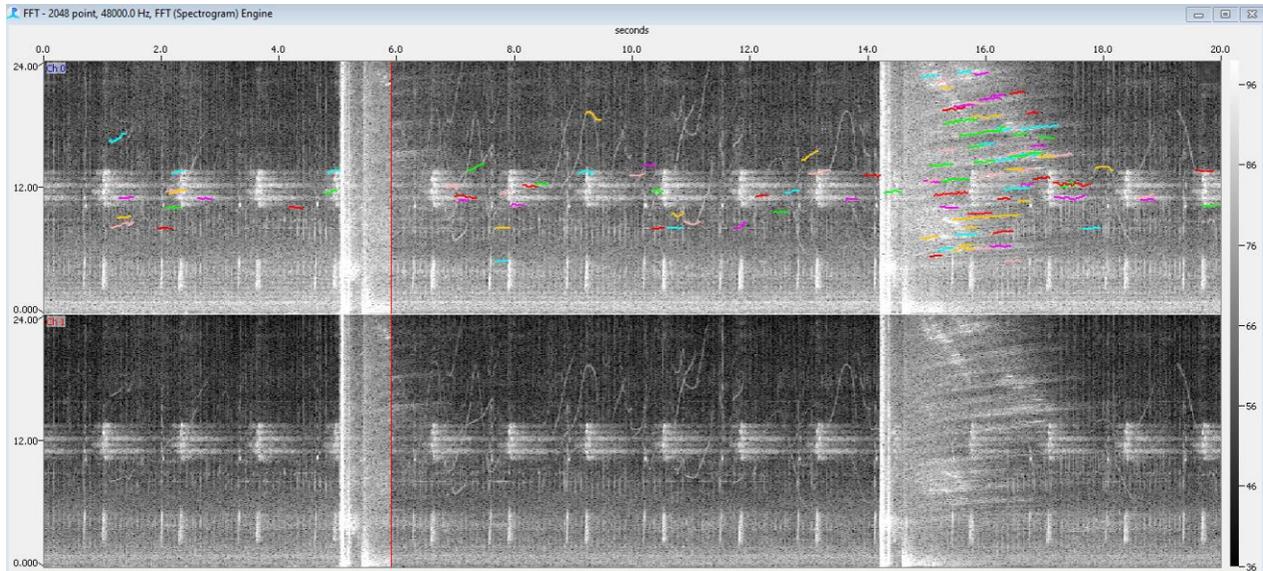


Figure 16: Acoustic detection #16; Unidentified dolphins; Panguard spectrogram; 16 January 2018.

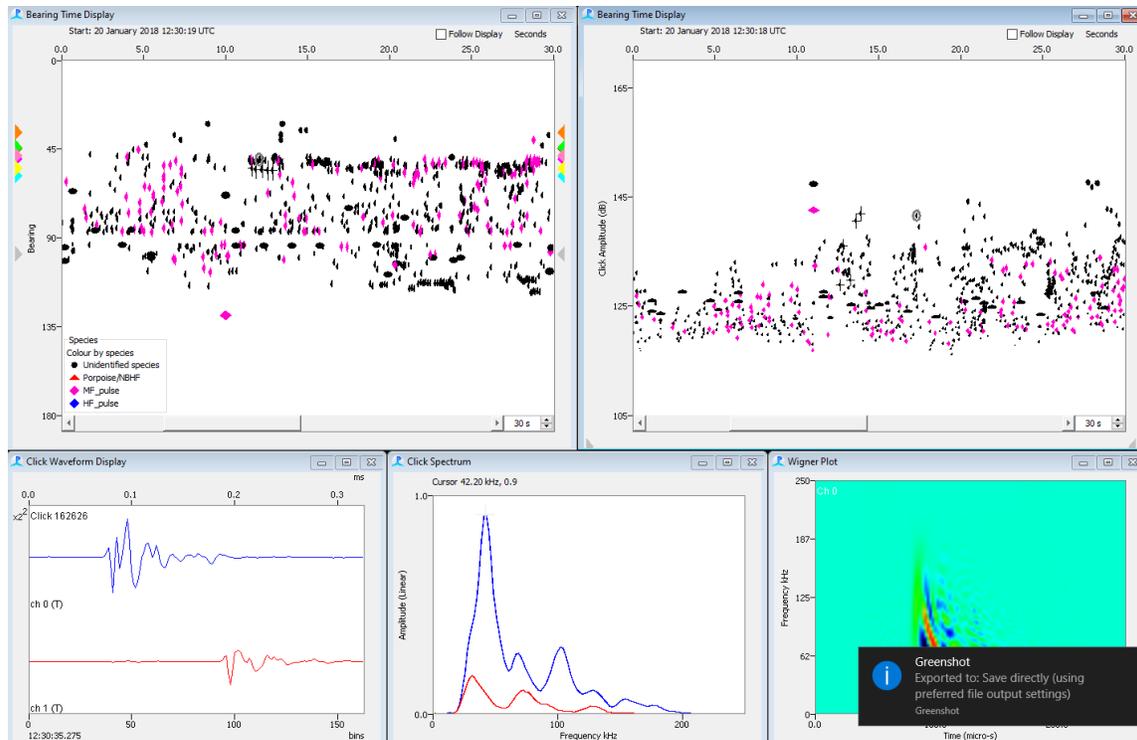


Figure 17: Acoustic detection #19; Unidentified dolphins; Panguardia high frequency click detector; 20 January 2018.

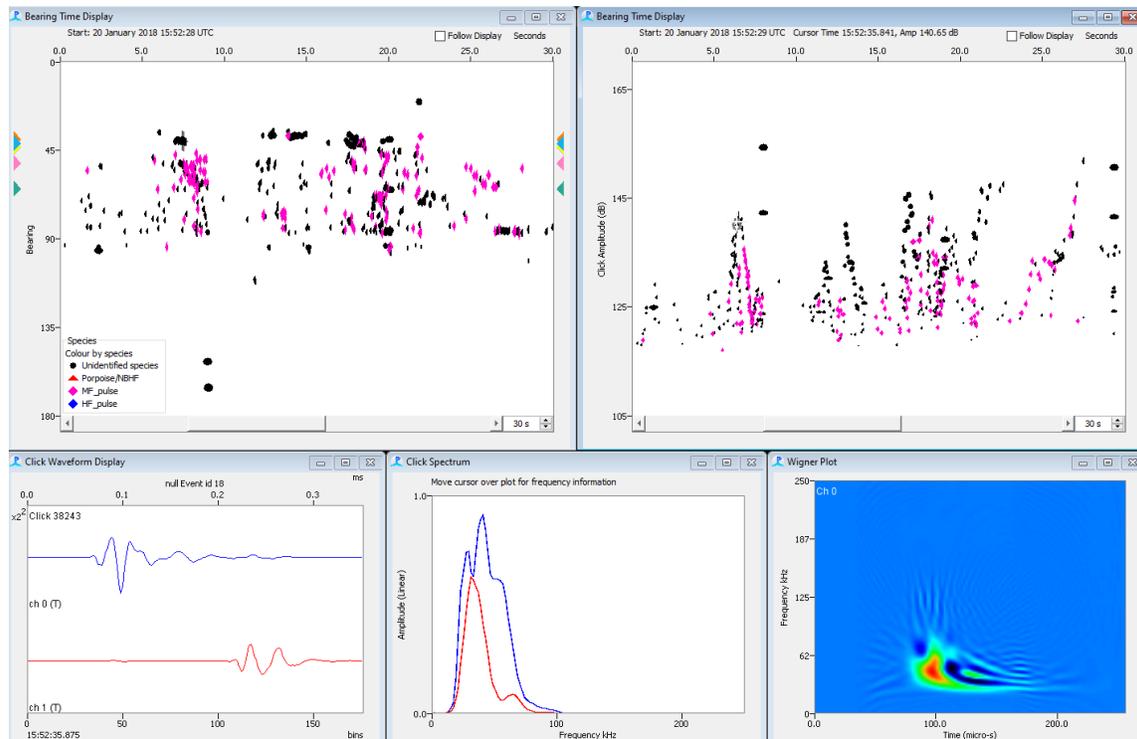


Figure 18: Acoustic detection #22; Unidentified dolphins; Panguardia high frequency click detector; 20 January 2018

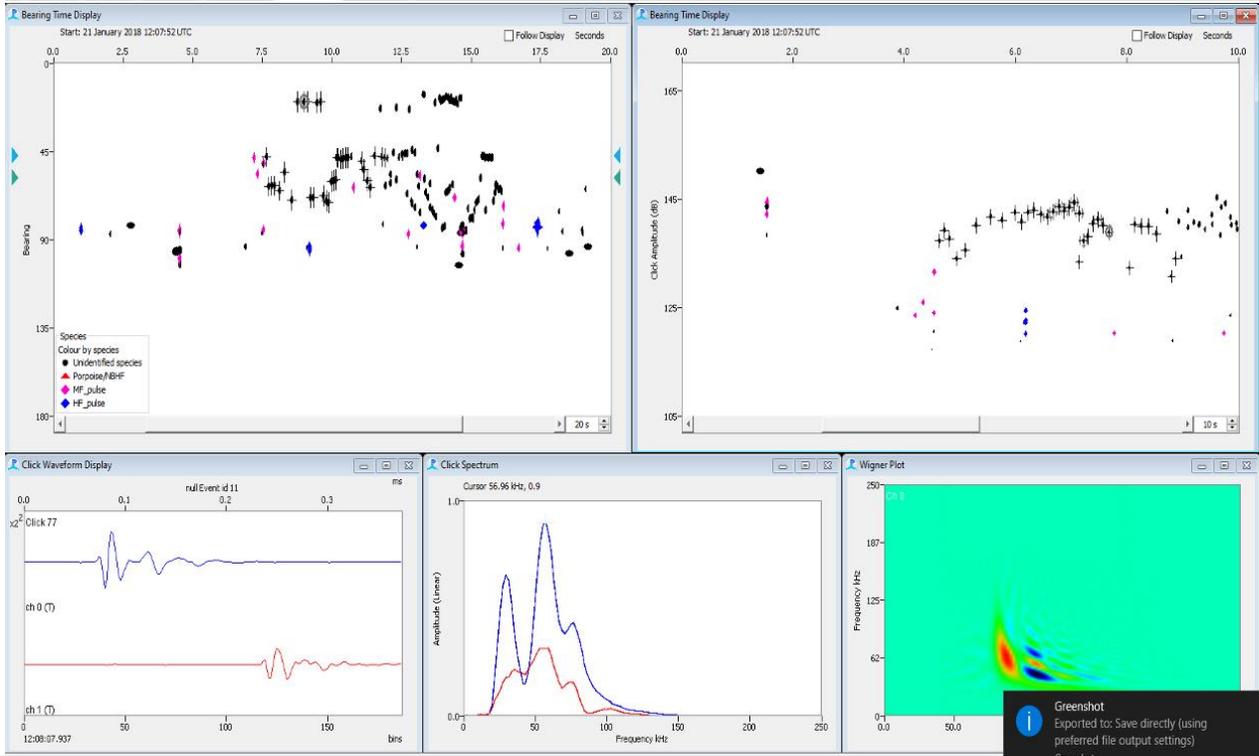


Figure 19: Acoustic detection #23; Unidentified dolphins; Panguard high frequency click detector; 21 January 2018.

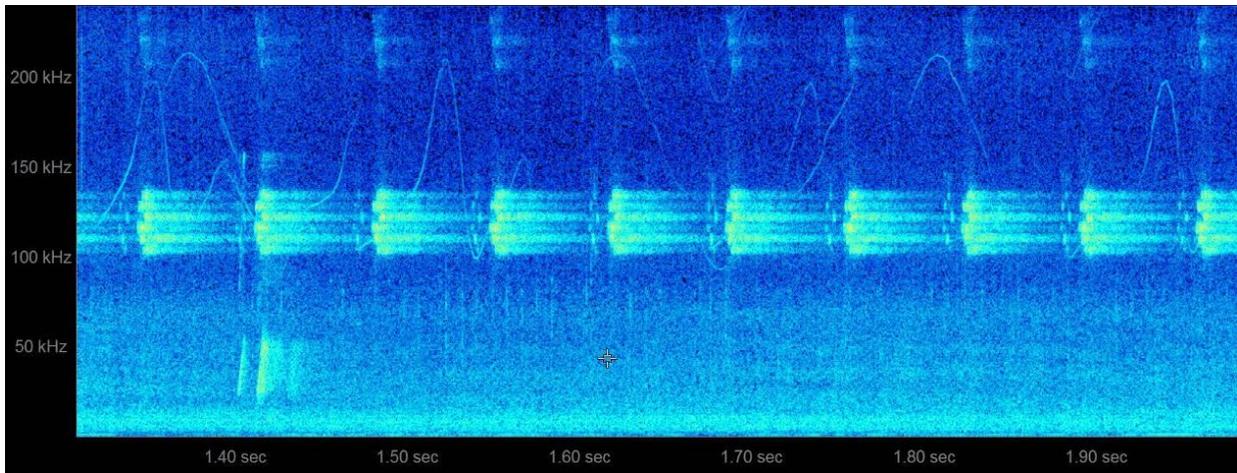


Figure 20: Acoustic detection #23; Unidentified dolphins; Spectrogram 16; 21 January 2018.

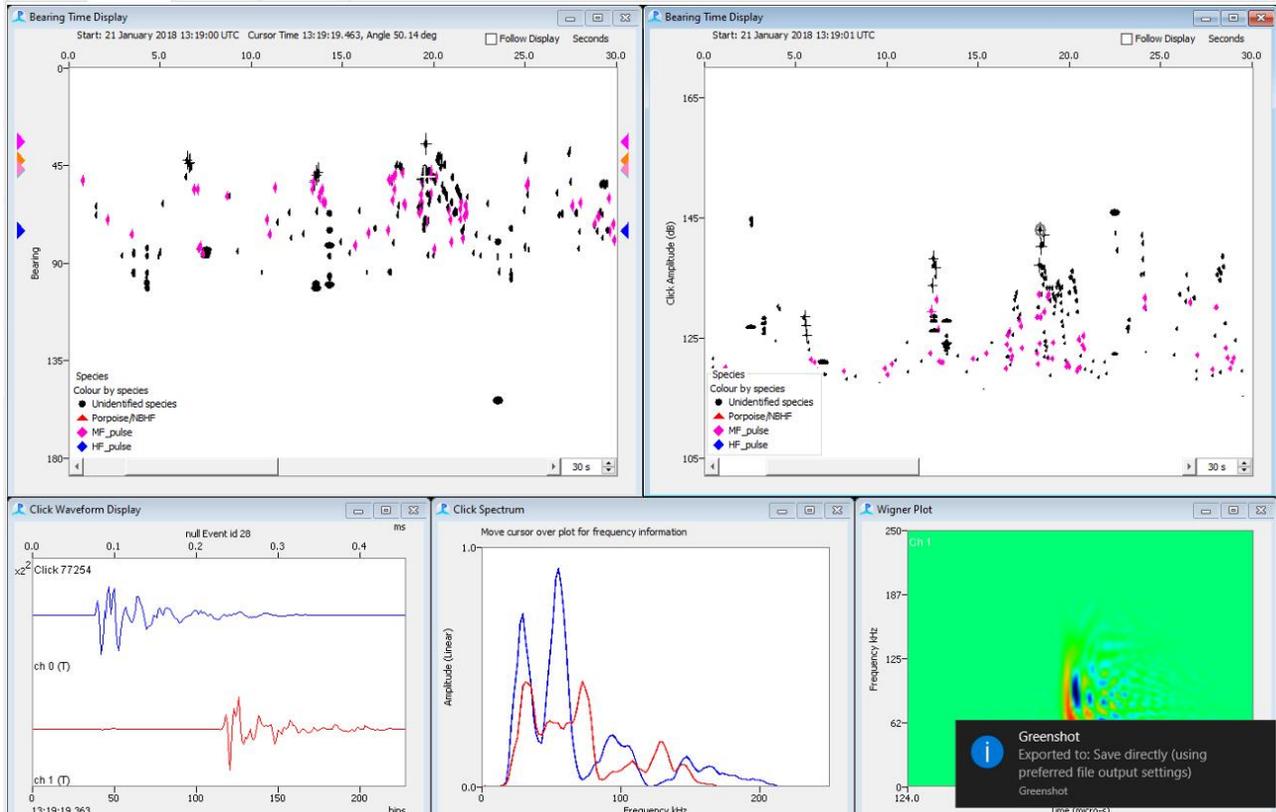


Figure 21: Acoustic detection #24; Unidentified dolphins; Pamguard high frequency click detector; 21 January 2018.

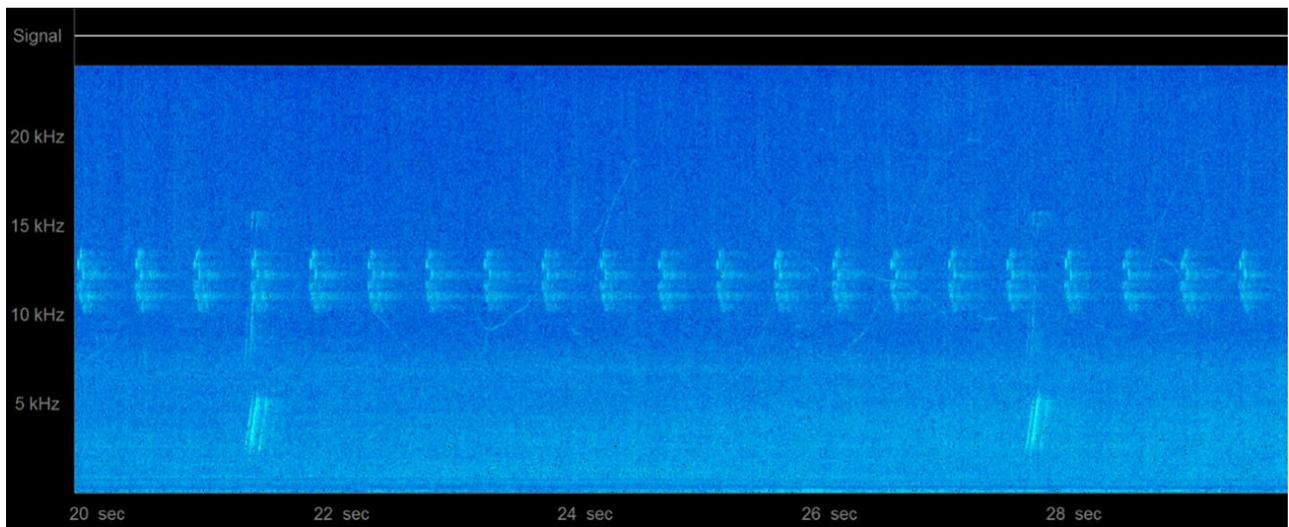


Figure 22: Acoustic detection #25; Short-beaked common dolphins; Spectrogram 16; 24 January 2018.

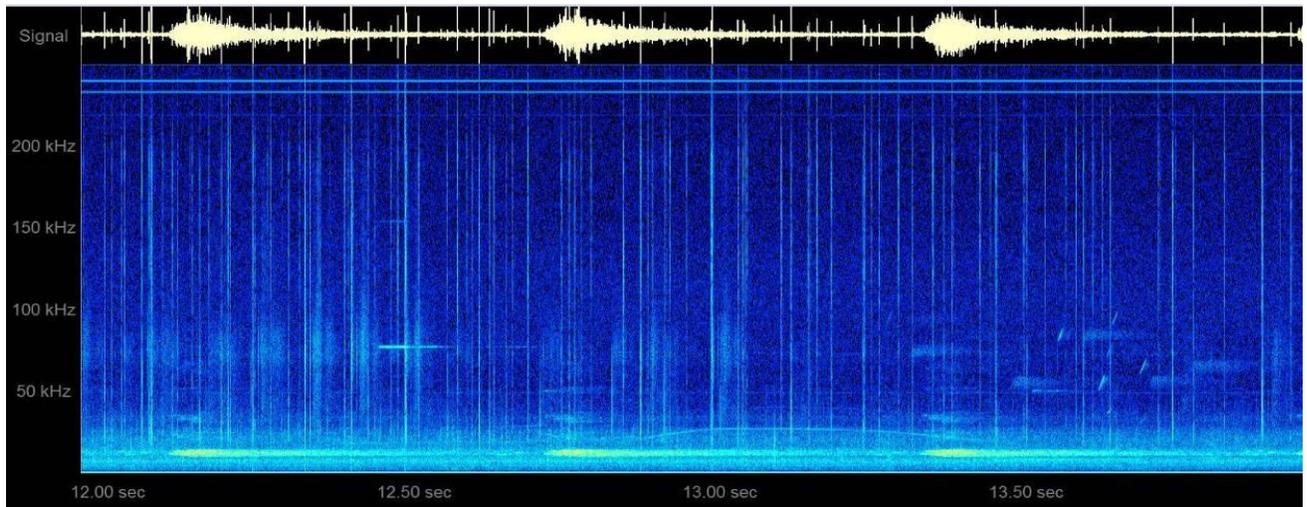


Figure 23: Acoustic Detection #27; Short-beaked Common dolphins; Spectrogram 16; 25 January 2018.

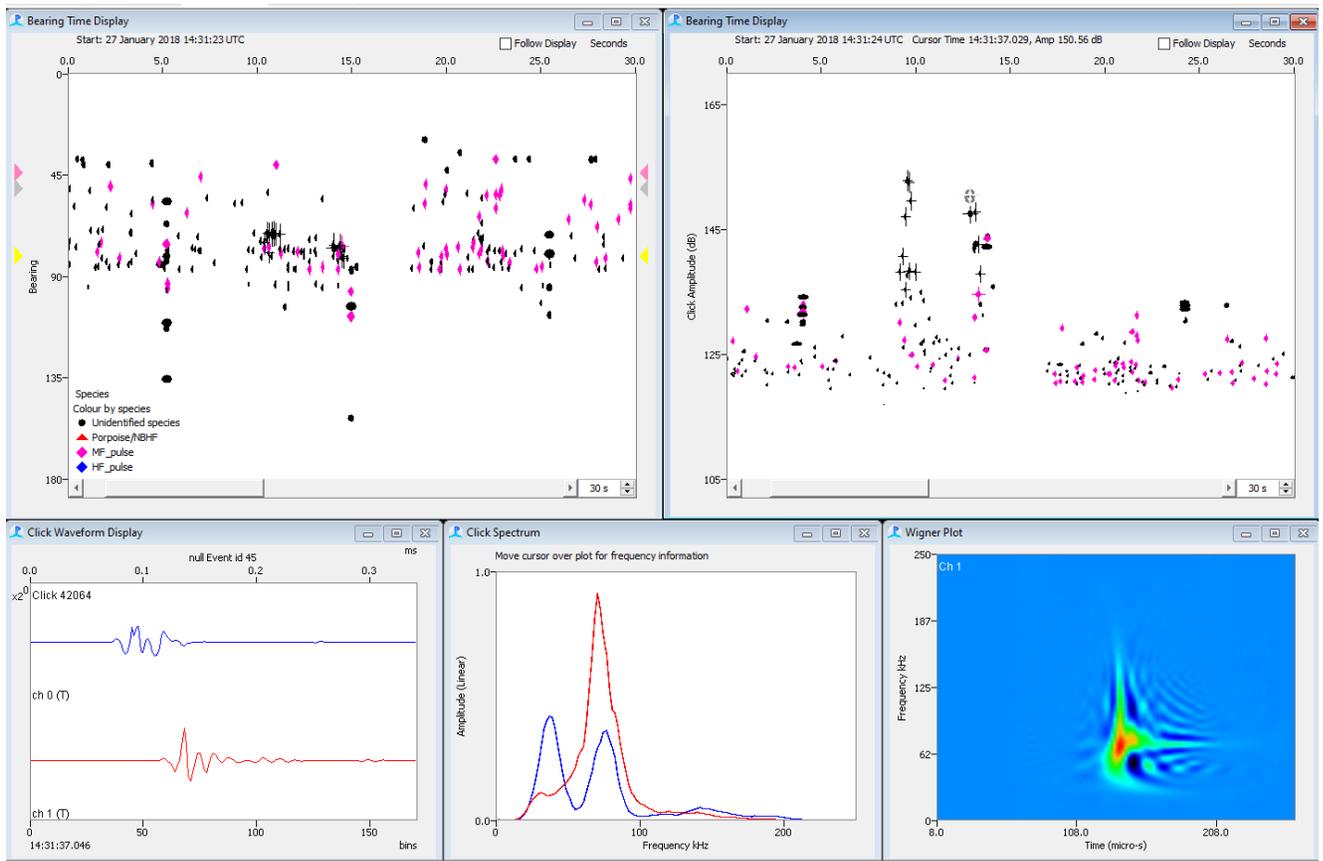


Figure 24: Acoustic Detection #28; Unidentified Dolphins; Panguardia high frequency click detector; 27 January 2018.

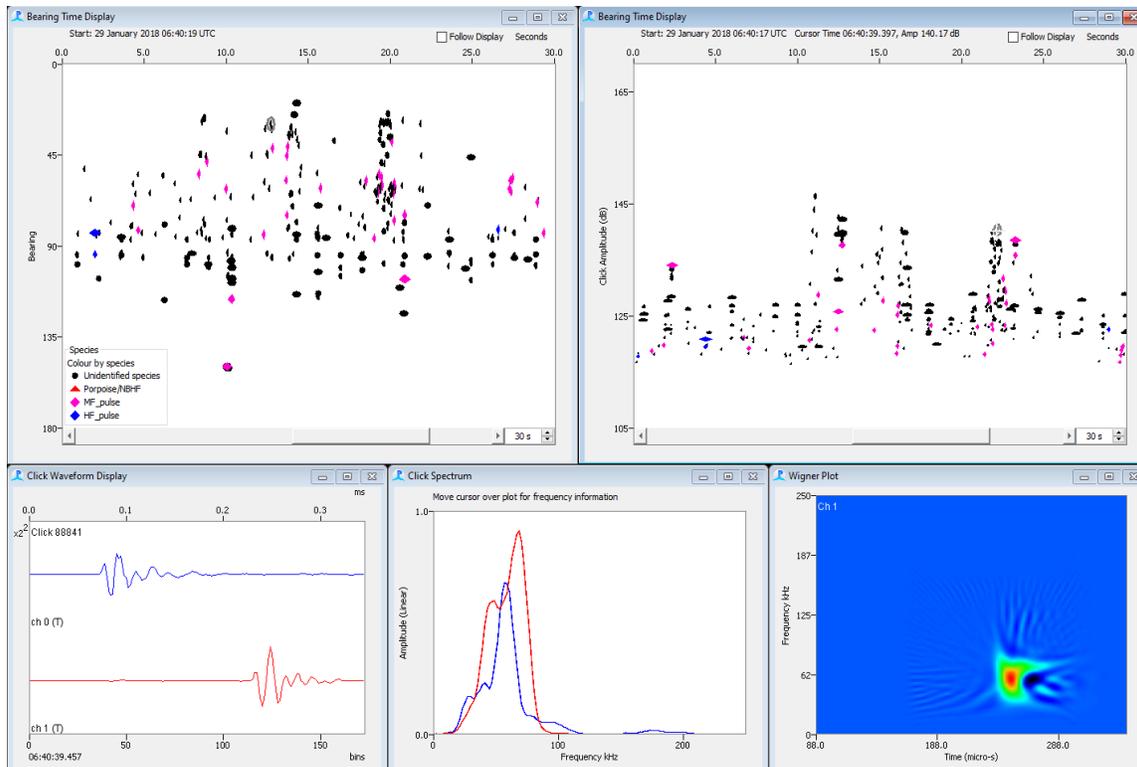


Figure 25: Acoustic detection #29; Short-beaked common dolphins; Pamguard high frequency click detector; 29 January 2018.

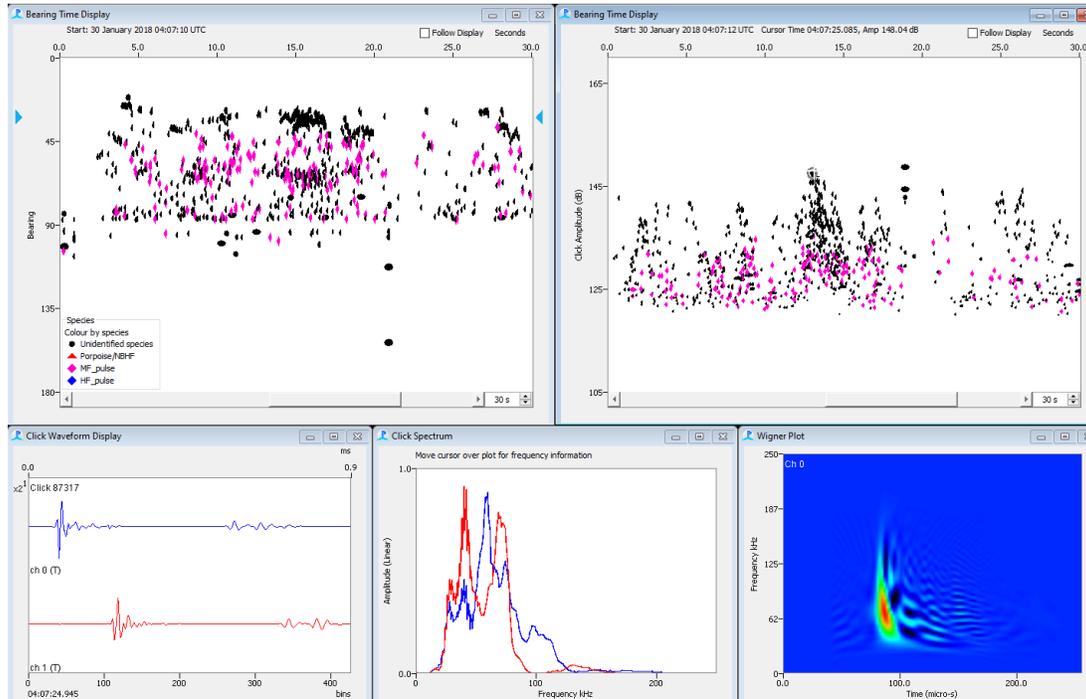


Figure 26: Acoustic detection #31; Unidentified dolphins; Pamguard high frequency click detector; 30 January 2018

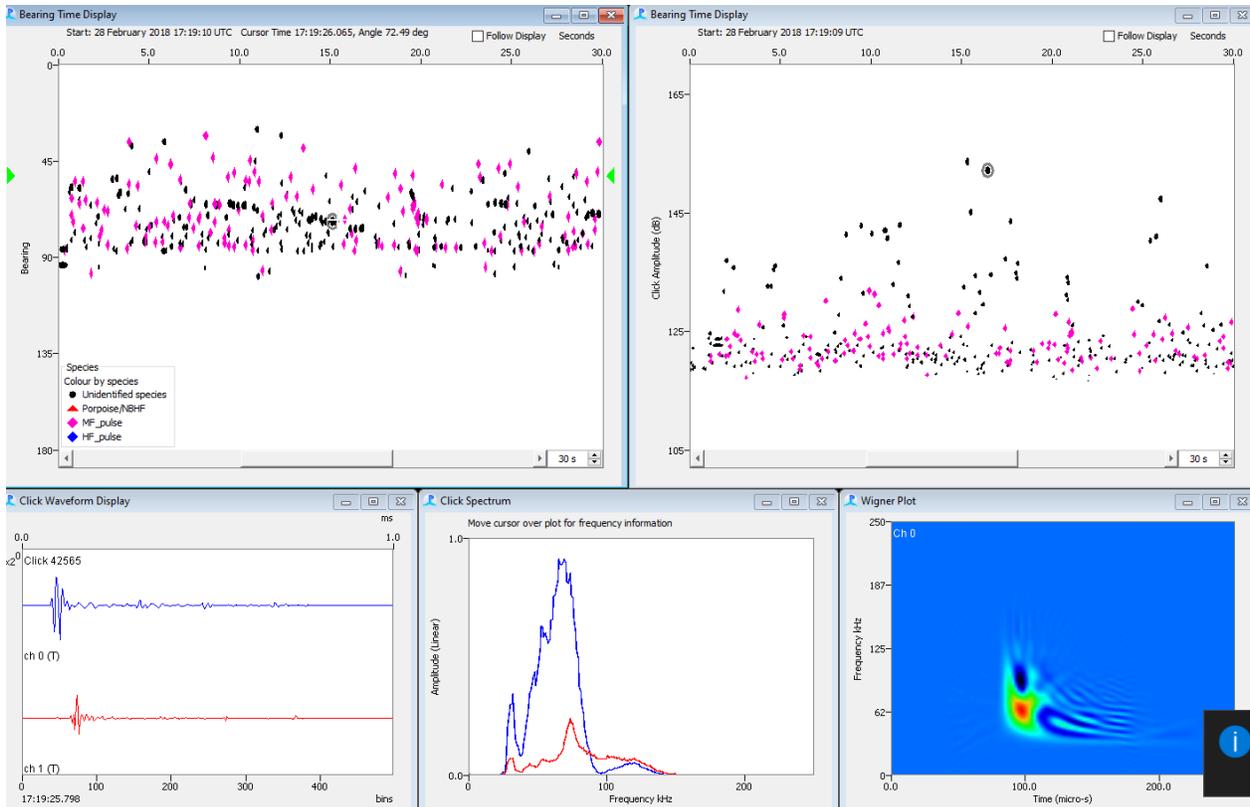


Figure 27: Acoustic Detection #34; Unidentified Dolphins; Pamguard high frequency click detector; 28 February 2018.

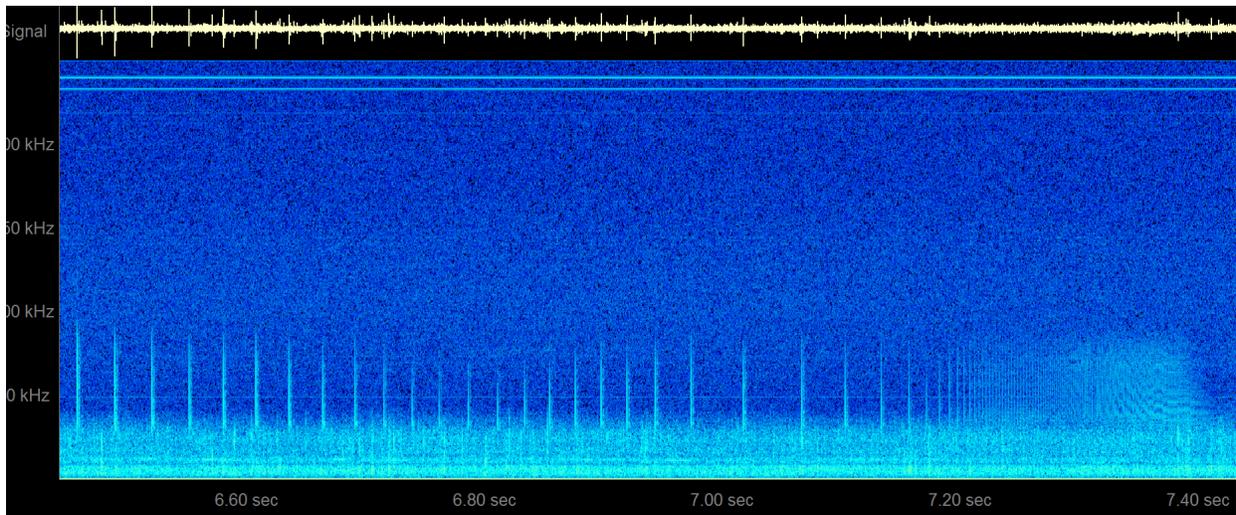


Figure 28: Acoustic Detection #34; Unidentified Dolphins; Spectrogram 16; 28 February 2018.

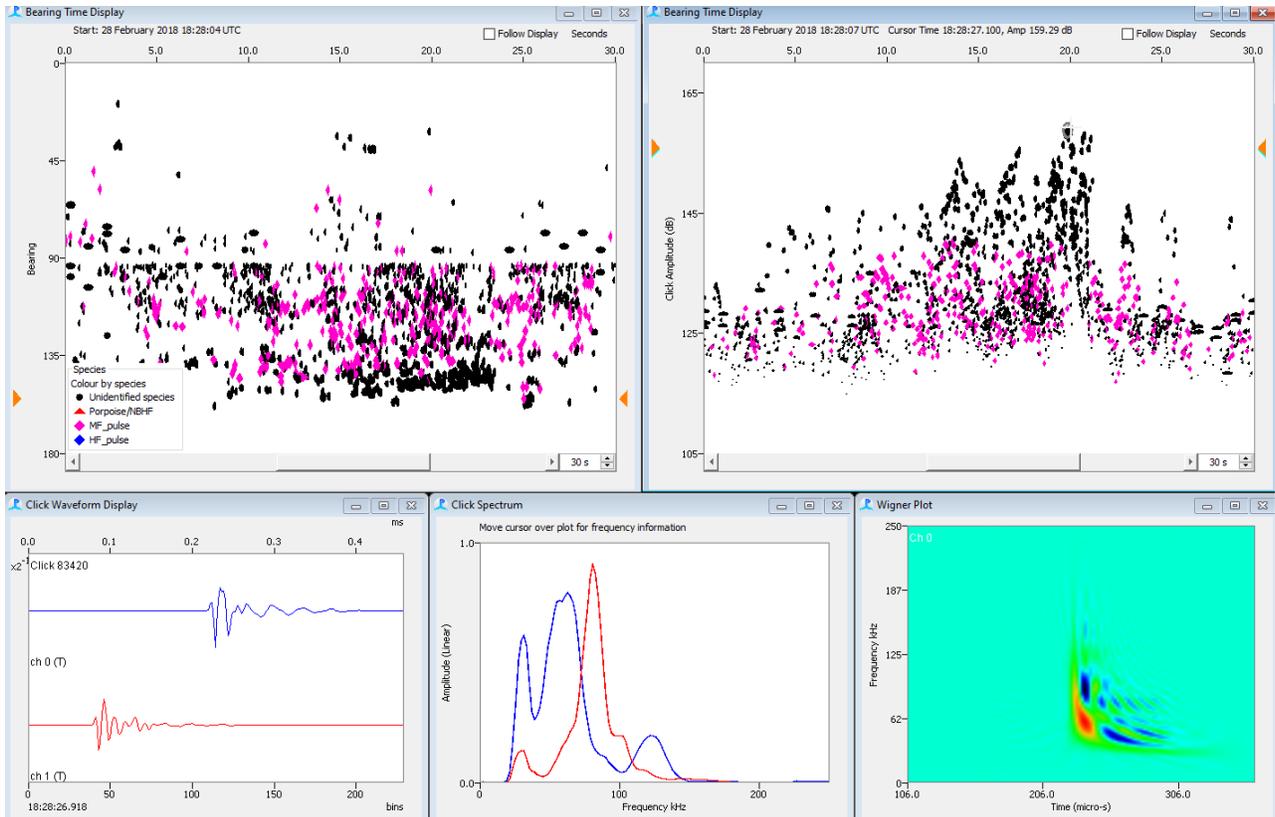


Figure 29: Acoustic Detection #35; Short-beaked Common Dolphins; Pamguard high frequency click detector; 28 February 2018.

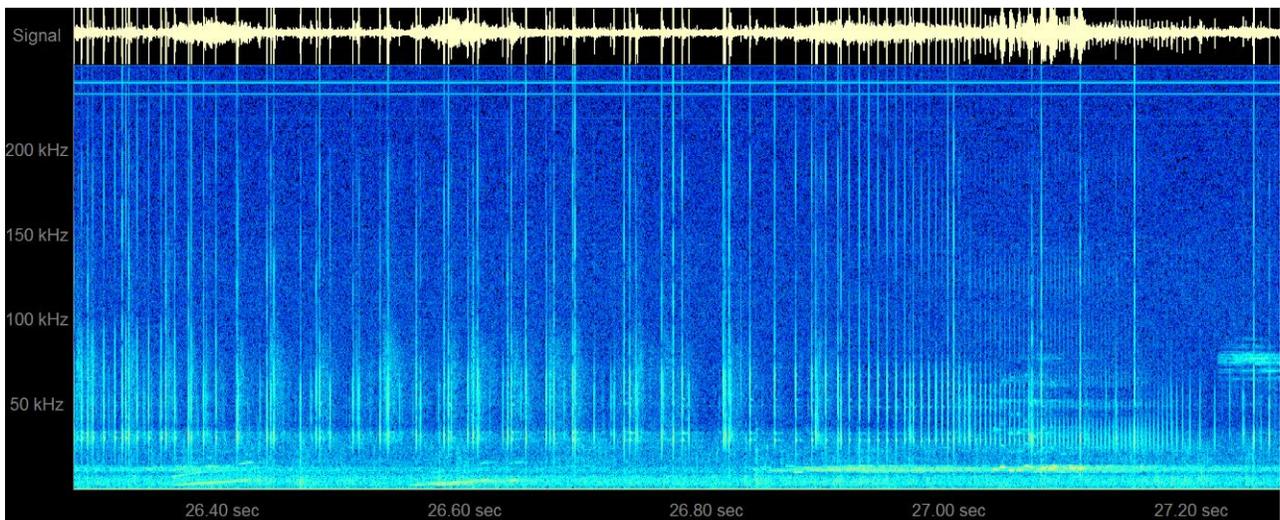


Figure 30: Acoustic Detection #35; Short-beaked Common Dolphins; Spectrogram 16; 28 February 2018.

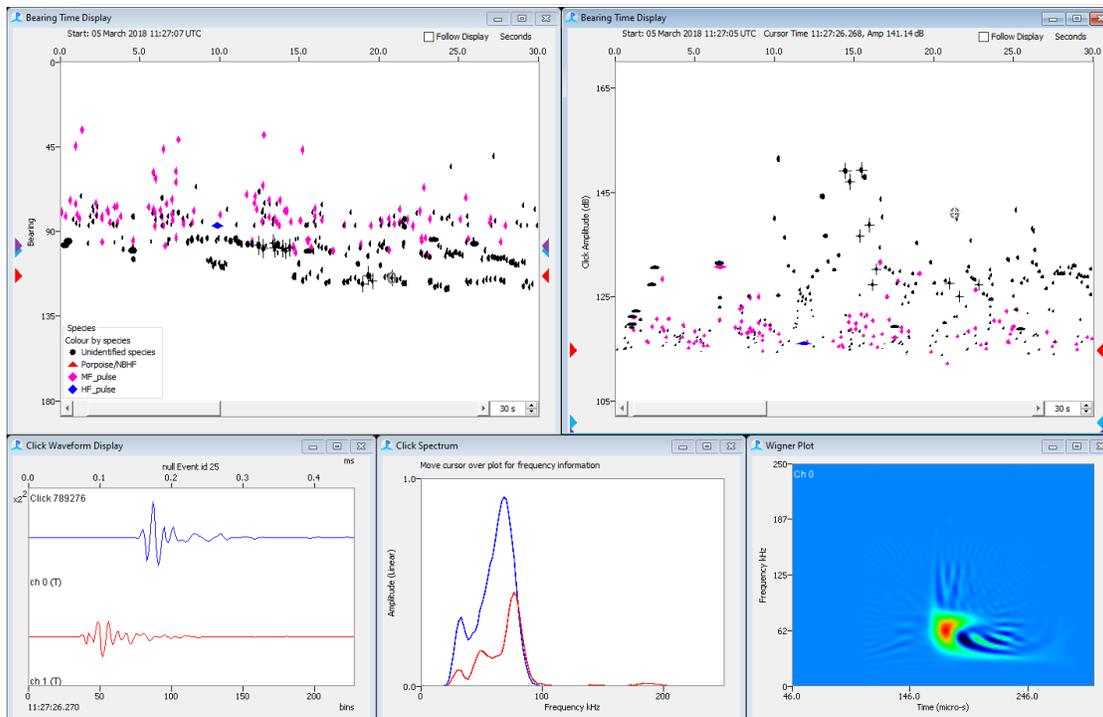


Figure 31: Acoustic Detection #36; Unidentified Dolphins; Parnguard high frequency click detector; 5 March 2018.

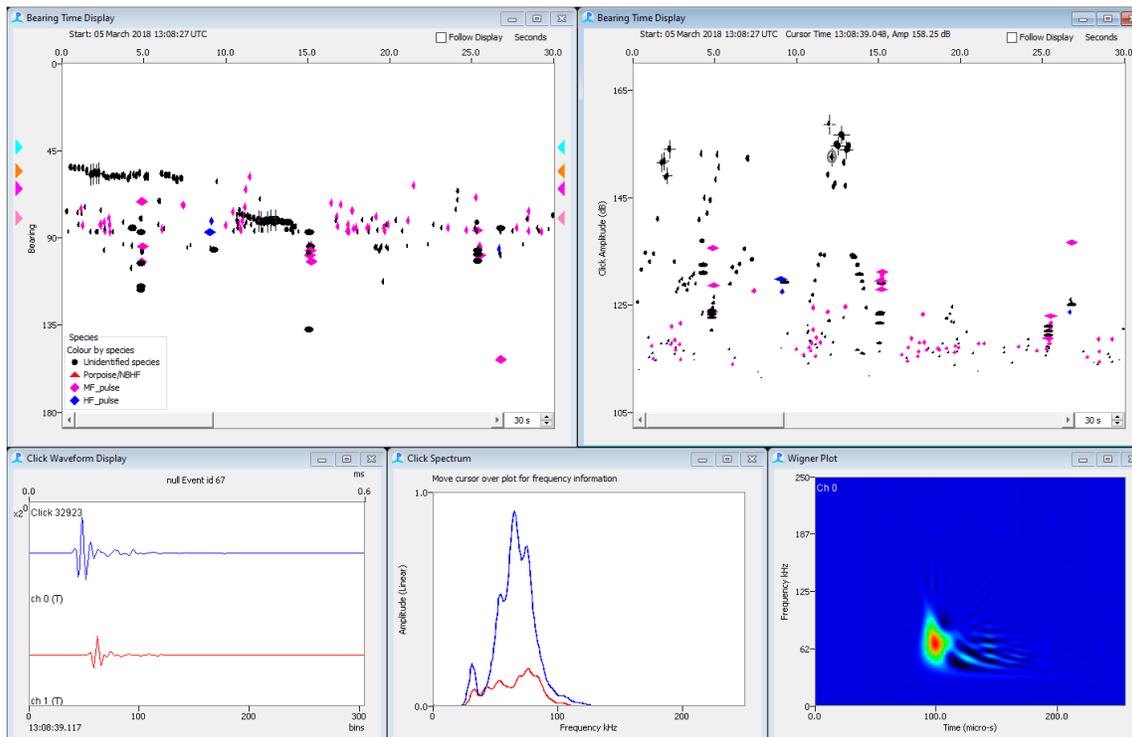


Figure 32: Acoustic Detection #37; Unidentified dolphins; Parnguard high frequency click detector; 5 March 2018.

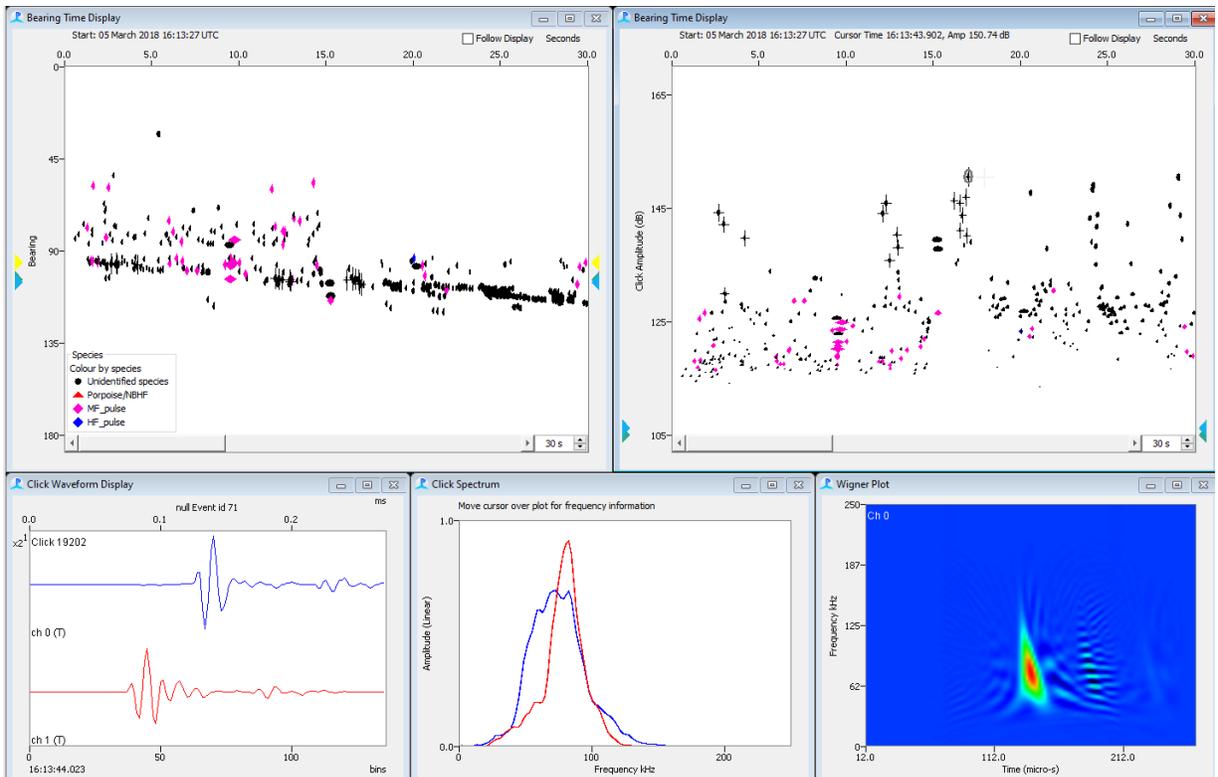


Figure 33: Acoustic Detection #38; Unidentified Dolphins; Pamguard high frequency click detector; 5 March 2018.

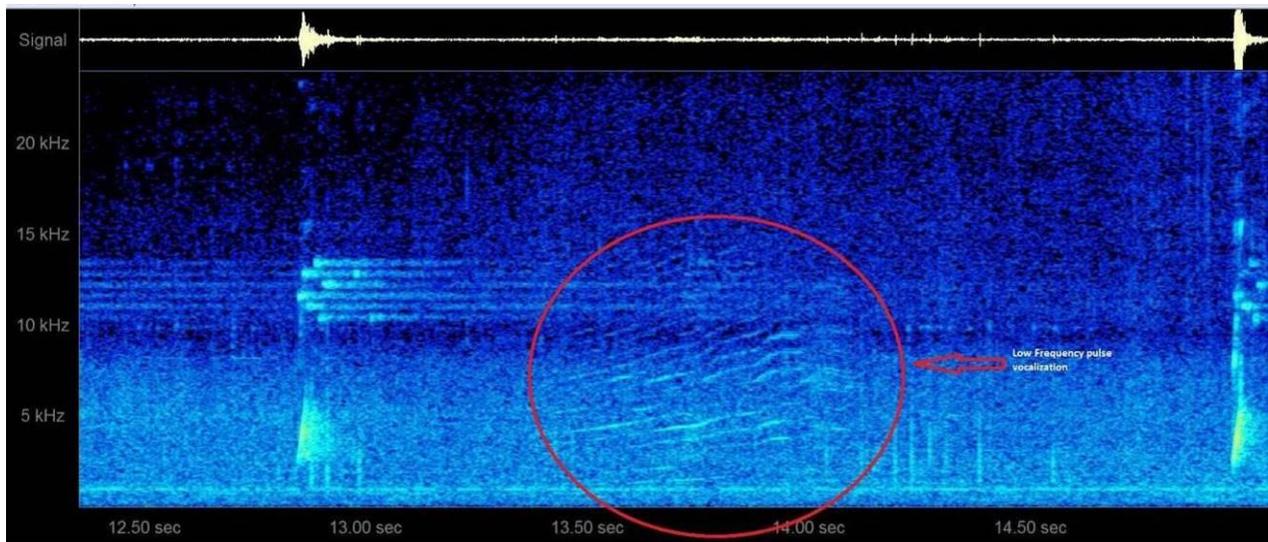


Figure 34: Acoustic detection #40; Unidentified dolphins; Spectrogram 16; 17 March 2018.

APPENDIX L: Species of Birds and Other Wildlife Observed during the Southwest Pacific Ocean New Zealand Seismic Survey

Birds: Common Name	Family	Genus	Species	Approximate Number Individuals Observed	Approximate Number of Days Species Was Observed
Antarctic Petrel	Procellariidae	<i>Thalassoica</i>	<i>antarctica</i>	1	1
Antarctic Prion	Procellariidae	<i>Pachyptila</i>	<i>desolata</i>	4	1
Antarctic Tern	Sternidae	<i>Sterna</i>	<i>vittata</i>	3	1
Antipodean Albatross	Diomedeidae	<i>Diomedea</i>	<i>antipodensis</i>	135	53
Australasian Gannet	Sulidae	<i>Sula</i>	<i>serrator</i>	1203	58
Black Cormorant	Phalacrocoracidae	<i>Phalacrocorax</i>	<i>carbo</i>	25	2
Black Petrel	Procellariidae	<i>Procellaria</i>	<i>parkinsoni</i>	27	11
Black Swan	Anatidae	<i>Cygnus</i>	<i>atratus</i>	63	3
Black-bellied Storm Petrel	Hydrobatidae	<i>Fregetta</i>	<i>tropica</i>	132	16
Black-billed Gull	Laridae	<i>Larus</i>	<i>bulleri</i>	2020	6
Black-browed Albatross	Diomedeidae	<i>Thalassarche</i>	<i>melanophris</i>	73	34
Black-fronted Tern	Sternidae	<i>Chlidonias</i>	<i>albostratus</i>	24	2
Black-winged petrel	Procellariidae	<i>Pterodroma</i>	<i>nigripennis</i>	9	7
Broad-billed Prion	Procellariidae	<i>Pachyptila</i>	<i>vittata</i>	93	10
Buller's Albatross	Diomedeidae	<i>Thalassarche</i>	<i>bulleri</i>	163	44
Buller's shearwater	Procellariidae	<i>Puffinus</i>	<i>bulleri</i>	673	59
Cape Petrel	Procellariidae	<i>Daption</i>	<i>capense</i>	276	31
Chatham Island Albatross	Diomedeidae	<i>Thalassarche</i>	<i>eremita</i>	74	28
Common Diving Petrel	Pelecanoididae	<i>Pelecanoides</i>	<i>urinatrix</i>	58	20
Cook's Petrel	Procellariidae	<i>Pterodroma</i>	<i>cookii</i>	4	3
Erect-crested Penguin	Spheniscidae	<i>Eudyptes</i>	<i>sclateri</i>	1	1
Eurasian Blackbird	Turdidae	<i>Turdus</i>	<i>merula</i>	1	1
Fairy Prion	Procellariidae	<i>Pachyptila</i>	<i>turtur</i>	79	22
Flesh Footed Shearwater	Procellariidae	<i>Ardenna</i>	<i>carneipes</i>	390	39
Fluttering Shearwater	Procellariidae	<i>Puffinus</i>	<i>gavia</i>	43	3
Fulmar Prion	Procellariidae	<i>Pachyptila</i>	<i>crassirostris</i>	102	18
Gould's Petrel	Procellariidae	<i>Pterodroma</i>	<i>leucoptera</i>	1	1
Great-winged Petrel	Procellariidae	<i>Pterodroma</i>	<i>macroptera</i>	297	48
Grey-backed Storm Petrel	Hydrobatidae	<i>Garrodia</i>	<i>neris</i>	7	4
Greylag Goose	Anatidae	<i>Anser</i>	<i>anser</i>	16	1
House Sparrow	Passeridae	<i>Passer</i>	<i>domesticus</i>	1	1

Birds: Common Name	Family	Genus	Species	Approximate Number Individuals Observed	Approximate Number of Days Species Was Observed
Hutton Shearwater	Procellariidae	<i>Puffinus</i>	<i>huttoni</i>	7	2
Kelp Gull	Laridae	<i>Larus</i>	<i>dominicanus</i>	351	28
Light-mantled Sooty Albatross	Diomedeidae	<i>Phoebetria</i>	<i>palpebrata</i>	5	3
Little Penguin	Spheniscidae	<i>Eudyptula</i>	<i>minor</i>	4	2
Little Pied Cormorant	Phalacrocoracidae	<i>Phalacrocorax</i>	<i>melanoleucos</i>	5	2
Little Shearwater	Procellariidae	<i>Puffinus</i>	<i>assimilis</i>	4	2
Mallard Duck	Anatidae	<i>Anas</i>	<i>platyrhynchos</i>	2	1
Mottled Petrel	Procellariidae	<i>Pterodroma</i>	<i>inexpectata</i>	72	18
Northern Giant Petrel	Procellariidae	<i>Macronectes</i>	<i>halli</i>	128	43
Pied Cormorant	Phalacrocoracidae	<i>Phalacrocorax</i>	<i>varius</i>	1188	3
Pink-footed shearwater	Procellariidae	<i>Puffinus</i>	<i>creatopus</i>	2	2
Pycroft's Petrel	Procellariidae	<i>Pterodroma</i>	<i>pycrofti</i>	2	2
Red-billed Gull	Laridae	<i>Larus</i>	<i>novaehollandiae</i>	306	10
Rockhopper Penguin	Spheniscidae	<i>Eudyptes</i>	<i>chrysocome</i>	1	1
Royal Albatross	Diomedeidae	<i>Diomedea</i>	<i>epomophora</i>	397	89
Royal Spoonbill	Threskiornithidae	<i>Platalae</i>	<i>regia</i>	20	1
Salvin's Albatross	Diomedeidae	<i>Diomedea</i>	<i>salvini</i>	83	25
Salvin's Prion	Procellariidae	<i>Pachyptila</i>	<i>salvini</i>	53	15
Short-tailed Shearwater	Procellariidae	<i>Puffinus</i>	<i>tenuirostris</i>	11	5
Song Thrush	Turdidae	<i>Turdus</i>	<i>phiomelas</i>	1	1
Sooty Shearwater	Procellariidae	<i>Puffinus</i>	<i>griseus</i>	4430	27
South Island Pied Oystercatcher	Haematopodidae	<i>Haematopus</i>	<i>finschi</i>	257	2
South Polar Skua	Stercorariidae	<i>Catharacta</i>	<i>maccormicki</i>	1	1
Southern Giant Petrel	Procellariidae	<i>Macronectes</i>	<i>giganteus</i>	6	4
Spotted Cormorant	Phalacrocoracidae	<i>Phalacrocorax</i>	<i>punctatus</i>	6	2
Stewart Island Cormorant	Phalacrocoracidae	<i>Leucocarbo</i>	<i>chalconotus</i>	40	4
Subantarctic Skua	Stercorariidae	<i>Catharacta</i>	<i>antarctica</i>	2	2
Variable Oystercatcher	Haematopodidae	<i>Haematopus</i>	<i>unicolor</i>	14	1
Wandering Albatross	Diomedeidae	<i>Diomedea</i>	<i>exulans</i>	259	69
Westland Petrel	Procellariidae	<i>Procellaria</i>	<i>westlandica</i>	339	57

Birds: Common Name	Family	Genus	Species	Approximate Number Individuals Observed	Approximate Number of Days Species Was Observed
White-bellied Storm-petrel	Hydrobatidae	<i>Fregetta</i>	<i>grallaria</i>	5	2
White-capped Albatross	Diomedidae	<i>Diomedea</i>	<i>c.cauta</i>	737	47
White-chinned Petrel	Procellariidae	<i>Procellaria</i>	<i>aequinoctialis</i>	420	37
White-faced Heron	Ardeidae	<i>Egretta</i>	<i>novaehollandiae</i>	2	2
White-faced Storm-petrel	Hydrobatidae	<i>Pelagodroma</i>	<i>marina</i>	19	6
White-fronted Tern	Sternidae	<i>Sterna</i>	<i>striata</i>	116	22
White-headed Petrel	Procellariidae	<i>Pterodroma</i>	<i>lessonii</i>	21	10
White-naped Petrel	Procellariidae	<i>Pterodroma</i>	<i>cervicalis</i>	5	1
White-throated Needletail	Apodidae	<i>Hirundapus</i>	<i>caudacutus</i>	1	1
Wilson's Storm-petrel	Hydrobatidae	<i>Oceanites</i>	<i>oceanicus</i>	37	11

Fish: Common Name	Family	Genus	Species	Approximate Number Individuals Observed	Approximate Number of Days Species Was Observed
Atlantic wreckfish Juvenile	Polyprionidae	<i>Polyprion</i>	<i>americanus</i>	1	1
Blackfin Tuna	Scombridae	<i>Thunnus</i>	<i>atlanticus</i>	10	1
Blue Shark	Carcharhinidae	<i>Prionace</i>	<i>glauca</i>	6	6
Flying Fish	Exocoetidae	<i>Cypselurus</i>	<i>lineatus</i>	2	1
Hammerhead Shark	Sphynidae	<i>Sphyrna</i>		2	2
Oceanic Sunfish	Molidae	<i>Mola</i>	<i>mola</i>	13	11
Oceanic White Tip Shark	Carcharhinidae	<i>Carcharhinus</i>	<i>longimanus</i>	1	1
Shortfin Mako Shark	Lamnidae	<i>Isurus</i>	<i>oxyrinchus</i>	1	1
Southern Sunfish	Molidae	<i>Mola</i>	<i>ramsayi</i>	3	2
Yellowtail Amberjack	Carangidae	<i>Seriola</i>	<i>lalandi</i>	30	1

Marine Invertebrates: Common Name	Family	Genus	Species	Approximate Number Individuals Observed	Approximate Number of Days Species Was Observed
Crystal Jellyfish	Aequoreidae	<i>Aequorea</i>	<i>victoria</i>	110	8
Egg-yolk Jellyfish	Phacellophoridae	<i>Phacellophora</i>	<i>camtschatica</i>	35	7
Giant Salp	Pyrosomatidae	<i>Pyrostremma</i>	<i>spinosum</i>	145	3
Lion's Mane Jellyfish	Cyaneidae	<i>Cyanea</i>	<i>capillata</i>	40	7
Moon Jellyfish	Ulmaridae	<i>Aurelia</i>	<i>aurita</i>	507	3
Portuguese man-o-war	Physaliidae	<i>Physalia</i>	<i>physalis</i>	537	11
Salpa aspera	Salpidae	<i>Salpa</i>	<i>aspera</i>	16103	8

APPENDIX M: Protected Species detection data from transit from the North to the South Island 11 February 2018 – 14 February 2018

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
73	2018-02-12	03:57	Short-beaked Common Dolphin	100	39.87083°S 177.24183°E	Not Firing/Silent	TV; V; AV	PO, FT, SA, SS, BR, DI	150m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Detection included 5 juveniles. A fishing trawler was sighted off the port beam of the vessel during the detection. Dolphins not considered to be potential takes.
74	2018-02-13	00:31	Sperm Whale	1	42.86245°S 174.60090°E	Not Firing/Silent	PV/S D; AV	BV; DF	4102m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Whale not considered to be a potential take.
75	2018-02-13	01:27	New Zealand Fur Seal	1	42.99300°S 174.45930°E	Not Firing/Silent	PV/O D; AV	FL, BA	250m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Pinniped not considered to be a potential take.
76	2018-02-13	03:34	New Zealand Fur Seal	1	43.28085°S 174.14370°E	Not Firing/Silent	AV; PV/O D	SR, PO, FT, DI	100m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Pinniped not considered to be a potential take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
77	2018-02-13	03:46	New Zealand Fur Seal	2	43.30889°S 174.11122°E	Not Firing/Silent	AV; UN	PO, FT, MI	200m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Pinnipeds not considered to be potential takes.
78	2018-02-13	04:00	New Zealand Fur Seal	2	43.33723°S 174.07761°E	Not Firing/Silent	PV/O D	NS, DI	150m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Pinnipeds not considered to be potential takes.
79	2018-02-13	04:20	New Zealand Fur Seal	1	43.38100°S 174.02493°E	Not Firing/Silent	SA; AV; PV/O D	BA, DI, SR, SS, PO	200m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Pinniped not considered to be a potential take.
80	2018-02-13	05:30	Unidentified Baleen Whale	1	43.53459°S 173.85448°E	Not Firing/Silent	PV/S D	BV, FT	670m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Whale not considered to be a potential take.
81	2018-02-13	05:48	Dwarf Minke Whale	1	43.57643°S 173.81017°E	Not Firing/Silent	PV/S D; AV	FF, BV, NS	525m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Whale not considered to be a potential take.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
82	2018-02-13	07:50	New Zealand Fur Seal	2	43.86583°S 173.49317°E	Not Firing/Silent	PE(AH); AV	PO, FT	165m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Pinnipeds not considered to be potential takes.
83	2018-02-13	19:04	New Zealand Fur Seal	2	45.23617°S 171.51783°E	Not Firing/Silent	AV; PV/S D	PO, FT, SS	230m/Silent	None	Source was silent and on board during the detection while the vessel was transiting from the North Island to the South Island. Pinnipeds not considered to be potential takes



Figure 1: Protected Species Detections during the Transit from the North Island to the South Island.

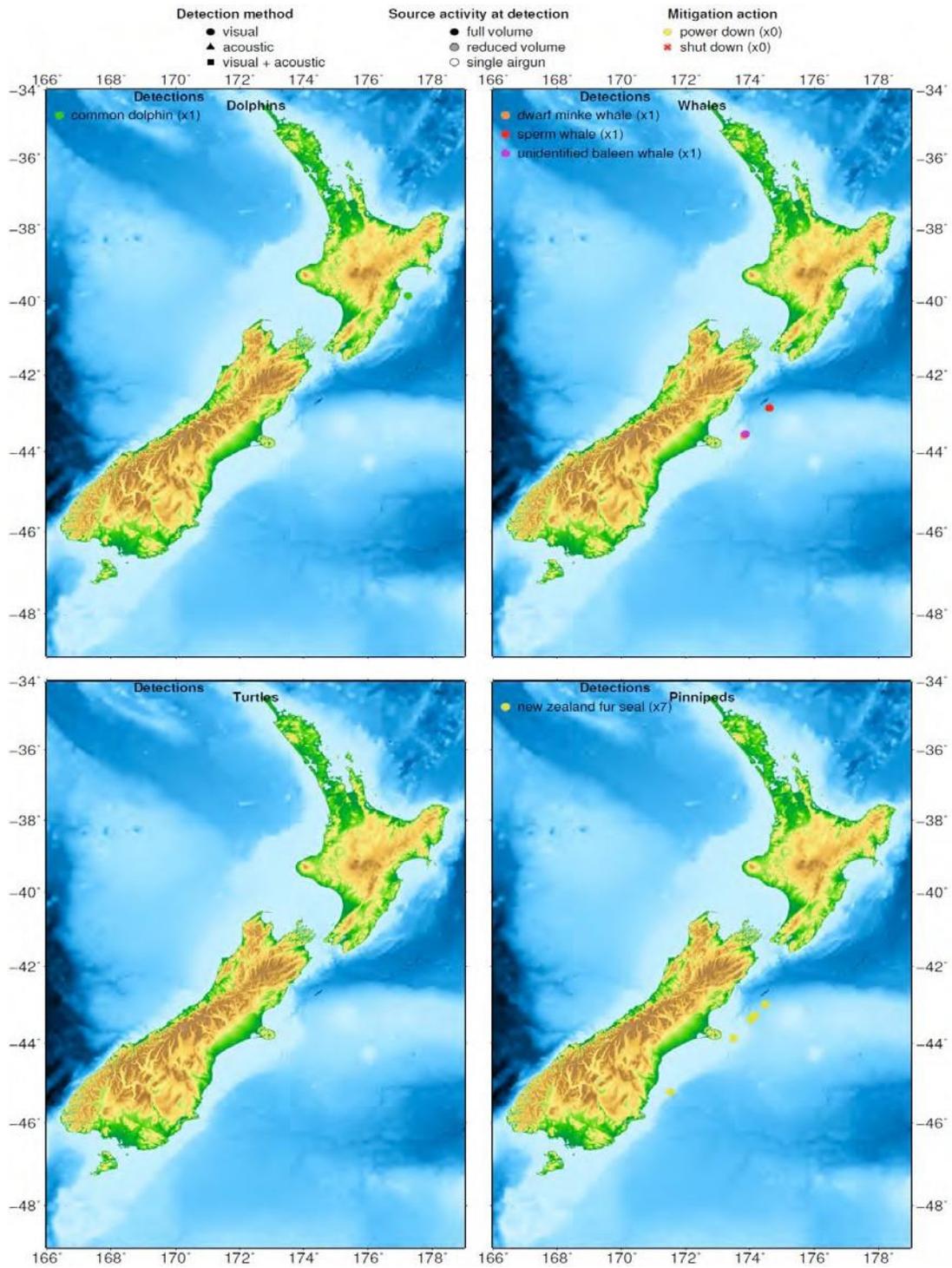


Figure 2: All Protected Species Observed during the Transit from the North Island to the South Island.



Figure 3: Visual Detection #73; Short-beak Common Dolphins; 12 February 2018.



Figure 4: Visual Detection #76; New Zealand Fur Seal; 13 February 2018.



Figure 5: Visual Detection #79; New Zealand Fur Seal; 13 February 2018.



Figure 6: Visual Detection #81; Dwarf Minke Whale; 13 February 2018.