Protected Species Mitigation and Monitoring Report

Line Islands Low-Energy Marine Geophysical Survey in the central Pacific Ocean

30 April 2012- 26 May 2012

R/V Marcus G. Langseth

Prepared for

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1. EXECUTIVE SUMMARY

The National Science Foundation (NSF) owned research vessel (R/V), *Marcus G. Langseth*, operated by Lamont-Doherty Earth Observatory (L-DEO), a part of Columbia University, conducted a seismic survey near the Line Islands Ridge in the central Pacific Ocean. The purpose of the survey was to collect water samples, multi-cores, gravity cores, and piston cores from a transect of sites along the ridge. The *Langseth* left the Honolulu Harbor in Hawaii on 30 April 2012. After conducting a coring test the *Langseth* briefly returned to Honolulu for repairs on 1 May 2012. The *Langseth* began coring on 5 May 2012. All coring was completed on 23 May 2012 and the *Langseth* returned to Honolulu on 26 May 2012.

L-DEO submitted an application to the National Marine Fisheries Service (NMFS) for a permit to harass marine mammals, incidental to the marine geophysical survey. An Incidental Harassment Authorization (IHA) was granted on 30 April 2012 (Appendix A) with several mitigation measures that stipulated harassment to marine mammals. Mitigation measures were implemented to minimize potential impacts to marine mammals throughout the duration of the survey. Mitigation measures included, but were not limited to, the use of NMFS approved Protected Species Observers (PSOs) for visual monitoring, establishment of safety radii, and implementation of ramp-up and shut-down procedures.

RPS was contracted by L-DEO to provide continuous protected species observation coverage and to fulfill the environmental regulatory requirements and reporting mandated by NMFS in the IHA. Three PSOs were present on board the *Langseth* throughout the survey in this capacity.

PSOs undertook dedicated visual watches which accumulated to a total of 331 hours 25 minutes of visual observations over the course of the survey.

This visual monitoring effort produced a project total of four protected species detection records; all of cetaceans. All four records were of Odontocetes, and consisted of one record of sperm whales and three records of unidentifiable dolphins. There were no detections of sea turtles during the survey. Passive acoustic monitoring was not implemented during the survey.

Detections of protected species did not result in any mitigation actions being implemented. During all visual detections the protected species remained outside of the 180 dB and 160 dB safety radii. No protected species were observed to be exposed to received sound levels equal to or greater than 160 dB of sound from the acoustic source, constituting a level B harassment take as defined by NMFS.

A project summary sheet of observation, detection, and operational totals 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 the Line Islands coring survey on board the *R/V Langseth* from 30 April to 26 May 2012 in the central Pacific Ocean.

This document serves to meet the reporting requirements dictated in the IHA issued to L-DEO by NMFS on 30 April 2012. The IHA authorized non-lethal takes of Level B harassment of specific marine mammals incidental to a marine seismic survey program. NMFS has stated that seismic source received sound levels greater than 160 dB could potentially disturb marine mammals, temporarily disrupting behavior, such that they could be considered as "takes" of these exposed animals. Potential consequences of Level B harassment taking could include effects such as temporary or permanent hearing threshold shifts, behavior modification and other reactions. It is unknown to what extent cetaceans exposed to seismic noise of this level would express these effects, and in order to take a precautionary approach, NMFS requires that provisions such as safety radii, ramp- ups and shut-downs be implemented to mitigate for these potential effects.

2.1. PROJECT OVERVIEW AND LOCATION

The survey was conducted on the Line Islands Ridge in the central Pacific Ocean. The survey took place in the approximate area 0.5° South to 8° North and 156 to 162° West, where water depths ranged from ~2000m to ~4500m (Figure 1). The *Langseth* deployed an array of two low-energy Sercel Generator Injector (GI) airguns as the energy source. The receiving system consisted of one 900 meter hydrophone streamer. As the airgun array was towed along the survey lines, the hydrophone streamer received the returning acoustic signals and transferred the data to the onboard processing system.

The total survey effort consisted of approximately 472 km of transect lines. The *Langseth*'s cruising speed was about 10-12 knots during transits and varied between 4 and 5 knots during the seismic survey. Seismic acquisition began on 6 May 2012 and continued with breaks until 11 May 2012.

The cruise was conducted to survey selected areas of the Line Islands Ridge that appeared promising for collecting cores suitable for paleoceanographic work. They also collected water samples, multi-cores, gravity cores, and piston cores from a meridional transect of sites along the ridge. This new material will be used for geochemical and micropaleontological studies of past changes in the Pacific Marine Intertropical Convergence zone El Nino/Southern Oscillation over time scales of thousands to hundreds of thousands of years. Previous work using corals and lake sediments on or near the northern Line Islands has been limited to the last 1000 years. Other previous work on longer time scales has been on sediments from deeper waters which are compromised by dissolution. The materials collected will allow scientists to investigate the behavior of the tropical Pacific ocean-climate system during the past. Better understanding of these important atmospheric occurrences in the past can constrain the ocean-atmosphere models which predict future climatic change. In addition, the material will be used to better understand the history and controls on biological productivity in the tropical Pacific.

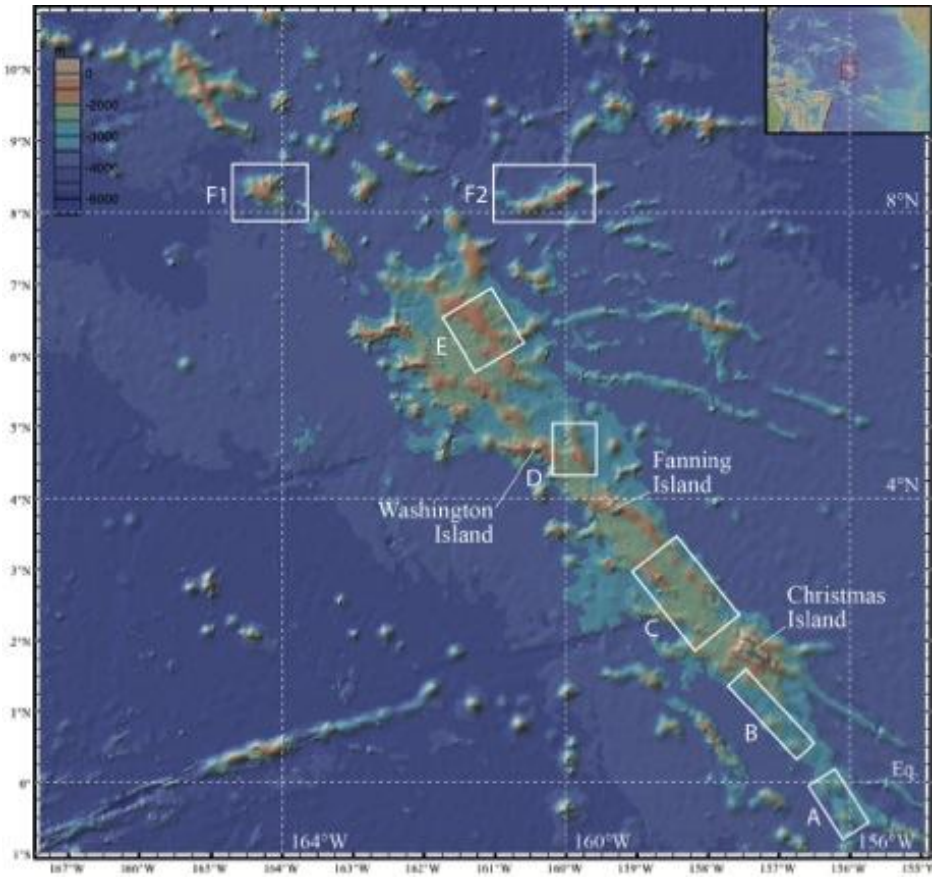

Figure 1. Location of the Line Islands Ridge coring survey in the central Pacific Ocean.

2.1.1. Energy Source

The acoustic source consisted of one towed airgun array and one hydrophone streamer cable. The array was deployed centrally astern. The airguns were towed at a depth of three meters and were situated 78 meters from the Navigational Reference Point (NRP), which was located on the PSO observation tower.

The source array consisted of a low-energy Sercel Generator Injector 2-airgun array that range in size from 45 to 115 in³. The full power source of the two airgun array had a total discharge volume of 225 in³ and a pressure of 2,000 psi.

The shot point interval for the MCS survey was 25 meters, equating to approximately eight seconds at typical survey speed. The sound signal receiving system during the acquisition of the MCS transect lines consisted of a single 900 meter long hydrophone streamer, which received the returning acoustic signals and transferred the data to the processing system located on board the vessel. Due to the length and placement of the cables, the maneuverability of the vessel was limited to turns of five degrees per minute while the gear was being towed.

In addition to the operations of the airgun array, a Kongsberg EM 122 multibeam echosounder (MBES), a Knudsen Chirp 3260 sub-bottom profiler (SBP), and a hull-mounted acoustic Doppler current profiler (ADCP) was operated from the *Langseth* continuously throughout the cruise. These sound sources are operated from the *Langseth* simultaneously with the airgun array.

3. MITIGATION AND MONITORING METHODS

The PSO monitoring program on the *Langseth* was established to meet the IHA requirements that were issued to the L-DEO by NMFS, which included both monitoring and mitigation objectives. The survey mitigation program is designed to minimize potential impacts of the *Langseth*'s seismic program on marine turtles, marine mammals, and other protected species of interest. The following monitoring protocols were followed to meet these objectives:

- Visual observations were established to provide real-time sighting data, allowing for the implementation of mitigation procedures as necessary.
- Ascertain the effects of marine mammals and marine turtles exposed to sound levels constituting a "take".

In addition to the mitigation objectives outlined in the IHA, PSOs collected and analyzed necessary data mandated by the IHA for this report including but not limited to:

- Dates, times and locations, heading, speed, weather, sea conditions (including Beaufort sea state and wind force), and related activities during all seismic operations and marine mammal detections.
- Species, number, location, distance from the vessel, and behavior of any marine mammals, as well as associated seismic activity including the number of power-downs and shut-downs, were observed and logged throughout all monitoring actions.
- An estimate of the number, decided by species, of marine mammals that: (A) are known to have been exposed to the seismic activity (based on visual observation) at received levels greater than or equal to 160 dB re 1 µPa (rms), 180 dB re 1 µPa (rms) and/or 190 dB re 1 µPa (rms) along with a discussion of any specific behaviors those individuals exhibited; and (B) may have been exposed (based on modeling results) to the seismic activity at received levels greater than or equal to 160 dB re 1 µPa (rms), 180 dB re 1 µPa (rms) and/or 190 dB re 1 µPa (rms) along with a discussion of the plausible consequences of that exposure on the individuals that were within the safety radii.
- A description of the implementation and effectiveness of the: (A) terms and conditions of the ITS and (B) mitigation measures of the IHA.

3.1. VISUAL MONITORING SURVEY METHODOLOGY

There were three trained and experienced PSOs on board to conduct the monitoring for marine mammals, record and report on observations, and request mitigation actions in accordance to the IHA. The PSOs on board were NMFS-approved and held certifications from a recognized Joint Nature Conservation Committee (JNCC) course and/or approved Bureau of Ocean Energy Management (BOEM) course. Visual monitoring was primarily carried out from an observation tower (Figure 2) located 18.9 meters above the water surface which afforded the PSOs a 360 degree viewpoint around the acoustic source.

Figure 2. Protected Species Observer observation tower with mounted big-eye binoculars.

The PSO tower was equipped with Fujinon 7x50 binoculars as well as two mounted 25x150 Big-eye binoculars. Inside the tent located in the middle of the platform was a laptop for data collection as well as a telephone for communication with the bridge or main lab. Also inside the tent was a monitor that displayed current information about the vessel's position, speed, and heading, along with water depth, wind speed and direction, and source activity. Most observations were held from the tower; however, when there was severe weather or poor environmental conditions, observations would be performed from the bridge (~12.8m above sea level) or the catwalk (~12.3m above sea level) in front of the bridge. Night Quest NQ2200 Night Vision Devices were also available to conduct night time observations for nighttime ramp-ups of the acoustic source, but were not used during this survey.

Visual monitoring methods were implemented in accordance with the survey requirements outlined in the IHA. At least one PSO, but most often two PSOs, watched for marine mammals and sea turtles at all times while airguns operated during daylight periods and whenever the vessel was underway when the airguns were not firing.

When the acoustic source was activated from silence, PSOs maintained a two-person watch for 30 minutes prior to the activation of the source. Visual watches commenced each day before sunrise, beginning as soon as the safety radii were visible, and continued past sunset until the safety radii became obscured. Start of observation times ranged from 5:32 to 6:16 local time, while end of observation times ranged from 18:50 to 19:34 local time.

A visual monitoring schedule was established by the PSOs where each person completed visual observations watches which varied in length between two to four hours, two to three times a day, for a total of eight to nine hours of visual monitoring per day. This schedule was arranged to ensure that two PSOs were on visual observation duty at all times except during meal breaks when PSOs would each maintain a solo watch so that the team could eat while maintaining visual monitoring. Solo watches lasted less than 45 minutes and occurred each day at meal times.

Observations were focused forward of the vessel and to the sides but with regular sweeps through the area around the active acoustic source. PSOs searched for blows indicating the presence of a marine mammal, splashes or disturbances to the sea surface, the presence of large flocks of feeding seabirds 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 acoustic source while identifying the observed animal (cetacean, pinniped, or sea turtle) to determine which safety radius applied to the animal. The visual PSOs would then notify the main science lab that there was an animal inside or outside of the safety radius. If the animal was observed inside the safety radius and a mitigation action was necessary the seismic technician would be notified. Table 1 describes the various exclusion zone radii applied to cetaceans and pinnipeds, as well as what constituted the Level-B harassment zone.

Table 1. Exclusion zone (EZ) radii for triggering mitigation.

Source and Volume	Array Tow Depth (m)	Water Depth (m)	Shut-down EZ for Pinnipeds 190 dB (m)	Shut-down EZ for Cetaceans 180 dB (m)	Level-B Harassment Zone 160 dB (m)
2 GI airguns (225 in^3)	3	Deep (>1,000)	20	70	670

When a protected species was observed range estimations were made using reticle binoculars, the naked eye, and by relating the animal to an object at a known distance, such as the acoustic array located 78 meters from the PSO tower. Specific species identifications were made whenever distance, length of sighting and visual observation conditions allowed. PSOs observed anatomical features of animals sighted with the naked eye and through the big-eyes and reticule binoculars and noted behavior of the animal or group. Photographs were taken during most sightings. Sometimes photographs were not taken due to the brevity of a sighting. The camera used was a Canon EOS 60D with a 300 millimeter telephoto lens. Marine mammal and sea turtle identification manuals were consulted and photos were examined during visual watch breaks to confirm identifications.

During or immediately after each sighting event PSOs recorded the position, time at first and last sighting, number of animals present (adults and juveniles), the initial and any subsequent behaviors observed, the initial range, bearing and movement of the animal(s), the source activity at the initial and final detections and any mitigation measures that were applied. Specific information regarding the animal(s) closest approach to the vessel, acoustic source and the acoustic source output at the closest approach were recorded to determine if the animals had been exposed to 160 dB and/or 180/190 dB of sound from the source during the sighting event. Additionally, the vessel position, water depth, vessel heading and speed, the wind speed and direction, Beaufort sea state, swell level, visibility and glare were recorded every half an hour at minimum or every time environmental conditions, vessel, or seismic activity changed. Each sighting event was linked to an entry on a datasheet such that environmental conditions were available for each sighting event.

4. MONITORING EFFORT SUMMARY

4.1. SURVEY OPERATIONS SUMMARY

The *R/V Langseth* departed Honolulu Harbor, Hawaii for the seismic survey site at 18:07 UTC on 30 April 2012. The seismic gear was deployed and use of the acoustic source commenced at 2:20 UTC on 6 May. Acquisition began on the first survey line began at 4:09 UTC on 6 May. Acquisition of the survey lines was completed at 22:13 UTC on 11 April. The airguns were disabled shortly after at 22:20 UTC. At this time the seismic gear was brought on board and the *Langseth* continued with coring operations. The *Langseth* began the transit to Honolulu, Hawaii arriving at approximately 15:30 UTC on 26 May 2012. Table 2 outlines the dates and times of acquisition for each survey line.

Table 2. Line Islands Low-Energy Marine Geophysical Survey multi-channel seismic lines acquired.

Survey Line	Date Acquisition Commenced	Time Acquisition Commenced	Date Acquisition Completed	Time Acquisition Completed
MGL1208E01 Seq001	06-May-12	04:09	06-May-12	14:48
MGL1208E02 Seq002	06-May-12	14:49	06-May-12	18:35
MGL120801A Seq003	10-May-12	16:44	11-May-12	03:05
MGL120801A1 Seq004	11-May-12	03:06	11-May-12	12:25
MGL120802A Seq005	11-May-12	12:33	11-May-12	15:52
MGL120803A Sea006	11-May-12	15:55	11-May-12	22:13

The acoustic source was rarely used throughout the survey, being activated twice, for a total of 46 hours of source activity. This includes ramp-up of the airguns, full power firing both online and during line changes, and airgun testing (Figure 3). The mitigation source was not used during this survey. Full power source operations while online accounted for 95% (43 hours 42 minutes) of airgun activity during the project. Line changes were all shot at full power, totalling 43 minutes of array activity.

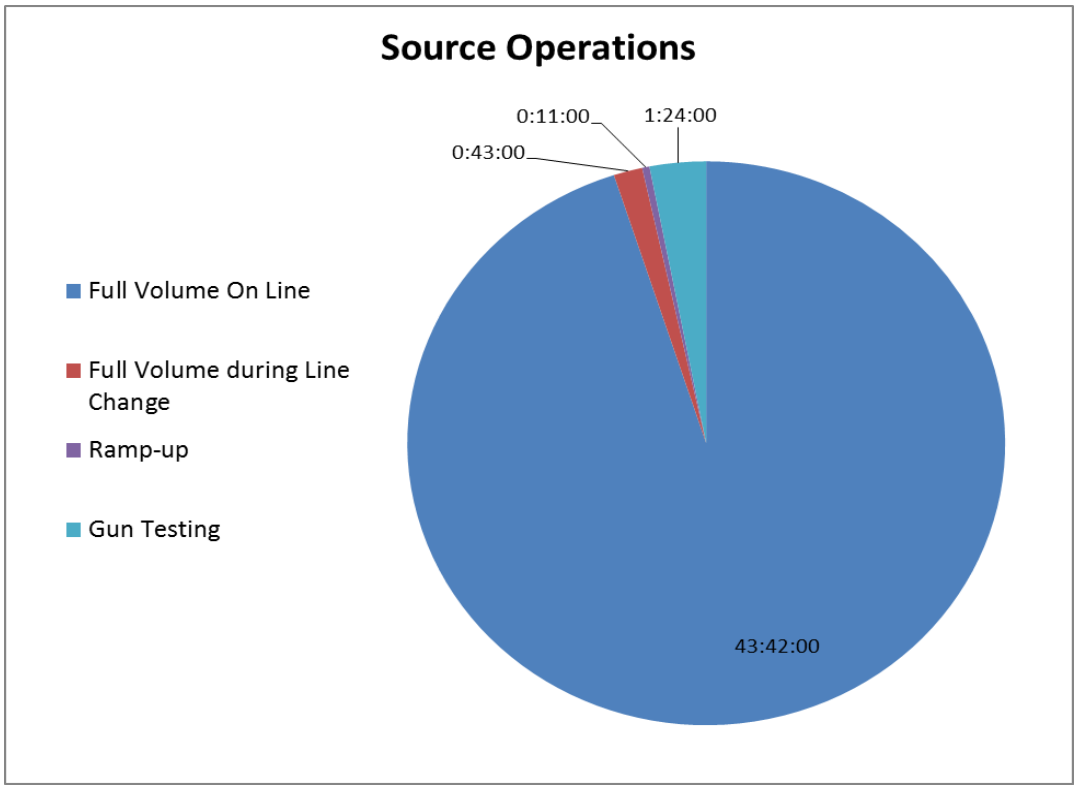

Figure 3. Total acoustic source operations.

The acoustic source was ramped up twice over the course of the survey in order to commence full power survey operations (Table 3). The first ramp up of the acoustic source was conducted from silence over the duration of 6 minutes. This ramp up was conducted to begin use of the acoustic source at the beginning of the survey. The second ramp up was conducted from silence over the duration of 5 minutes. This ramp up was conducted to return to full power production after airgun silence. The ramp ups were conducted by turning on the first GI airgun and waiting five minutes before adding the second GI airgun.

Table 3. Total acoustic source operations during the Line Islands low-energy marine geophysical survey.

Acoustic Source Operations	Number	Duration (hh:mm)
Gun Tests		**1:24**
Ramp-up	**2**	**0:11**
Day time ramp-ups from silence	**2**	
Day time ramp-ups from mitigation	**0**	
Night time ramp-ups from mitigation	**0**	
Full power survey acquisition		**43:42**
Full power line changes		**00:43**
Total time acoustic source was active		**46:00**

4.2. VISUAL MONITORING SURVEY SUMMARY

The PSOs began visual observations immediately upon departure and while in transit to the survey site. This was done to collect baseline data about protected species abundance in the

area. Visual monitoring began at 18:07 UTC on 30 April 2012 and continued until 5:34 UTC on 26 May 2012 when the vessel arrived at Honolulu Harbor at the completion of the survey project. Visual monitoring was over a period of about 26 days. Monitoring was conducted by two PSOs each day between just before dawn until just after dusk, when it became too dark for the entire safety radius to be visible, averaging approximately 13 hours 05 minutes of visual observations per day.

Visual watches were held by two PSOs except during the scheduled meal hours when a single PSO continued visual monitoring while the PSOs rotated for a meal break. Single PSO visual observations during these periods lasted a maximum of 45 minutes. In the event of a sighting event during a single PSO watch a second PSO would be notified and would immediately return to assist observations.

The acoustic source was not active during the majority of visual monitoring (93%), as shown in Figure 4. The acoustic source was only activated twice during the survey. The acoustic source was active once on 6 May for a total of 16 hours 15 minutes and again on 10 May for 29 hours 45 minutes.

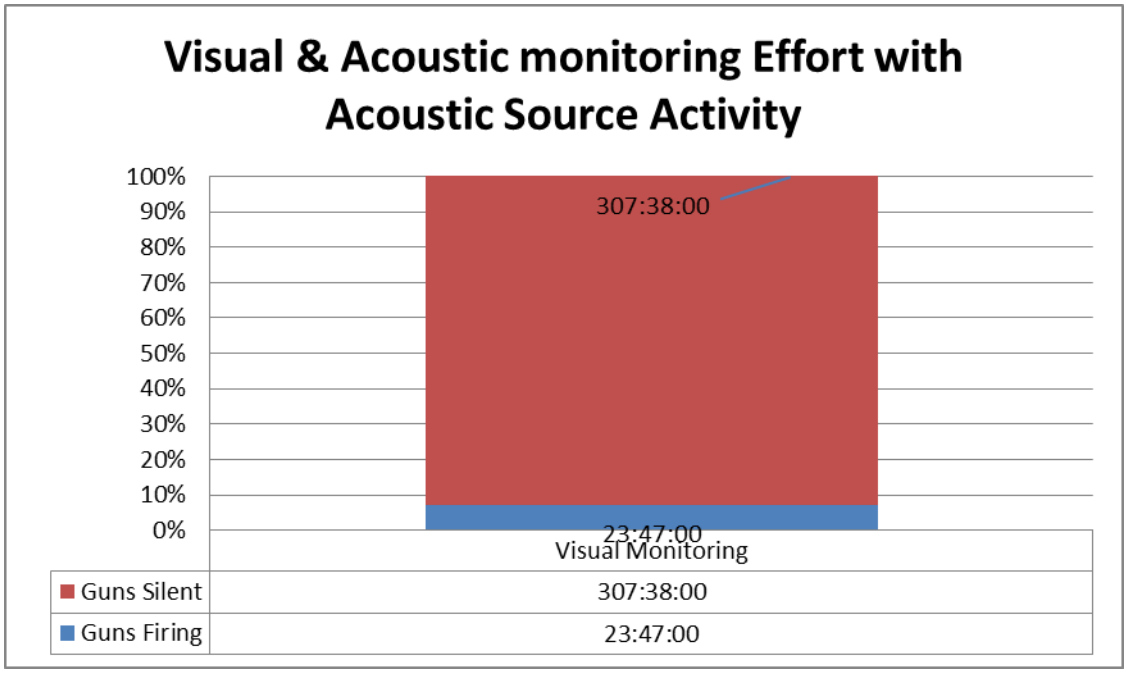

Figure 4. Duration of visual monitoring effort while the acoustic source was active vs. silent.

Total visual monitoring effort, divided by monitoring effort while the acoustic source was active and monitoring effort while the source was silent, is listed in Table 4.

Table 4. Total visual monitoring effort.

Visual Monitoring Effort	Duration (hh:mm)
Total monitoring while acoustic source active	**23:47**
Total monitoring while acoustic source silent	**307:38**
Total monitoring effort	**331:25**

The PSOs preferred to conduct visual observations from the PSO tower, which provided the PSOs with a 360° view of the water around the vessel and acoustic source. However, visual watches would be conducted from the catwalk or bridge for any health or safety reason or during periods with high winds, large swells, or heavy rain. During coring operations the vessel would remain stationary facing directly into the wind, often causing the ship's exhaust to blow directly on the PSO tower. As Figure 5 demonstrates approximately 77% of visual monitoring was conducted from the PSO tower during the Line Islands survey.

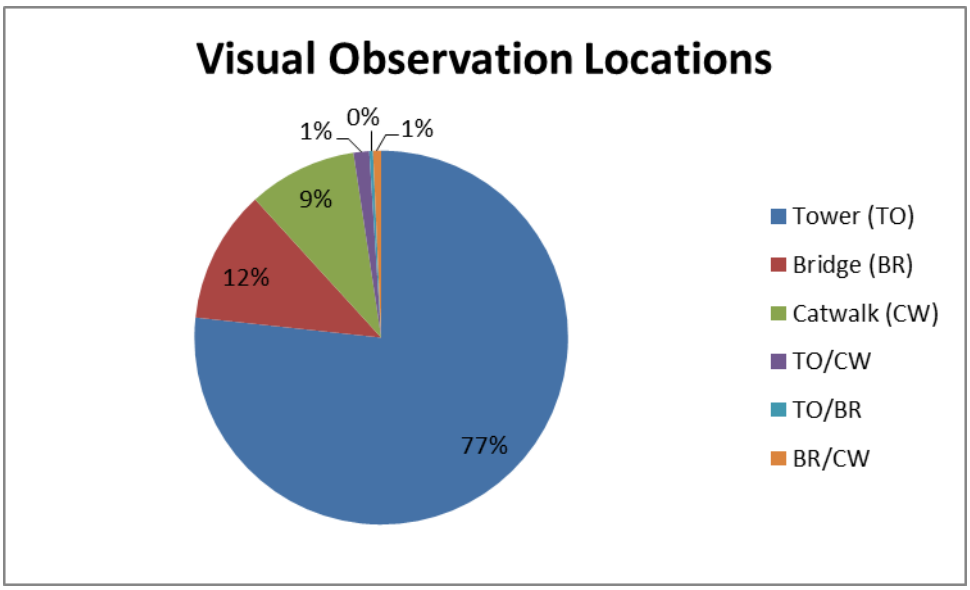

Figure 5. Total visual effort from observation locations on board the *R/V Langseth*.

4.3. ENVIRONMENTAL CONDITIONS

A majority of visual monitoring effort was conducted during moderate observations conditions. There were a few brief periods where visibility was obscured by precipitation and fog, as well as general cloud cover. Scattered showers were frequent throughout the survey and did at times affect visual observations. A total of 10 hours of precipitation was recorded. Visibility remained clear with a range of eight kilometers or more for the majority of the survey.

The Beaufort Sea states ranged from levels 1 through 7 but generally remained between a level 4 and level 5. A level 4 or 5 sea state was observered for approximately 217 hours of the survey. Sea levels dropped to 3 or below for only 51 hours, while reaching a level of 6 or more for 62 hours (Figure 6).

Wind forces remained relatively stable throughout the survey with a minimum of 2 knots during the fourth week to a maximum of 30 knots during the second and fourth weeks. Forces from 10-21 knots were the average during the cruise totalling 223 hours (Figure 7).

During the Line Islands survey, swell height remained less than 2 meters for 241 hours, while reaching heights of 2-4 meters for only 89 hours (Figure 8). Swells did not increase to greater than 4 meters.

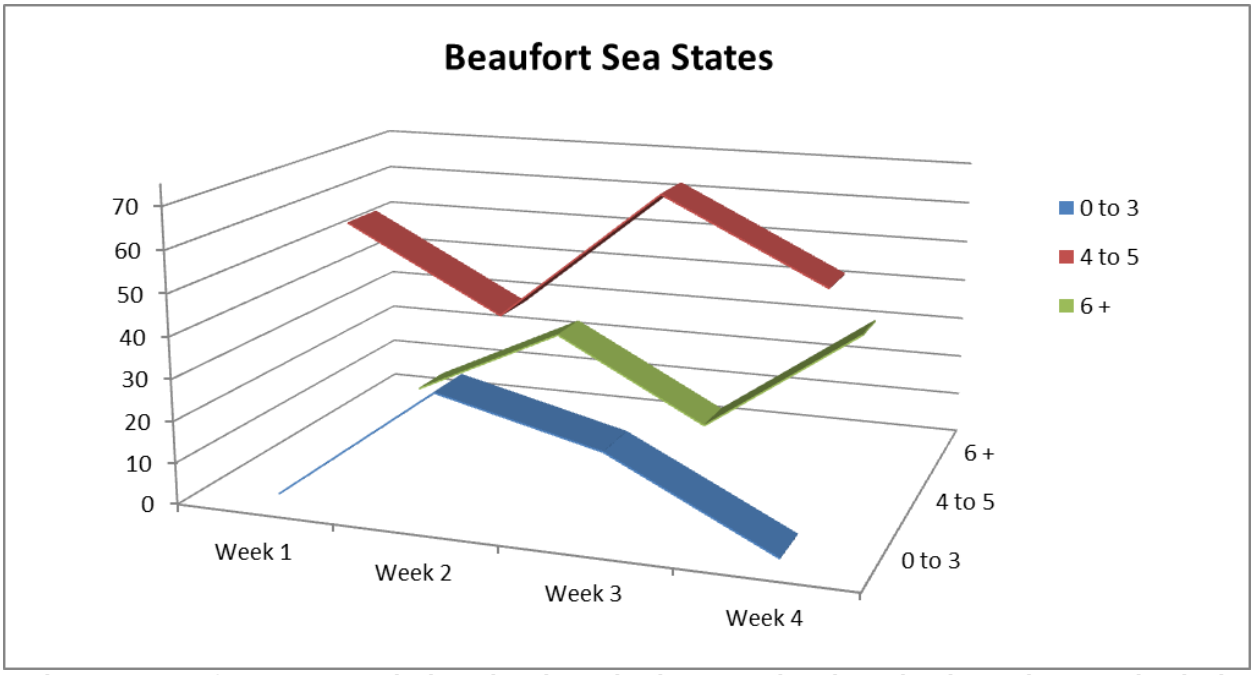

Figure 6. Beaufort sea state during visual monitoring over the Line Islands marine geophysical survey.

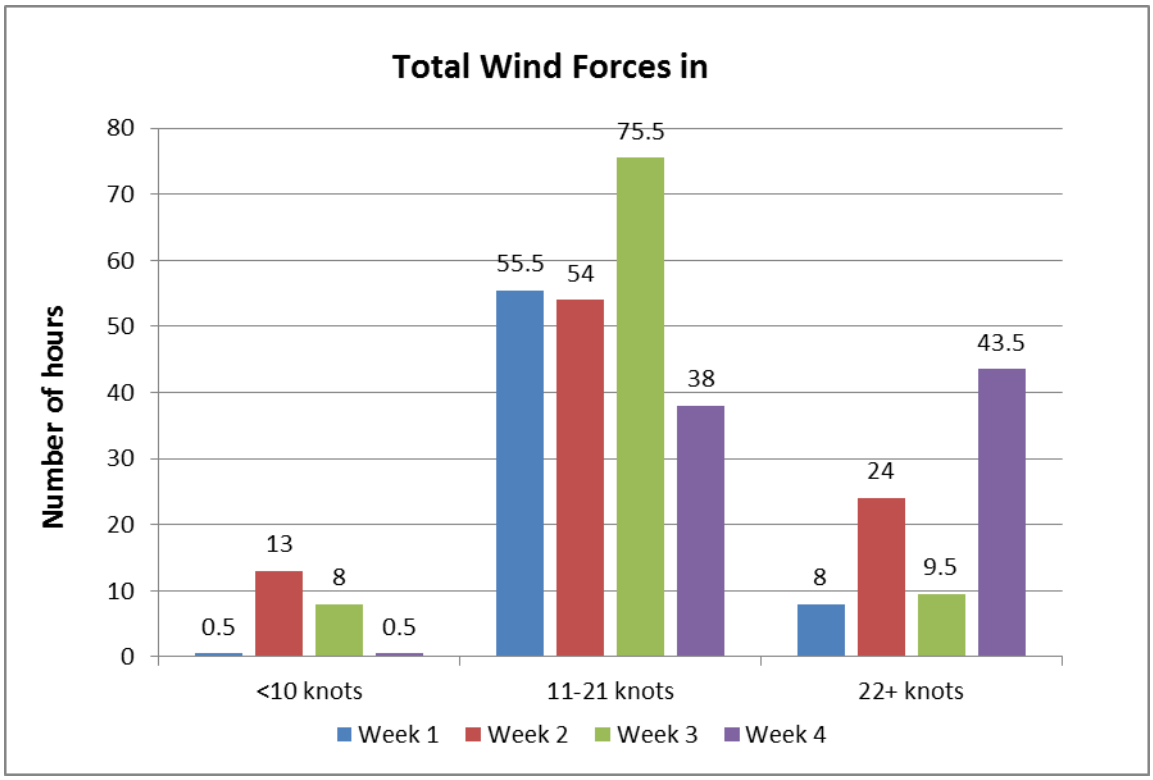

Figure 7. Average wind force each week during visual monitoring.

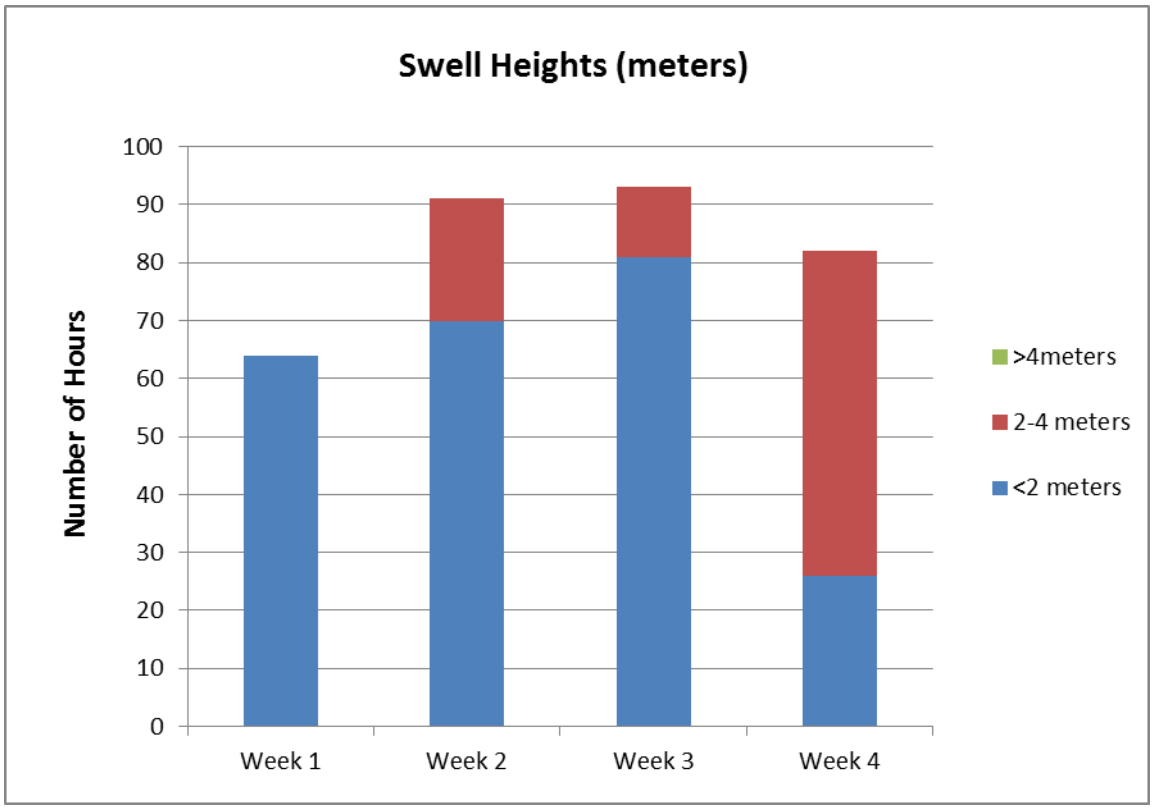

Figure 8. Swell heights while visual monitoring was conducted.

5. MONITORING AND DETECTION RESULTS

5.1. VISUAL DETECTIONS

Visual monitoring conducted during the Line Islands low-energy marine geophysical survey resulted in the collection of four records of detection for protected species (summarized in Appendix C). One species of marine mammal were positively identified, along with three detections of unidentifiable dolphins. The total number of detection events and the total number of animals recorded by species is described in Table 5.

A complete list of bird species 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 D.

Table 5. Number of visual detection records collected for each protected species.

	Total Number of Detection Records	Total Number of Animals Recorded
Odontocetes		
Unidentifiable dolphins	3	78
Sperm whale	1	2
TOTAL	**4**	**80**

There were very few sightings of protected species during the Line Islands survey and it was common to go multiple days without detections of protected species (Figure 9). The most detections occurred on 10 May when there were two detections of protected species totalling at least 75 individual animals.

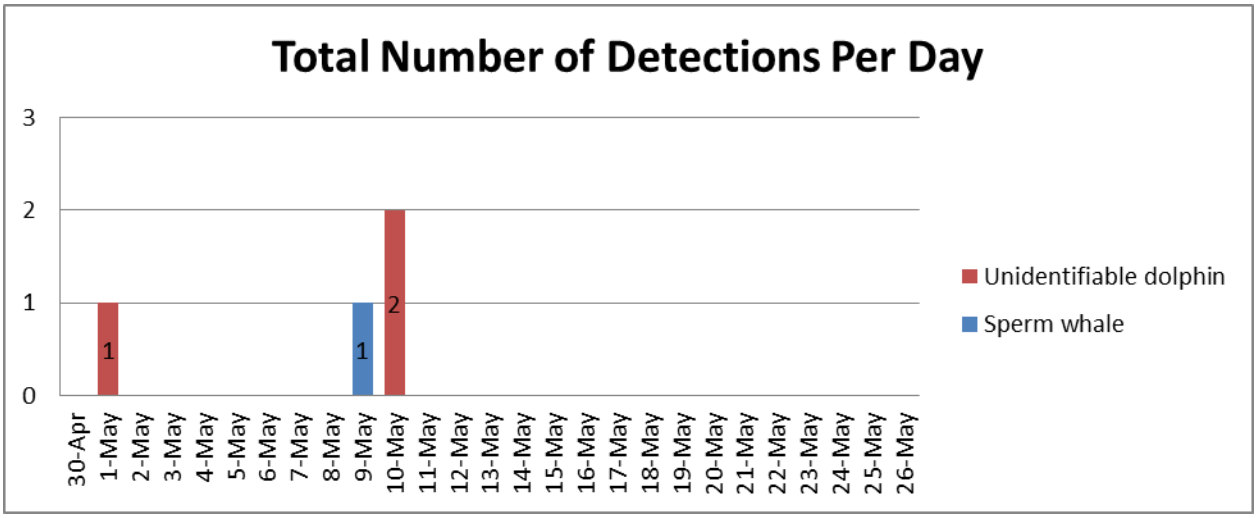

Figure 9. Number of protected species detections each day of the Line Islands low-energy marine geophysical survey.

Of the four protected species detection events during the Line Islands survey, two detections (50%) occurred while the acoustic source was active and two detections (50%) occurred while the acoustic source was silent. Figure 10 demonstrates the species detected compared to airgun activity.

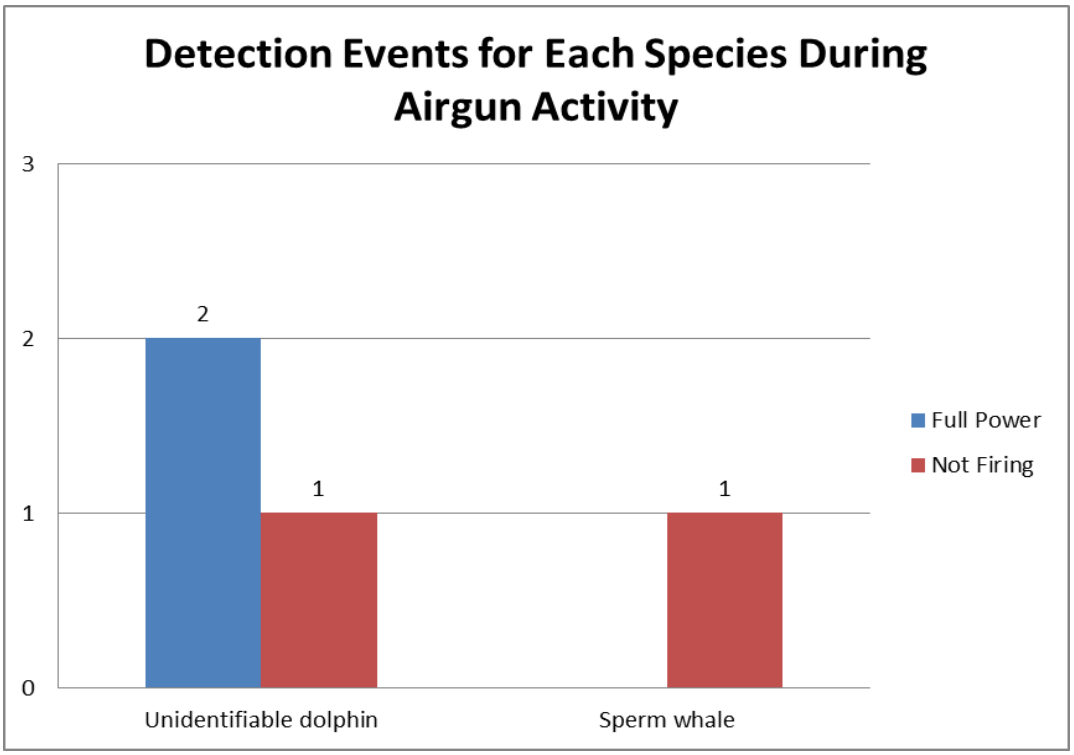

Figure 10. Species detected compared to airgun activity.

Table 6 demonstrates the average closest approach of protected species to the source at various volumes.

Table 6. Average closest approach of protected species to the acoustic source at various volumes.

Species Detected	Full Power (225 in³)		Ramp-up		Not Firing	
	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)
Unidentifiable dolphin	2	3832	-	-	1	600
Sperm whale	-	-	-	-	1	1150

All four detection records for the Line Islands survey were of cetaceans. Figure 11 demonstrates the total number of animals observed, per species, during the detection events. Sperm whales were the most abundant positively identified protected species accounting for one visual detection of two individuals.

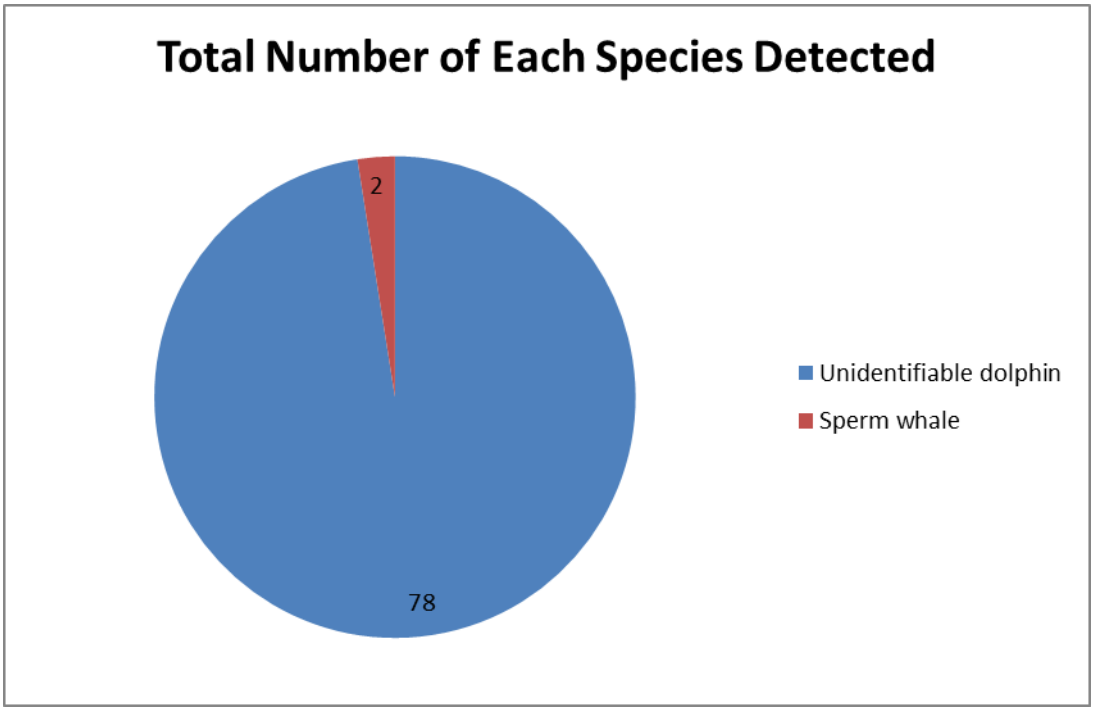

Figure 11. Number of individuals per species detection.

The spatial distribution of marine mammal detections can be seen in Figure 12.

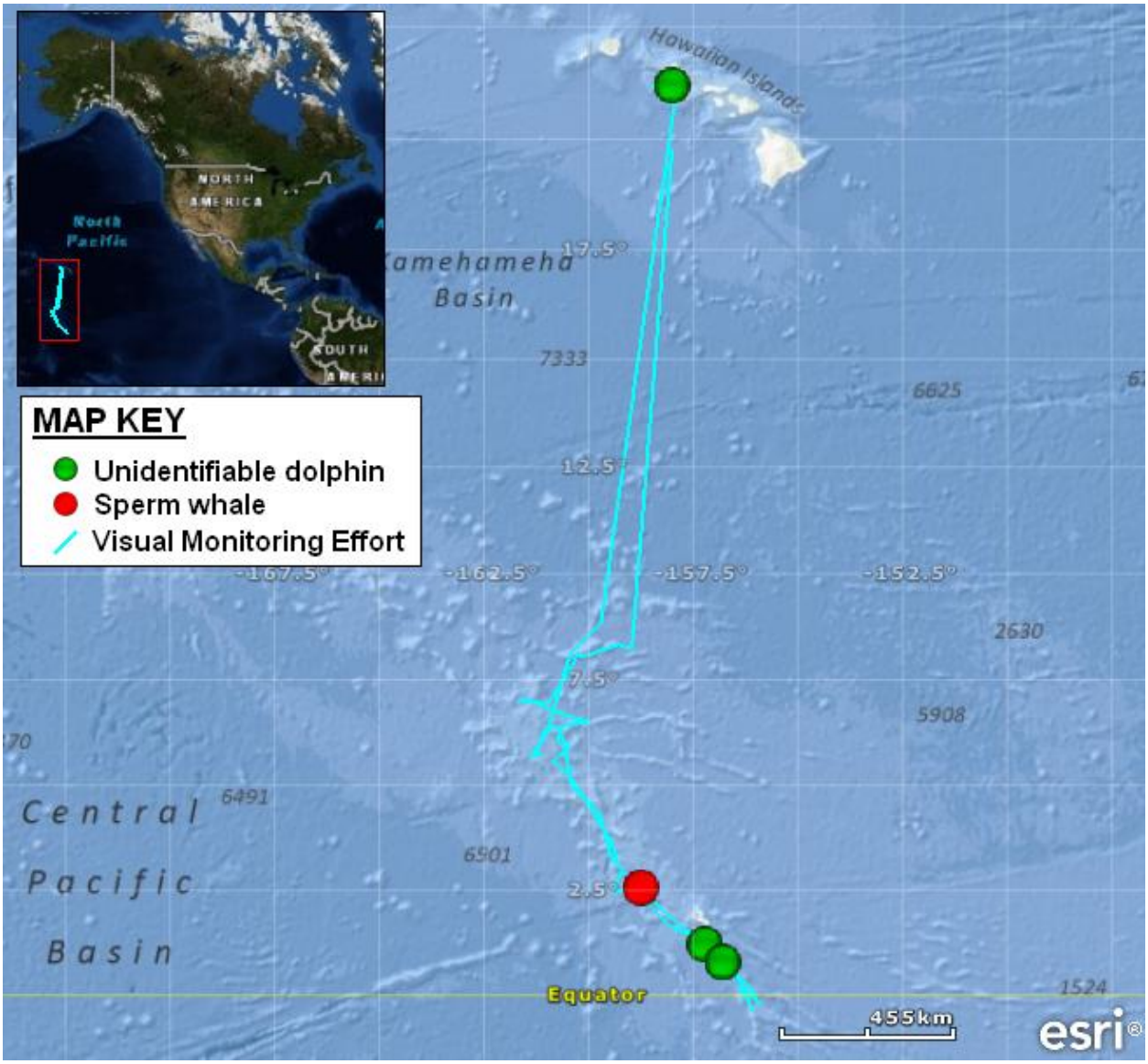

Figure 12. Marine mammal spatial distribution of detections from 30 April 2012 – 26 May 2012 on board the *Langseth*.

5.1.1. Cetacean Detections

5.1.1.1. Unidentifiable dolphin

On 1 May 2012 at 16:31 UTC there was a very brief sighting of unidentifiable dolphins. Three dolphins were observed surfacing approximately 400 meters off the starboard side of the vessel, heading towards the vessel. This detection occurred while the *Langseth* was returning to port for gear repairs and near the island of Oahu. All seismic gear was onboard.

On 10 May 2012 at 17:05 UTC a pod ~25 unidentifiable "blackfish" was observed ~2.5 km off the port side of the vessel. The pod was very spread out and traveled behind the vessel as it passed. The airguns were firing at full power (225 in^3) during this observation and the animals remained outside of the 160 dB safety radius, with their closest approach to the guns being 2 km.

Later on 10 May 2012 at 23:24 UTC a large pod of at least 50 unidentifiable dolphins were observed porpoising ~5.5 km off the starboard side of the vessel. The airguns were firing at full power (225 in^3) during the sighting and the dolphins remained well outside of the 160 dB safety radius.

5.1.1.2. Sperm whale

On 9 May at 23:47 UTC two sperm whales (*Physeter macrocephalus)* were observed ~1 km off the bow of the *Langseth.* One whale was observed fluking at 23:49 UTC. The vessel was in transit moving at ~11 knots. The whales were observed again blowing at 00:08 UTC ~4 km off the starboard stern. This was likely a mother calf pair. All seismic gear was onboard at the time of the detection.

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

NMFS granted an IHA to L-DEO for a low-energy marine seismic survey allowing Level B harassment takes (exposure to sound pressure levels greater than or equal to 160 dB re: 1 µPa (rms)) for 16 marine mammal species: one mysticete and 15 odontocete species. There were no direct visual observations recorded by PSOs of one species of marine mammals for which takes were granted in the IHA to provide a minimum estimate of the actual number of cetaceans exposed to received sound levels or 180/190 dB and 160 dB.

During the Line Islands low-energy marine geophysical survey no protected species were observed within the 160 dB safety radius, where Level B harassment is expected to occur, while the acoustic source was active (Table 7).

Table 7. Level B Harassment Takes authorized by NMFS IHA for the Line Islands low-energy marine geophysical and number of known individuals exposed to 160 dB and 180/190 dB through visual observations.

Species	IHA Authorized Takes	Number of animals exposed to 180/190 dB	Number of animals exposed to 160 dB
Mysticetes			
Bryde's whale	4	0	0
Odontocetes			
Sperm whale	8	0	0
Dwarf sperm whale	18	0	0
Cuvier's beaked whale	16	0	0
Longman's beaked whale	14	0	0
Mesoplodon spp.	4	0	0
Rough-toothed dolphin	13	0	0
Bottlenose dolphin	12	0	0
Pantropical spotted dolphin	279	0	0
Spinner dolphin	425	0	0
Striped dolphin	46	0	0
Fraser's dolphin	182	0	0
Risso's dolphin	14	0	0
Melon-headed whale	101	0	0
False killer whale	9	0	0
Short-finned pilot whale	24	0	0

These numbers are possibly an underestimate and provide the absolute minimum number of animals actually exposed, due to the airguns firing at night time when no visual observations or passive acoustic monitoring were held.

6.1. IMPLEMENTATION AND EFFECTIVENESS OF THE BIOLOGICAL OPINIONS'S ITS AND IHA

In order to minimize the Level-B incidental taking of marine mammals and sea turtles during the Line Islands marine geophysical survey, mitigation measures were to be implemented whenever these protected species were seen near or within the safety radii designated in the IHA. Because of the minimal use of the acoustic source and small safety radii no mitigation actions were necessary during this survey.

7. ACKNOWLEDGEMENTS

The Protected Species Observers on board *Langseth* during the Line Islands low-energy marine geophysical survey in the central Pacific Ocean would like to thank the National Science Foundation and Lamont-Doherty Earth Observatory for the opportunity to work on this project. It was a pleasure to work with Drs. Jean Lynch-Stieglitz and Pratigya Polissar, as well as Meagan Cummings, the Marine Environmental Safety Coordinator for L-DEO. We would also like to thank the marine crew and science team on board the *R/V Langseth* for their assistance and hospitality.

We would like to thank the following individuals for their considerable help in making the program a success.

- Meagan Cummings and Jeff Rupert from L-DEO and Holly Smith and Olivia Lee from NSF for their assistance, planning and preparation for the cruise.
- Matthew Dellinger from RPS for providing logistical support for the project.
- We also thank Meagan Cummings and Anne Unietis for reviewing this report.

We would like to extend our sincere thanks and gratitude to everyone who helped support this project as it would not have been possible without the efforts and assistance of the many individuals and organizations involved.

APPENDIX A: Incidental Harassment Authorization for the Line Islands low-energy marine geophysical survey

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

DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE

INCIDENTAL HARASSMENT AUTHORIZATION

We hereby authorize the Lamont-Doherty Earth Observatory (Observatory), Columbia University, P.O. Box 1000, 61 Route 9W, Palisades, New York 10964-8000, under section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA) (16 U.S.C. 1371(a)(5)(D)) and 50 CFR 216.107, to incidentally harass small numbers of marine mammals incidental to a marine geophysical survey conducted by the R/V *Marcus G. Langseth* (*Langseth*) in the central Pacific Ocean, May-June, 2012.

1. This Authorization is valid from May 1, 2012 through June 11, 2012.

2. This Authorization is valid only for specified activities associated with the R/V *Marcus G. Langseth*'s (*Langseth*) seismic operations as specified in the Observatory's Incidental Harassment Authorization (IHA) application and environmental analysis in the following specified geographic area:

   (a) In the central Pacific Ocean in the Exclusive Economic Zones of the United States and the Republic of Kiribati, within the boundary of approximately 0.5–8° S by 156–162° W specified in the Observatory's application and the National Science Foundation's environmental analysis.

3. SPECIES AUTHORIZED AND LEVEL OF TAKES

(a) This authorization limits the incidental taking of marine mammals, by Level B harassment only, to the following species in the area described in Condition 2(a):

(i) Mysticetes – see Table 1 (attached) for authorized species and take numbers.

(ii) Odontocetes – see Table 1 (attached) for authorized species and take numbers.

(iii) During the seismic activities, if the Holder of this Authorization encounters any marine mammal species that are not listed in Table 1 (attached) for authorized taking and are likely to be exposed to sound pressure levels greater than or equal to 160 decibels (dB) re: 1 μPa, then the Holder must alter speed or course or shut-down the airguns to avoid take.

(b) This Authorization prohibits the taking by injury (Level A harassment), serious injury, or death of any of the species listed in Condition 3(a) or the taking of any kind of any other species of marine mammal. Thus, it may result in the modification, suspension or revocation of this Authorization.

(c) This Authorization limits the methods authorized for taking by Level B harassment to the following acoustic sources without an amendment to this Authorization:

(i) a low-energy Sercel Generator Injector (GI) 2-airgun array that may range in size from 45 or 105 cubic inches (in^3) with a total volume of approximately 210 in^3 at a tow depth of 3 meters (m).

(ii) an acoustic Doppler current profiler;

(iii) a multi-beam echosounder; and

(iv) a sub-bottom profiler.

4. The Holder of this Authorization must report the taking of any marine mammal in a manner prohibited under this Authorization immediately to the Office of Protected Resources, National Marine Fisheries Service, at 301-427-8401and/or by email to Jolie.Harrison@noaa.gov and ITP.Cody@noaa.gov and the Pacific Islands Regional Stranding Coordinator at 808-944-2269 (David.Schofield@noaa.gov).

5. We require the Holder of this Authorization to cooperate with the Office of Protected Resources, National Marine Fisheries Service and any other Federal, state or local agency monitoring the impacts of the activity on marine mammals.

6. Mitigation and Monitoring Requirements

We require the Holder of this Authorization to implement the following mitigation and monitoring requirements when conducting the specified activities to achieve the least practicable adverse impact on affected marine mammal species or stocks:

6. Visual Observers

(a) Utilize two, National Marine Fisheries Service-qualified, vessel-based Protected Species Visual Observers (visual observers) to watch for and monitor marine mammals near the seismic source vessel during daytime airgun operations (from civil twilight-dawn to civil twilight-dusk) and before and during start-ups of airguns day or night.

(i) At least one visual observer will be on watch during meal times and restroom breaks.

(ii) Observer shifts will last no longer than four hours at a time.

(iii) Visual observers will also conduct monitoring while the Langseth crew deploy and recover the airgun array and streamers from the water.

(iv) When feasible, visual observers will conduct observations during daytime periods when the seismic system is not operating for comparison of sighting rates and behavioral reactions during, between, and after airgun operations.

(v) The *Langseth*'s vessel crew will also assist in detecting marine mammals, when practicable. Visual observers will have access to reticle binoculars (7x50 Fujinon), big-eye binoculars (25x150), and night vision devices.

6. EXCLUSION ZONES

(b) Establish a 180-dB exclusion zone (zone) for cetaceans and a 190-dB exclusion zone for pinnipeds before starting the two GI airgun array (90 in^3 through 210 in^3 in total volume). See Table 2 (attached) for distances of the exclusion zones. Observers will use the predicted radius distance for the 180-dB zone for cetaceans and the predicted distance for the 190-dB zone for pinnipeds.

6. VISUAL MONITORING AT THE START OF AIRGUN OPERATIONS

(c) Monitor the entire extent of the zones listed in Table 2 (attached) for at least 30 minutes (day or night) prior to the ramp-up of airgun operations or after an extended shutdown (*i.e.*, 15 minutes).

(d) Delay airgun operations if the visual observer sees a cetacean within the 180-dB zone for cetaceans or the 190-dB zone for pinnipeds until the marine mammal(s) has left the area.

(i) If the visual observer sees a marine mammal that surfaces, then dives below the surface, the observer shall wait 30 minutes. If the observer sees no marine mammals during that time, he/she should assume that the animal has moved beyond the 180-dB zone for cetaceans or the 190-dB zone for pinnipeds.

(ii) If for any reason the visual observer cannot see the full 180-dB zone for cetaceans or the full 190-dB zone for pinnipeds for the entire 30 minutes (*i.e.*, rough seas, fog, darkness), or if marine mammals are near, approaching, or within zone, the *Langseth* may not resume airgun operations.

(iii) If one airgun is already running at a source level of at least 180 dB re: 1 μPa, the *Langseth* may start the second gun without observing relevant exclusion zones for 30 minutes, provided that the observers have not seen any marine mammals near the relevant exclusion zones (in accordance with Condition 6(b)).

6. RAMP-UP PROCEDURES

(e) Implement a "ramp-up" procedure when starting the airguns at the beginning of seismic operations or anytime after the entire array has been shut down for more than 15 minutes. Start with a single GI airgun and add the second GI airgun after five minutes.

(f) Monitor the full 180-dB zone for cetaceans and the full 190-dB zone for pinnipeds during ramp-up. If the observer sees a marine mammal within or about to enter the relevant zone, then the *Langseth* will implement a course/speed alteration or shutdown as though the full array (both GI airguns) were operational. Initiation of ramp-up procedures requires that the observers can effectively monitor the full exclusion zones described in Condition 6(b).

6. RECORDING VISUAL DETECTIONS

(g) Visual observers must record the following information when they have sighted a marine mammal:

(i) Species, group size, age/size/sex categories (if determinable), behavior when first sighted and after initial sighting, heading (if consistent), bearing and distance from seismic vessel, sighting cue, apparent reaction to the airguns or vessel (*e.g.*, none, avoidance, approach, paralleling, etc., and including responses to ramp-up), and behavioral pace; and

(ii) Time, location, heading, speed, activity of the vessel (including number of airguns operating and whether in state of ramp-up or shut-down), Beaufort sea state and wind force, visibility, and sun glare; and

(iii) The data listed under 6(g)(ii) at the start and end of each observation watch and during a watch whenever there is a change in one or more of the variables.

6. PASSIVE ACOUSTIC MONITORING

(h) Utilize the passive acoustic monitoring system (system), to the maximum extent practicable, to detect and allow some localization of marine mammals around the *Langseth* during all airgun operations and during most periods when airguns are not operating.

(i) One visual observer and/or bioacoustician will monitor the system at all times in shifts no longer than six hours.

(ii) A bioacoustician shall design and set up the system and be present to operate or oversee it. He/she shall be available when technical issues arise during the survey.

(i) The bioacoustician must record the following when the passive acoustic monitoring system detects an animal:

(i) Notify the visual observers immediately of a vocalizing marine mammal so that the *Langseth* can initiate a power-down or shut-down, if required;

(ii) Enter the information regarding the vocalization into a database. This includes:
- an acoustic encounter identification number;
- any linkages to a visual sighting;
- the date/time of the first and last signal detected;
- the position, water depth when first detected, and bearing if determinable,
- the species or species group (*e.g.*, unidentified dolphin, sperm whale);
- the types and nature of sounds heard (*e.g.*, clicks, continuous, sporadic, whistles, creaks, burst pulses, strength of signal, etc.); and
- any other notable information.

6. SPEED OR COURSE ALTERATION

(j) Alter speed or course during seismic operations if a marine mammal, based on its position and relative motion, appears likely to enter the relevant exclusion zone. If speed or course alteration is not safe or practicable, or if after alteration the marine mammal still appears likely to enter the exclusion zone, the Holder of this Authorization will implement further mitigation measures, such as a shutdown.

6. SHUTDOWN PROCEDURES

(k) Shutdown the airgun(s) if a visual observer detects a marine mammal within, approaching, or entering the relevant exclusion zones (as defined in Table 2, attached). A shutdown means that the *Langseth* turns off each operating airgun.

6. RESUMING AIRGUN OPERATIONS AFTER A SHUTDOWN

(l) Following a shutdown, the *Langseth* shall not resume airgun activity until the visual observer has seen the marine mammal(s) exiting the relevant exclusion zone and the animal is not likely to return or the observer has not seen the animal within the relevant exclusion zone for 15 minutes for species with shorter dive times (*i.e.*, small odontocetes and pinnipeds) or 30 minutes for species with longer dive durations (*i.e.*, mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, killer, and beaked whales).

(m) Following shut-down and subsequent animal departure, the *Langseth* may resume airgun operations following ramp-up procedures described in Conditions 6(e) and 6(f).

6. SURVEY OPERATIONS AT NIGHT

(n) The *Langseth* may continue marine geophysical surveys into night and low-light hours if the Holder of the Authorization initiates these segment(s) of the survey when the observers can view and effectively monitor the full relevant exclusion zones.

(o) This Authorization does not permit the Holder of this Authorization to initiate airgun array operations from a shut-down position at night or during low-light hours (such as in dense fog or heavy rain) when the visual observers cannot view and effectively monitor the full relevant exclusion zones.

(p) To the maximum extent practicable, the Holder of this Authorization should schedule seismic operations (*i.e.*, shooting the airguns) during daylight hours.

7. REPORTING REQUIREMENTS

This Authorization requires the Holder of this Authorization to:

(a) Submit a draft report on all activities and monitoring results to the Office of Protected Resources, National Marine Fisheries Service, within 90 days of the completion of the *Langseth*'s central Pacific Ocean cruise. This report must contain and summarize the following information:

(i) Dates, times, locations, heading, speed, weather, sea conditions (including Beaufort sea state and wind force), and associated activities during all seismic operations and marine mammal sightings;

(ii) Species, number, location, distance from the vessel, and behavior of any marine mammals, as well as associated seismic activity (number of shutdowns), observed throughout all monitoring activities.

(iii) An estimate of the number (by species) of marine mammals with known exposures to the seismic activity (based on visual observation) at received levels greater than or equal to 160 dB re: 1 μPa and/or 180 dB re 1 μPa for cetaceans and 190 dB re 1 μPa for pinnipeds and a discussion of any specific behaviors those individuals exhibited.

(iv) An estimate of the number (by species) of marine mammals with estimated exposures

(based on modeling results) to the seismic activity at received levels greater than or equal to 160 dB re: 1 μPa and/or 180 dB re 1 μPa for cetaceans and 190 dB re 1 μPa for pinnipeds with a discussion of the nature of the probable consequences of that exposure on the individuals.

(v) A description of the implementation and effectiveness of the: (A) terms and conditions of the Biological Opinion's Incidental Take Statement (attached); and (B) mitigation measures of the Incidental Harassment Authorization. For the Biological Opinion, the report will confirm the implementation of each Term and Condition, as well as any conservation recommendations, and describe their effectiveness, for minimizing the adverse effects of the action on Endangered Species Act listed marine mammals.

(b) Submit a final report to the Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, within 30 days after receiving comments from us on the draft report. If we decide that the draft report needs no comments, we will consider the draft report to be the final report.

8. REPORTING PROHIBITED TAKE

In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by this Authorization, such as an injury (Level A harassment), serious injury or mortality (*e.g.*, ship-strike, gear interaction, and/or entanglement), the Observatory shall immediately cease the specified activities and immediately report the incident to the Acting Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to Jolie.Harrison@noaa.gov and ITP.Cody@noaa.gov and the Pacific Islands Regional Stranding Coordinator at 808-944-2269 (David.Schofield@noaa.gov).

The report must include the following information:

- Time, date, and location (latitude/longitude) of the incident;
- Name and type of vessel involved;
- Vessel's speed during and leading up to the incident;
- Description of the incident;
- Status of all sound source use in the 24 hours preceding the incident;
- Water depth;
- Environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, and visibility);
- Description of all marine mammal observations in the 24 hours preceding the incident;
- Species identification or description of the animal(s) involved;
- Fate of the animal(s); and
- Photographs or video footage of the animal(s) (if equipment is available).

The Observatory will not resume their activities until we are able to review the circumstances of the prohibited take. We will work with the Observatory to determine what is necessary to minimize the likelihood of further prohibited take and ensure Marine Mammal Protection Act compliance. The Observatory may not resume their activities until we notify them by letter, email, or telephone.

9. **Reporting an Injured or Dead Marine Mammal with an Unknown Cause of Death**

In the event that the Observatory discovers an injured or dead marine mammal, and the lead visual observer determines that the cause of the injury or death is unknown and the death is relatively recent (*i.e.*, in less than a moderate state of decomposition as described in the next paragraph), the Observatory will immediately report the incident to the Acting Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to Jolie.Harrison@noaa.gov and ITP.Cody@noaa.gov and the Pacific Islands Regional Stranding Coordinator at 808-944-2269 (David.Schofield@noaa.gov).

The report must include the same information identified in the Condition 8. Activities may continue while we review the circumstances of the incident. We will work with the Observatory to determine whether modifications in the activities are appropriate.

10. **Reporting an Injured or Dead Marine Mammal not Related to the Activities**

In the event that the Observatory discovers an injured or dead marine mammal, and the lead visual observer determines that the injury or death is not associated with or related to the activities authorized in the Authorization (*e.g.*, previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), the Observatory will report the incident to the Acting Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to Jolie.Harrison@noaa.gov and ITP.Cody@noaa.gov and the Pacific Islands Regional Stranding Coordinator at 808-944-2269 (David.Schofield@noaa.gov), within 24 hours of the discovery. The Observatory will provide photographs or video footage (if available) or other documentation of the stranded animal sighting to us.

11. **Endangered Species Act Biological Opinion and Incidental Take Statement**

The Observatory is required to comply with the Terms and Conditions of the Incidental Take Statement corresponding to the Endangered Species Act Biological Opinion issued to both the National Science Foundation and the National Marine Fisheries Service's Office of Protected Resources, Permits and Conservation Division (attached).

A copy of this Authorization and the Incidental Take Statement must be in the possession of all contractors and protected species observers operating under the authority of this Incidental Harassment Authorization.

Helen M. Golde
Acting Director,
Office of Protected Resources
National Marine Fisheries Service

4/30/12
Date

Attachments

Attachment

Table 1. Authorized Level B take for the Observatory's seismic survey in the central Pacific Ocean, during May through June, 2012.

Species	Requested Take Authorization
Bryde's whale	4
Sperm whale	8
Dwarf sperm whale	18
Cuvier's beaked whale	16
Longman's beaked whale	14
Mesoplodon spp.	4
Rough-toothed dolphin	13
Bottlenose dolphin	12
Pantropical spotted dolphin	279
Spinner dolphin	425
Striped dolphin	46
Fraser's dolphin	182
Risso's dolphin	14
Melon-headed whale	101
False killer whale	9
Short-finned pilot whale	24

Table 2. Distances to which sound levels ≥ 160, 180, 190 dB re: 1 μPa (rms) could be received in deep water during the proposed seismic survey in the central Pacific Ocean, May through June, 2012.

Source and Volume	Tow Depth (m)	Water Depth (m)	Predicted RMS Radii Distances (m)		
			160 dB	180 dB	190 dB
Two GI airguns (105 in^3)	3	Deep (> 1,000)	670	70	20

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the "take" of endangered and threatened species, respectively, without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of sections 7(b)(4) and 7(o)(2), taking that is incidental and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are nondiscretionary, and must be undertaken by the Lamont-Doherty Earth Observatory and NMFS' Office of Protected Resources Permits and Conservation Division so that they become binding conditions for the exemption in section 7(o)(2) to apply. Section 7(b)(4) of the ESA requires that when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA and the proposed action may incidentally take individuals of listed species, NMFS will issue a statement that specifies the impact of any incidental taking of endangered or threatened species. To minimize such impacts, reasonable and prudent measures, and term and conditions to implement the measures, must be provided. Only incidental take resulting from the agency actions and any specified reasonable and prudent measures and terms and conditions identified in the incidental take statement are exempt from the taking prohibition of section 9(a), pursuant to section 7(o) of the ESA.

Section 7(b)(4)(C) of the ESA specifies that in order to provide an incidental take statement for an endangered or threatened species of marine mammal, the taking must be authorized under section 101(a)(5) of the MMPA. One of the federal actions considered in this Opinion is NMFS' Permits and Conservation Division's proposed authorization of the incidental taking of sperm whales pursuant to section 101(a)(5)(D) of the Marine Mammal Protection Act. With this authorization, the incidental take of sperm whales is exempt from the taking prohibition of section 9(a), pursuant to section 7(o) of the ESA.

NMFS anticipates the incidental harassment of sperm whales (*Physeter macrocephalus*), as well as green sea turtles (*Chelonia mydas*), hawksbill sea turtles (*Eretmochelys imbricata*), olive ridley (*Lepidochelys olivacea*) and leatherback sea turtles (*Dermochelys coriacea*) during the proposed survey activities.

Amount or Extent of Take

NMFS anticipates the proposed action to conduct a seismic survey in the central North Pacific Ocean might result in the incidental take of listed species. Sperm whales as well as green, hawksbill, olive ridley and leatherback sea turtles may be exposed to seismic sounds at received levels above 160 dB re 1 μPa. The proposed action might take 8 sperm whales by exposing

individuals to received levels greater than 160 dB re 1 μPa. These estimates are based on the best available information on whale densities in the area to be ensonified above 160 dB re 1 μPa during the proposed activities. This incidental take would result from exposure to acoustic energy during seismic operations, would be in the form of harassment, and is not expected to result in the death or injury of any individuals that are exposed.

We also expect the proposed action might also take individual green, hawksbill, olive ridley and leatherback sea turtles as a result of exposure to acoustic energy during seismic surveying, and we expect this take would also be in the form of harassment, with no death or injury expected for individuals exposed. Harassment of these sea turtles is expected to occur at received levels of seismic sounds above 166 dB re 1 μPa. Because density estimates of sea turtles in the survey area are unknown, we estimate take as all the sea turtles that occur within the geographical extent of sound above 166 dB re 1 μPa during the proposed activities. These turtles could be of all ages and life stages in the survey area.

Harassment of sperm whales exposed to seismic surveys at levels less than 160 dB re 1 μPa, or of green, hawksbill, olive ridley or leatherback sea turtles at levels less than 166 dB re 1 μPa, is not expected. We do not expect listed species to be taken by operation of the multibeam echosounder, the sub-bottom profiler or the acoustic Doppler current profiler. However, if overt adverse reactions (for example, dive reactions, or rapid departures from the area) by listed whales or listed sea turtles are observed outside of the 160 dB re 1 μPa, or 166 dB re 1 μPa isopleths, respectively, while airguns are operating, incidental take may be exceeded. Additionally, if such reactions by listed species are observed while the multibeam echosounder, the sub-bottom profiler or the acoustic Doppler current profiler are in operation, this may constitute take that is not covered in this Incidental Take Statement. If such overt adverse reactions are observed the Lamont-Doherty Earth Observatory and NMFS' Permits and Conservation Division must contact the Endangered Species Act Interagency Cooperation Division within 48 hours of the incident at 301-427-8403 and/or by email to kellie.foster-taylor@noaa.gov to determine whether reinitation of consultation is required.

Any incidental take of sperm whales, or green, hawksbill, olive ridley and leatherback sea turtles is restricted to the permitted action as proposed. If the actual incidental take meets or exceeds the predicted level, the Lamont-Doherty Earth Observatory and NMFS' Permits and Conservation Division must reinitiate consultation. All anticipated takes would be "takes by harassment", as described previously, involving temporary changes in behavior.

Reasonable and Prudent Measures

NMFS believes the reasonable and prudent measure described below is necessary and appropriate to minimize the amount of incidental take of listed sperm whales and green, hawksbill, olive ridley and leatherback sea turtles resulting from the proposed action. This measure is non-discretionary and must be a binding condition of the Lamont-Doherty Earth Observatory and NMFS' authorization for the exemption in section 7(o)(2) to apply. If the Lamont-Doherty Earth Observatory or NMFS fail to ensure compliance with this term and conditions and its implementing terms and conditions, the protective coverage of section 7(o)(2) may lapse.

The Lamont-Doherty Earth Observatory must implement and monitor the effectiveness of mitigation measures incorporated as part of the proposed authorization of the incidental taking of sperm whales pursuant to section 101(a)(5)(D) of the MMPA and as specified below for sea turtles.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, NMFS' Permits and Conservation Division and the Lamont-Doherty Earth Observatory must comply with the following terms and conditions, which implement the Reasonable and Prudent Measure described above. These terms and conditions are non-discretionary.

To implement the Reasonable and Prudent Measure, Lamont-Doherty Earth Observatory and NMFS' Permits and Conservation Division shall ensure that:

Mitigation and Monitoring Requirements

1. Visual Observers
   The Lamont-Doherty Earth Observatory shall:

   (a) utilize two, National Marine Fisheries Service-qualified, vessel-based Protected Species Visual Observers (visual observers) to watch for and monitor marine mammals and sea turtles near the seismic source vessel during daytime airgun operations (from civil twilight-dawn to civil twilight-dusk) and before and during start-ups of airguns day or night.

   (i) At least one visual observer will be on watch during meal times and restroom breaks.

   (ii) Observer shifts will last no longer than four hours at a time.

   (iii) Visual observers will also conduct monitoring while the Langseth crew deploy and recover the airgun array and streamers from the water.

   (iv) When feasible, visual observers will conduct observations during daytime periods when the seismic system is not operating for comparison of sighting rates and behavioral reactions during, between, and after airgun operations.

   (v) The *Langseth*'s vessel crew will also assist in detecting marine mammals and sea turtles, when practicable. Visual observers will have access to reticle binoculars (7x50 Fujinon), big-eye binoculars (25x150), and night vision devices.

2. Exclusion Zones
   The Lamont-Doherty Earth Observatory shall:

(a) Establish a 180-dB exclusion zone (EZ) for cetaceans and sea turtles before starting the two GI airgun array (90 in^3 or 210 in^3 in total volume). Observers will use the predicted radius distance for the 180-dB EZ for cetaceans and sea turtles.

3. Visual Monitoring at the Start of Airgun Operations
The Lamont-Doherty Earth Observatory shall:

(a) Monitor the entire extent of the EZ for at least 30 minutes (day or night) prior to the ramp-up of airgun operations or after an extended shutdown (*i.e.*, 15 minutes) for marine mammals and 15 minutes for sea turtles.

(b) Delay airgun operations if the visual observer sees a cetacean or sea turtle within the 180-dB EZ for cetaceans until the animal(s) has left the area.

(i) If the visual observer sees a marine mammal that surfaces, then dives below the surface, the observer shall wait 30 minutes. If the observer sees no marine mammals during that time, he/she should assume that the animal has moved beyond the 180-dB EZ for cetaceans.

(ii) If for any reason the visual observer cannot see the full 180-dB EZ for cetaceans for the entire 30 minutes or 15 minutes for sea turtles (*i.e.*, rough seas, fog, darkness), or if marine mammals or sea turtles are near, approaching, or within zone, the *Langseth* may not resume airgun operations.

(iii) If one airgun is already running at a source level of at least 180 dB re: 1 μPa, the *Langseth* may start the second gun without observing relevant EZ for 15 or 30 minutes for sea turtles and marine mammals, respectively, provided that the observers have not seen any sea turtles or mammals near the relevant EZ (in accordance with Condition 2(a)).

4. Ramp-Up Procedures
The Lamont-Doherty Earth Observatory shall:

(a) Implement a "ramp-up" procedure when starting the airguns at the beginning of seismic operations or anytime after the entire array has been shut down for more than 15 minutes. Start with a single GI airgun and add the second GI airgun after five minutes.

(b) Monitor the full 180-dB zone for cetaceans and sea turtles during ramp-up. If the observer sees a marine mammal or sea turtle within or about to enter the relevant zone, then the *Langseth* will implement a course/speed alteration or shutdown as though the full array (both GI airguns) were operational. Initiation of ramp-up procedures requires that the observers can effectively monitor the full exclusion zones described in Condition 2(a).

5. Recording Visual Detections
The Lamont-Doherty Earth Observatory shall:

(a) Visual observers must record the following information when they have sighted a marine mammal or sea turtle:

(i) Species, group size, age/size/sex categories (if determinable), behavior when first sighted and after initial sighting, heading (if consistent), bearing and distance from seismic vessel, sighting cue, apparent reaction to the airguns or vessel (*e.g.*, none, avoidance, approach, paralleling, etc., and including responses to ramp-up), and behavioral pace; and

(ii) Time, location, heading, speed, activity of the vessel (including number of airguns operating and whether in state of ramp-up or shut-down), Beaufort sea state and wind force, visibility, and sun glare; and

(iii)The data listed under 5(a)(ii) at the start and end of each observation watch and during a watch whenever there is a change in one or more of the variables.

6. Speed or Course Alteration
The Lamont-Doherty Earth Observatory shall:

(a) Alter speed or course during seismic operations if a marine mammal or sea turtle, based on its position and relative motion, appears likely to enter the relevant exclusion zone. If speed or course alteration is not safe or practicable, or if after alteration the animal still appears likely to enter the exclusion zone, further mitigation measures shall be implemented, such as a shutdown.

7. Shutdown Procedures
The Lamont-Doherty Earth Observatory shall:

(a) Shut down the airgun(s) if a visual observer detects a marine mammal or sea turtle within, approaching, or entering the relevant exclusion zones. A shutdown means that the *Langseth* turns off each operating airgun.

8. Resuming Airgun Operations After a Shutdown
The Lamont-Doherty Earth Observatory shall:

(a) Following a shutdown, the *Langseth* shall not resume airgun activity until the visual observer has seen the marine mammal or sea turtles exiting the relevant exclusion zone and the animal is not likely to return or the observer has not seen the animal within the relevant exclusion zone for 15 minutes for species with shorter dive times (*i.e.*, small odontocetes and pinnipeds) or 30 minutes for species with longer dive durations (*i.e.*, mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, killer, and beaked whales).

(b) Following shut-down and subsequent animal departure, the *Langseth* may resume airgun operations following ramp-up procedures described in Conditions 4(a) and 4(b).

9. Survey Operations at Night
The Lamont-Doherty Earth Observatory shall:

(a) The *Langseth* may continue marine geophysical surveys into night and low-light hours if these segment(s) of the survey when the observers can view and effectively monitor the full relevant exclusion zones.

(b) Initiation of airgun array operations from a shut-down position at night or during low-light hours (such as in dense fog or heavy rain) when the visual observers cannot view and effectively monitor the full relevant exclusion zones is prohibited.

(c) To the maximum extent practicable, seismic operations (*i.e.*, shooting the airguns) should be scheduled during daylight hours.

Reporting Requirements

1. The Lamont-Doherty Earth Observatory shall:

(a) Submit a draft report on all activities and monitoring results to the Office of Protected Resources, National Marine Fisheries Service, within 90 days of the completion of the *Langseth*'s central Pacific Ocean cruise. This report must contain and summarize the following information:

(i) Dates, times, locations, heading, speed, weather, sea conditions (including Beaufort sea state and wind force), and associated activities during all seismic operations and marine mammal sightings;

(ii) Species, number, location, distance from the vessel, and behavior of any marine mammals, as well as associated seismic activity (number of shutdowns), observed throughout all monitoring activities.

(iii) An estimate of the number (by species) of marine mammals and sea turtles with known exposures to the seismic activity (based on visual observation) at received levels greater than or equal to 160 dB re: 1 μPa and/or 180 dB re 1 μPa for cetaceans and a discussion of any specific behaviors those individuals exhibited.

(iv) An estimate of the number (by species) of marine mammals with estimated exposures (based on modeling results) to the seismic activity at received levels greater than or equal to 160 dB re: 1 μPa and/or 180 dB re 1 μPa for cetaceans with a discussion of the nature of the probable consequences of that exposure on the individuals.

(v) A description of the implementation and effectiveness of the: (A) terms and conditions of the Biological Opinion's Incidental Take Statement; and (B) mitigation measures of the Incidental Harassment Authorization. For the Biological Opinion, the report will confirm the implementation of each Term and Condition, as well as any conservation recommendations, and describe their effectiveness, for minimizing the adverse effects of the action on Endangered Species Act listed marine mammals.

(b) Submit a final report to the Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, within 30 days after receiving comments from NMFS on the draft report. If the draft report needs no comments, NMFS will consider the draft report to be the final report.

2. Reporting Prohibited Take
   The Lamont-Doherty Earth Observatory shall:

In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by this Authorization, such as an injury (Level A harassment), serious injury or mortality (*e.g*., ship-strike, gear interaction, and/or entanglement), the Lamont Doherty Earth Observatory shall immediately cease the specified activities and immediately report the incident to the Acting Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to Jolie.Harrison@noaa.gov and ITP.Cody@noaa.gov and the Pacific Islands Regional Stranding Coordinator at 808-944-2269 (David.Schofield@noaa.gov).

The report must include the following information:

- Time, date, and location (latitude/longitude) of the incident;
- Name and type of vessel involved;
- Vessel's speed during and leading up to the incident;
- Description of the incident;
- Status of all sound source use in the 24 hours preceding the incident;
- Water depth;
- Environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, and visibility);
- Description of all marine mammal observations in the 24 hours preceding the incident;
- Species identification or description of the animal(s) involved;
- Fate of the animal(s); and
- Photographs or video footage of the animal(s) (if equipment is available).

The Lamont Doherty Earth Observatory will not resume their activities until NMFS reviews the circumstances of the prohibited take. NMFS with L-DEO to determine what is necessary to minimize the likelihood of further prohibited take and ensure Marine Mammal Protection Act compliance. The Lamont Doherty Earth Observatory may not resume their activities we notify them by letter, email, or telephone.

3. Reporting an Injured or Dead Marine Mammal with an Unknown Cause of Death

In the event that the Lamont Doherty Earth Observatory discovers an injured or dead marine mammal, and the lead visual observer determines that the cause of the injury or death is unknown and the death is relatively recent (*i.e*., in less than a moderate state of decomposition as described in the next paragraph), the Lamont Doherty Earth Observatory will immediately report the incident to the Acting Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to Jolie.Harrison@noaa.gov and ITP.Cody@noaa.gov and the Pacific Islands Regional Stranding Coordinator at 808-944-2269 (David.Schofield@noaa.gov).

The report must include the same information identified in the Reporting Prohibited Take Condition above. Activities may continue while NMFS reviews the circumstances of the

incident. The Permits and Conservation Division will work with the Lamont Doherty Earth Observatory to determine whether modifications in the activities are appropriate.

4. Reporting an Injured or Dead Marine Mammal not Related to the Activities

   In the event that the Lamont Doherty Earth Observatory discovers an injured or dead marine mammal, and the lead visual observer determines that the injury or death is not associated with or related to the activities authorized in the Authorization (*e.g.*, previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), the Lamont Doherty Earth Observatory will report the incident to the Acting Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to Jolie.Harrison@noaa.gov and ITP.Cody@noaa.gov and the Pacific Islands Regional Stranding Coordinator at 808-944-2269 (David.Schofield@noaa.gov), within 24 hours of the discovery. The Lamont Doherty Earth Observatory will provide photographs or video footage (if available) or other documentation of the stranded animal sighting to the Permits and Conservation Division.

APPENDIX B: Basic Summary Data Form

BASIC DATA FORM				
LDEO Project Number		MGL1208		
Seismic Contractor		Lamont-Doherty Earth Observatory of Columbia University		
Area Surveyed During Reporting Period		Line Islands in the central Pacific Ocean		
		Approximately between 0.5°S to 8°N and 156 to 162°W		
Survey Type		Coring / Low-energy seismic		
Vessel and/or Rig Name		*R/V Marcus G. Langseth*		
Permit Number		IHA granted by NMFS on 30 April 2012		
Location / Distance of Airgun Deployment		78 meters aft of PSO tower		
Water Depth	**Min**	~2000m		
	Max	~4500m		
Dates of project		30 April 2012	THROUGH	26 May 2012
Total time airguns operating – all power levels:		46 hours		
Time airguns operating at full power on survey lines:		43 hours 42 minutes		
Time airguns operating at full power on line changes:		43 minutes		
Amount of time mitigation gun (40 in³) operations:		None		
Amount of time in ramp-up:		11 minutes		
Number daytime ramp-ups:		2		
Number of night time ramp-ups:		0		
Number of ramp-ups from mitigation source:		0		
Amount of time conducted in airgun testing:		1 hour 24 minutes		
Duration of visual observations:		331 hours 25 minute		
Duration of observations while airguns firing:		23 hours 47 minutes		
Duration of observation during airgun silence:		307 hours 38 minutes		
Lead Protected Species Observer:		Heidi Ingram		
Protected Species Observers:		Emily Ellis		
		Tatiana Moreno		
Number of Marine Mammals Visually Detected:		4		
Number of Sea Turtles detected:		0		
List Mitigation Actions (eg. Power-downs, shut-downs, ramp-up delays)		None		
Duration of operational downtime due to mitigation:		None		

APPENDIX C: Summary of visual detections of protected species during the Line Islands low-energy marine geophysical survey.

Record No.	Date	Time (UTC)	Species	Group Size	Vessel Position	Source Activity Initial Detection	Movement/ Behaviour		CPA Source / Source Activity	Mitigation Action	Comments
1	1-May	16:31	Unidentifiable dolphin	3	21.20697°N 158.01033°W	Not firing	TV	PO NS	600m Not Firing	None	Near Oahu, all seismic gear on board.
2	9-May	23:47	Sperm whale	2	02.55620°N 158.75493°W	Not firing	AV	DF BV	1150m Not firing	None	All seismic gear on board.
3	10-May	17:05	Unidentifiable dolphin	25	01.21587°N 157.22365°W	Firing Full Power	PV/OD	NS	2000m Full power	None	Unidentifiable small blackfish.
4	10-May	23:24	Unidentifiable dolphin	50+	00.79283°N 156.79512°W	Firing Full Power	PV/SD	PO	5664m Full power	None	

APPENDIX D: Species of birds and other wildlife observed during the Line Islands low-energy marine geophysical survey.

Common Name	Family	Genus	Species	Approximate Number of Individuals Observed	Approximate Number of Days Species Was Observed
Brown Booby	Pelicaniformidae	*Sula*	*leucogaster*	4	4
Masked Booby	Pelecaniformidae	*Sula*	*dactylatra*	105	19
Red-footed Booby	Pelecaniformidae	*Sula*	*sula*	112	16
White Tern	Laridae	*Gygis*	*alba*	176	16
Sooty Tern	Laridae	*Sterna*	*fuscata*	514	13
Red-tailed Tropicbird	Phaethontidae	*Phaethon*	*rubricauda*	38	20
White-tailed Tropicbird	Phaethontidae	*Phaethon*	*lepturus*	2	2
Christmas Shearwater	Procellariidae	*Puffinus*	*nativitatis*	194	10
Short-tailed Shearwater	Procellariidae	*Puffinus*	*tenuirostris*	4	3
Lesser Frigatebird	Fregatidae	*Fregata*	*ariel*	3	1
Great Frigatebird	Fregatidae	*Fregata*	*minor*	3	2
Grey Noddy	Laridae	*Procelsterna*	*cerulea*	2	3
Pheonix Petrel	Procellariidae	*Pterodroma*	*Alba*	2	2
Stejneger's Petrel	Procellariidae	*Pterodroma*	*longirostris*	1	1
White-throated Storm-petrel	Hydrobatidae	*Nesofregetta*	*fuliginosa*	6	3
Black-footed Albatross	Diomedeidae	*Diomedea*	*nigripes*	1	1
Unidentified Booby	Pelecaniformidae			1	1
Unidentified Tern	Laridae			81	6
Unidentified Shearwater	Procellariidae			142	14
Unidentified Frigatebird	Fregatidae			11	4
Unidentified Petrel	Procellariidae			9	6

Common Name	Family	Genus	Species	Approximate Number of Individuals Observed	Approximate Number of Days Species Was Observed
Flying Fish	Exocoetidae			13,345+	23
Puffer Fish	Tetraodontidae			1	1
Mahi Mahi	Coryphaenidae	*Coryphenus*	*hippurus*	2	2
Manta Ray	Mobulidae	*Manta*		1	1
Whale Shark	Rhincodontidae	*Rhincodon*	*Typus*	1	1
Remora	Echeneidae	*Remora*	*remora*	2	1
Unidentified Shark				3	3
Unidentified Fish				4	4