Draft
Request by the National Science Foundation for an Incidental Harassment Authorization to Allow the Incidental Take of Marine Mammals during a Marine Geophysical Survey by the R/VIB Nathaniel B. Palmer in the Scotia Sea and South Atlantic Ocean

NSF-Funded Research Project: Role of the Central Scotia Sea Floor and North Scotia Ridge in the Onset and Development of the Antarctic Circumpolar Current

Period of Performance for the Proposed Action:
30-Day Cruise in 2014

Submitted to:
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INTRODUCTION

In support of the United States Antarctic Program (USAP), the National Science Foundation (NSF) proposes to perform marine-based studies, including evaluation of the lithosphere adjacent to and beneath the Scotia Sea and South Atlantic Ocean, as shown in Figure 1. Two areas are proposed for study: the South Georgia (SG) microcontinent and the seafloor of the eastern portion of the central Scotia Sea (CSS), as shown in Figure 2.

Pursuant to 50 C.F.R. § 216.104, items required to be addressed in a Submission of Requests for an Incidental Harassment Authorization (IHA) are set forth below. Table 1 provides a summary of these requirements and a cross-reference to supplemental information that is available in related environmental documents, including the Initial Environmental Evaluation (IEE)/Environmental Assessment (EA) to conduct marine-based studies of the Scotia Sea and the Final Programmatic Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) (hereafter called PEIS) for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey (http://www.nsf.gov/geo/oce/envcomp/index.jsp).

Descriptions of the marine mammal species that may be found in the proposed study area are derived primarily from information contained in the PEIS supplemented by scientific research surveys and observations. In addition, a significant portion of the analysis of the effects to marine mammals was based on the PEIS and information contained in the Environmental Analysis of a Marine Geophysical Survey by the R/V Marcus G. Langseth on the mid-Atlantic Ridge, April–May 2013, prepared by LGL Ltd., environmental research associates on behalf of Lamont-Doherty Earth Observatory and the National Science Foundation, Revised 4 April 2013 (LGL Report TA8220-1).

Figure 1. Scotia Sea and South Atlantic Ocean Study Area

= Study Area

Figure 2. Scotia Sea Proposed Cruise Track

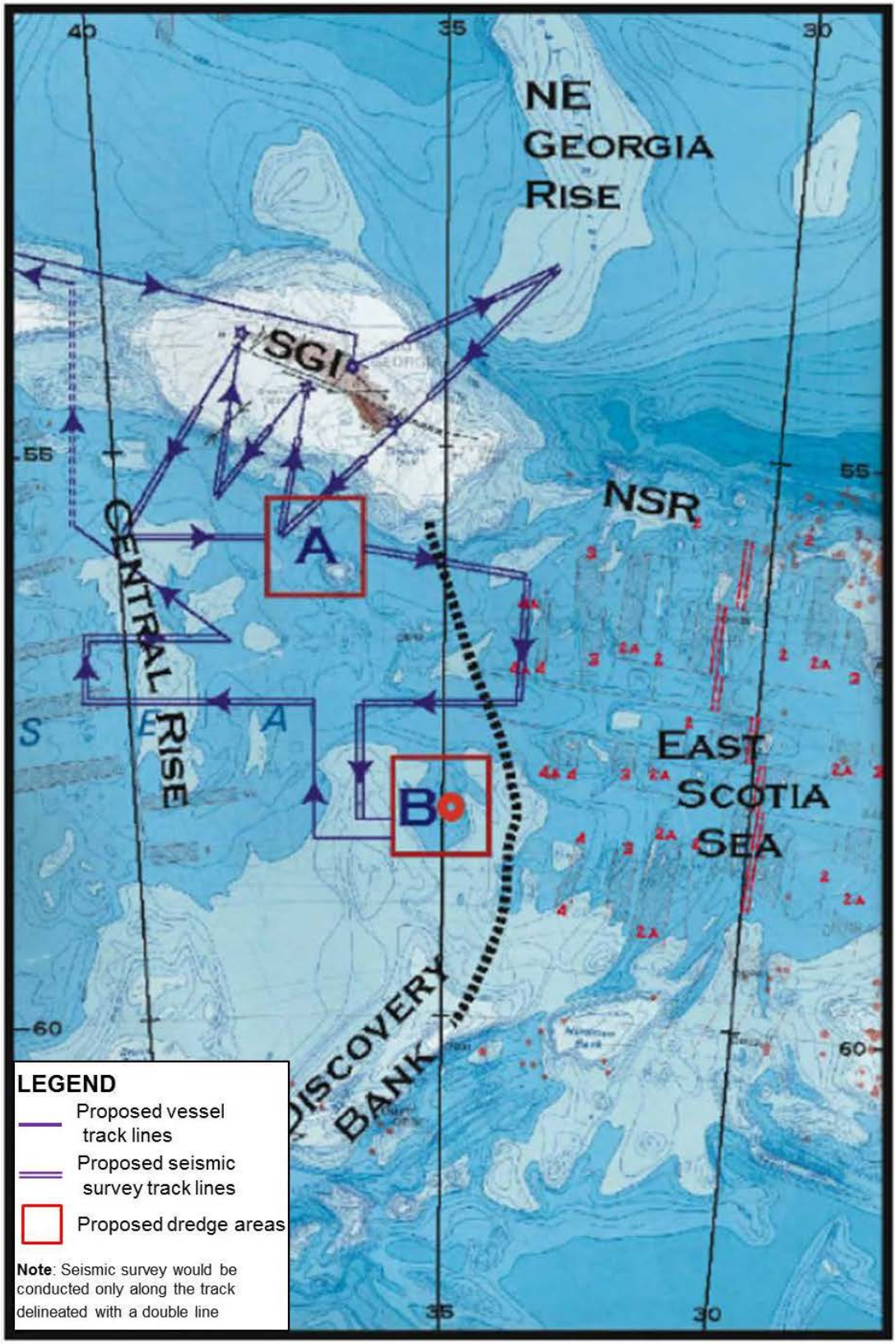


Table 1. IHA Application and IEE/EA/PEIS Information Crosswalk Table

IHA Application Section	NOAA Fisheries Requirement	Related IEE/EA and PEIS Documentation
1.0	A detailed description of the specific activity or class of activities that can be expected to result in incidental taking of marine mammals	Section 2.1 of the IEE/EA provides a description of the seismic survey activities (seismic survey with low-energy acoustic source, sediment, and water sampling).
2.0	The date(s) and duration of such activity and the specific geographical region where it will occur	Section 3.0 of the IEE/EA provides a description of the study areas and dates of proposed activities (30-day cruise in 2014).
3.0	The species and numbers of marine mammals likely to be found within the activity area	Tables 12 and 13 of the IEE/EA provide detailed estimates of the number of animals (Note: estimates based on historical sightings; comprehensive population density data for most marine mammal species in the Scotia Sea and South Atlantic Ocean is not available).
4.0	A description of the status, distribution, and seasonal distribution (when applicable) of the affected species or stocks of marine mammals likely to be affected by such activities	Section 3.3.6 of the IEE/EA provides a description of the marine mammals in the study area, their migration and breeding patterns (Note: information is based on historical sightings; comprehensive migration and breeding pattern data for most marine mammal species in the South Atlantic Ocean is not available).
5.0	The type of incidental taking authorization that is being requested (i.e., takes by harassment only; takes by harassment, injury and/or death) and the method of incidental taking	Level B harassment.
6.0	By age, sex, and reproductive condition (if possible), the number of marine mammals (by species) that may be taken by each type of taking identified in paragraph (a)(5) of this section, and the number of times such takings by each type of taking are likely to occur	Section 5.1.6 of the IEE/EA provides a description of the number of marine mammals expected to be encountered in the study area (detailed data characterizing the age, sex, and reproductive condition for marine mammals in the Scotia Sea and South Atlantic Ocean is not available).

Table 1. IHA Application and IEE/EA/PEIS Information Crosswalk Table

IHA Application Section	NOAA Fisheries Requirement	Related IEE/EA and PEIS Documentation
7.0	The anticipated impact of the activity upon the species or stock	Section 4.1 of the IEE/EA describes the impacts of the proposed survey activities to the species expected to be present in the Scotia Sea; Sections 3.6, 3.7, and 3.8 of the PEIS describe the impacts of low-energy seismic surveys to marine mammals.
8.0	The anticipated impact of the activity on the availability of the species or stocks of marine mammals for subsistence uses	No impact; species or stocks of marine mammals found in the proposed study areas are not used for subsistence purposes.
9.0	The anticipated impact of the activity upon the habitat of the marine mammal populations and the likelihood of restoration of the affected habitat	No impacts to marine mammal habitats are expected.
10.0	The anticipated impact of the loss or modification of the habitat on the marine mammal populations involved	No impacts to marine mammal habitats are expected.
11.0	The availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks, their habitat, and on their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance	Section 4.1 of the IEE/EA summarizes the mitigation measures that will be used during the proposed seismic survey, such as using the smallest airgun array needed to attain research objectives; Section 2.4.2 of the PEIS describes mitigation measures for low-energy acoustic sources; Section 3.2.5 identifies the use of low-energy sources as the preferred alternative.
12.0	Where the proposed activity would take place in or near a traditional Arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammal for Arctic subsistence uses, the applicant must submit either a "plan of cooperation" or information that identifies what measures have been taken and/or will be taken to minimize any adverse effects on the availability of marine mammals for subsistence uses	Not applicable.

Table 1. IHA Application and IEE/EA/PEIS Information Crosswalk Table

IHA Application Section	NOAA Fisheries Requirement	Related IEE/EA and PEIS Documentation
13.0	The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities and suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such activity. Monitoring plans should include a description of the survey techniques that would be used to determine the movement and activity of marine mammals near the activity site(s) including migration and other habitat uses, such as feeding. Guidelines for developing a site-specific monitoring plan may be obtained by writing to the Director, Office of Protected Resources	Section 4.1 of the IEE/EA summarizes the monitoring and mitigation measures that will be used during the proposed seismic survey. Additionally, Section 2.4.2 of the PEIS describes generic mitigation measures for low-energy acoustic sources.
14.0	Suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects	The proposed action will complement Scotia Sea and South Atlantic Ocean oceanographic and geological/geophysical studies, and ongoing development of ice sheet and other ocean models. It will facilitate learning at sea and ashore by students, help to fill important spatial gaps in a lightly sampled region of the world's oceans, provide additional data on marine mammals present in the study areas, and communicate its findings via reports, publications and public outreach.

1.0 DESCRIPTION OF ACTIVITIES

NOAA NMFS Requirement: A detailed description of the specific activity or class of activities that can be expected to result in incidental taking of marine mammals.

The proposed research activities would include: 1) conducting a seismic survey along a 2,950-km track (Figure 2) using a two generator-injector (GI) airgun array (with a 'hot spare') as a low-energy seismic source and a hydrophone streamer, 2) conducting a bathymetric profile survey of the seafloor using transducer-based instruments such as a multibeam sonar and sub-bottom profiler, 3) collecting GPS information through the temporary installation of three continuous Global Navigation Satellite Systems (cGNSS) on the SG microcontinent, and 4) collecting dredge samples around the edges of seamounts or ocean floor with significant magnetic

anomalies to determine the nature and age of bathymetric highs near the eastern edge of the CSS. Incidental takes, if they were to occur, are anticipated to result primarily from the proposed airgun activities.

The survey of the Scotia Sea and South Atlantic Ocean will involve conducting single channel seismic reflection profiling across the northern central Scotia Sea along two lines that cross the seismically active and apparently compressive boundary between the SG microcontinent and the Northeast Georgia Rise. The targeted seismic survey will occur in the unexplored zones of elevated crust in the eastern CSS and are designed to address several critical questions with respect to the tectonic nature of the northern and southern boundaries of the SG microcontinent.

Opening of deep Southern Ocean gateways between Antarctica and South America and between Antarctica and Australia that permitted complete circum-Antarctic circulation, the Antarctic Circumpolar Current (ACC) is not well understood. The ACC may have been critical in the transition from a warm Earth in the early Cenozoic to the subsequent much cooler conditions that persist to the present day. Opening of Drake Passage and the West Scotia Sea likely broke the final barrier formed by the Andes of Tierra del Fuego and the 'Antarctandes' of the Antarctic Peninsula. Once this deep gateway, usually referred to as the Drake Passage gateway (DPG), was created, the strong and persistent mid-latitude winds could generate one of the largest deep currents on Earth at ~135 Sverdrup [A Sverdrup (Sv) is a measure of average flow rate with 1 Sv equal to one million cubic meters of water per second]. This event is widely believed to be closely associated in time with a major, abrupt drop in global temperatures and the rapid expansion of the Antarctic ice sheets at 33-34 million years from the present (Ma), the Eocene-Oligocene boundary.

The events leading to the complete opening of the DPG are very poorly known. The uncertainty is due to the complex tectonic history of the Scotia Sea and its enclosing Scotia Ridge, the eastward-closing, locally emergent submarine ridge that joins the southernmost Andes to the Antarctic Peninsula and deflects the ACC through gaps in its northern limb. The critical keys to this problem are the enigmatic floor of the CSS between the high relief South Georgia (~3000 m) and the lower South Orkney islands (~1,200 m), emergent parts of microcontinental blocks on the North and South Scotia ridges respectively, and the North Scotia Ridge itself.

In 2008, an International Polar Year (IPY) research program was conducted using RVIB Nathaniel B. Palmer (Cruise NBP 0805) that was designed to elucidate the structure and history of this area to help provide the constraints necessary for understanding of the initiation of the critical Drake Passage – Scotia Sea gateway. Underway data and dredged samples produced unexpected results that led to a structurally different view of the CSS and highlighted factors bearing on initiation of the ACC that had not been previously considered.

The results from this study of the CSS are fragmentary due to the limited time available during Cruise NBP 0805. Therefore, the extent, geometry and physiography of a submerged volcanic arc that may have delayed formation of a complete ACC until after the initiation of Antarctic glaciation are poorly defined, with direct dating limited to a few sites. To remedy these deficiencies, thereby further elucidating the role of the CSS in the onset and development of the ACC, the proposed targeted surveying and dredging will determine likely arc constructs in the

eastern CSS. These will be combined with a survey of the margins of the South Georgia microcontinent and installation of three continuous GPS stations on SG that will test the hypothesis regarding the evolution of the North Scotia Ridge, also an impediment to the present ACC.

Vessel Specifications

The USAP research vessel RVIB Nathaniel B. Palmer (NBP) would be used to conduct the proposed research activities. The NBP has a length of 93.9 meters (m), a beam of 18.3 m, and a design draft of 6.8 m. It is equipped with four Caterpillar Model 3608 diesel engines (each rated at 3,300 brake horsepower (BHP) @ 900 rpm) and a water jet azimuthing bow thruster. Electrical power is provided by four Caterpillar 3512, 1,050-kW diesel generators. The maximum speed of the NBP is 14.5 knots and the average speed is 10.1 knots. The cruising speed would be approximately 5 knots (vary between 4 and 6 knots) when the GI airguns are operating. The NPB operating range is 27,780 km (approximately 70 to 75 days).

The NBP also would serve as the platform from which vessel-based protected species observers (PSOs) will watch for marine mammals before and during airgun operations. The characteristics of the vessel that make it suitable for visual monitoring are described in Sections 11 and 13. Other details of the NBP include the following:

Owner:	Edison Chouest Offshore, Inc
Operator:	Edison Chouest Offshore, Inc
Chartered:	NSF
Flag:	United States of America
Date Built:	1992
Gross Tonnage:	6,174 GT
GI Airgun Compressor:	Borsig-LMF Seismic Air Compressors, 1,200 cfm at 2000 psi
Accommodation Capacity:	22 crew and 37 scientists

2.0 DATE, DURATION, AND GEOGRAPHICAL REGION OF ACTIVITIES

NOAA NMFS Requirement: The date(s) and duration of such activity and the specific geographical region where it will occur.

The research would begin in 2014 and span a 30-day period using the USAP research vessel RVIB Nathaniel B. Palmer (NBP). The cruise includes transit time to and from Punta Arenas, Chile (departing approximately on September 20, returning approximately on October 20). The preferred period for the proposed 30-day cruise is September-October.

The proposed marine action would occur in selected regions of the Scotia Sea (located northeast of the Antarctic Peninsula) and South Atlantic Ocean and focus on two areas: 1) between the central rise of the Scotia Sea and the East Scotia Sea, and 2) the far South Atlantic Ocean immediately northeast of SG towards the NE Georgia Rise (both encompassing the region between 53°S and 58°S, and between 33°W and 40°W) as shown on Figure 2. The species present are expected to be the same in both locations. Figure 3 illustrates the general bathymetry

of the study area and the border of the existing SG Maritime Zone (SGMZ) which also represents the Exclusive Economic Zone (EEZ) for the South Georgia and South Sandwich Islands (green line). The red line is the proposed seismic track and the yellow boxes are the locations where dredging would occur.

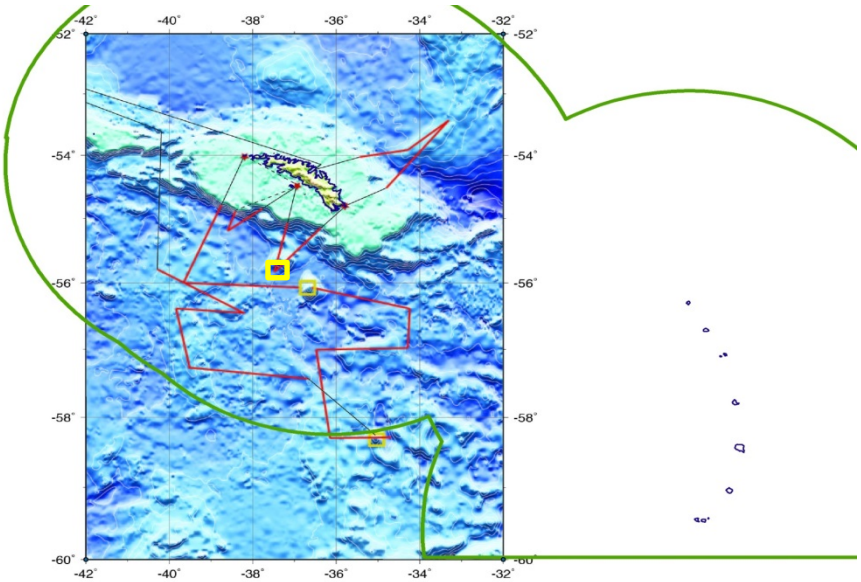


Figure 3. Scotia Sea Bathymetry and South Georgia Maritime Zone Boundary

The seismic surveys would be conducted within an area of approximately 3,953 km^2. This estimate is based on the maximum number of kilometers for the seismic survey (2,950 km) multiplied by the area ensonified around the planned seismic lines (0.675 km x 2). This ensonified area is based on the predicted RMS radii (m) presented in modeling data (Attachment B) assuming 100% use of 2 x 105 in^3 GI airguns in >1,000 m water depths) which was calculated to be 675 m (0.675 km).

Specific details of the activities to be performed are described below.

Seismic Survey

The proposed seismic survey would be performed in the Scotia Sea and South Atlantic along track lines totaling approximately 2,950 km and exclusively in water more than 1,000 m deep (Figure 2). The trackline distance includes equipment testing, start-up, line changes, repeat coverage of areas as needed, and equipment recovery. The proposed research activities including the seismic survey would bisect approximately 250,000 square kilometers (km^2) in the Scotia Sea region (see Figure 2). Seismic surveys would be conducted during the day and night, and for up to 40 hours of continuous operation.

The seismic survey would involve the use of a low-energy acoustic source consisting of a two GI airgun array and either one or two 100-m solid-state hydrophone streamer towed behind the vessel. A third gun would serve as a “hot spare” to be used as a backup in the event that one of the two firing guns malfunctions. Detailed specifications, including dominant frequency and

source output, for the airguns can be found in Attachment B. The airguns would be deployed in one string at a depth of approximately 3 to 4 m below the surface, spaced approximately 3 m apart and between 15 and 40 m astern. Each airgun would be configured to a displacement volume of 1,720 cubic centimeters (cm^3)(105 cubic inches) for both the generator and injector, and are considered a low-energy acoustic source as defined in the PEIS. The guns would fire the compressed air volume in unison in a harmonic mode and at an approximate firing pressure of 2,000 pounds per square inch (psi). In harmonic mode, the injector volume is designed to destructively interfere with the reverberations of the generator (source component). Firing the guns in harmonic mode maximizes resolution in the data and minimizes any excess noise in the water column or data caused by the reverberations (or bubble pulses).

Weather conditions permitting, it is anticipated that the seismic surveying **would not exceed 2,950 km in length and 325 hours of operation for the entire cruise** as summarized in Table 2. The long transit time between port (Punta Arenas, Chile) and the study site constrains how long the ship can be in the study area and limits the maximum amount of time the guns can operate.

Table 2. Proposed Seismic Survey Activities in the Scotia Sea

Survey Length (km)	Cumulative Duration [1] (hours)	Airgun Array Total Volume	Frequency Between Seismic Shots	Streamer Length
2,950	≤ 325	2 x 105 in^3 (2 x 1,720 cm^3)	5-10 seconds	100 m

Note: [1] Seismic operations are planned for no more than 40 continuous hours at a time.

During the seismic survey, the vessel would attempt to maintain a constant cruise speed of approximately 5 knots (9 km/hr). There would be between 360 and 720 shots per hour (distributed over the 9 km distance), and the relative linear distance between shots would be between 15 and 30 m. The airguns would operate continuously for no more than 40 hours at a time and duration of continuous operation is dependent on operational constraints. The cumulative duration of airgun operation will not exceed 325 hrs. The operation hours and survey length would include equipment testing, ramp-up, line changes, and repeat coverage.

Weather and sea conditions would be closely monitored including conditions that could limit visibility. Pack ice is not anticipated to be encountered during the cruise and, therefore, no ice breaking is expected. If situations are encountered which pose a risk to the equipment, impede data collection, or require the vessel to stop forward progress, the seismic survey equipment would be shut down and retrieved until conditions improve. In general, the streamer and sources could be retrieved in less than 30 minutes.

Bathymetric Survey

Besides the seismic survey, other geophysical measurements would be made using swath bathymetry, backscatter sonar imagery, high-resolution sub-bottom profiling ("CHIRP"), imaging, and magnetometer instruments. In addition, other transducer-based instruments onboard the vessel would be used continuously during the cruise for operational and navigational

purposes. During operations, when the vessel is not towing seismic equipment, its average speed would be 10.1 knots (18.8 km/hr). Operating characteristics for the instruments to be used are described below.

Single Beam Echo Sounder (Knudsen 3260) – The hull-mounted CHIRP sonar would be operated continuously during all phases of the cruise. This instrument is operated at 12 kHz for bottom-tracking purposes or at 3.5 kHz in the sub-bottom profiling mode. The sonar emits energy in a 30° beam from the bottom of the ship.

Single Beam Echo Sounder (Bathy 2000) – The hull-mounted sonar characteristics of the Bathy 2000 are similar to the Knudsen 3260. Only one hull-mounted echo sounder can be operated at a time and the specific model to be used is expected to be selected by the scientific researchers. The Bathy 2000 was the preferred instrument for many previous surveys on the RVIB Palmer.

Multi-beam Sonar (Simrad EM120) – The hull-mounted multi-beam sonar would be operated continuously during the cruise. This instrument operates at a frequency of 12 kHz and has an estimated maximum source energy level of 242 dB re 1μPa (rms) and emits a very narrow (< 2°) beam fore to aft and 150° in cross-track. The multi-beam system emits a series of nine consecutive 15 millisecond (ms) pulses.

Acoustic Doppler Current Profiler (ADCP) (Teledyne RDI VM-150) –The hull-mounted ADCP would be operated continuously throughout the cruise. The ADCP operates at a frequency of 150 kHz with an estimated acoustic output level at the source of 223.6 dB re 1μPa (rms). Sound energy from the ADCP is emitted as a 30^0 conically-shaped beam.

Acoustic Doppler Current Profiler (ADCP) (Ocean Surveyor OS-38) – The characteristics of this backup hull-mounted ADCP unit are similar to the Teledyne VM-150. It would be continuously operated.

Acoustic Locator (Pinger) – A pinger would be deployed with certain instruments (e.g., camera) and equipment (e.g., dredges) so these devices can be located in the event they become detached from their lines. A pinger typically operates at a frequency of 12 kHz, generates a 5 ms pulse per second, and has an acoustical output of 162 dB re 1μPa (rms). A maximum total of six dredge samples would be obtain using these devices and require approximately 6 hours per sample. Therefore, the pinger would operate a total of 36 hours.

Passive Instruments – During the seismic survey in the Scotia Sea and south Atlantic Ocean, a precession magnetometer and Air-Sea gravity meter would be deployed. In addition, approximately 60 expendable bathythermographs (XBTs) would also be released over the course of the cruise to obtain temperature data necessary to calculate sound velocity profiles used by the multi-beam sonar.

Dredge Sampling

The primary sampling goals involve the acquisition of *in situ* rock samples from deep marine rises (escarpments) at 3,000 to 4,000 m depths to determine the composition and age of the seafloor. Underway multibeam and seismic data will be used to locate submarine outcrops.

Dredging will be conducted upslope on escarpments. No dredging will be undertaken across the top of any seamounts and the final selection of dredge sites will include review to ensure that the tops of seamounts and corals in the area are avoided.

It is anticipated that researchers would survey and dredge two deep marine rises and one topographic high (see areas A and B in Figure 2). No more than three samples would be collected by dredge in each area (Table 3). The dredge buckets would be less than one meter across and each sample area to be dredged would be no longer than approximately 1,000 meters. Approximately 1,000 m^2 of seafloor would be disturbed by each deployment of the dredge at three different sites (resulting in a total of 6,000 m^2 of affected seafloor for the project).

Table 3. Proposed Dredging Activities in the Scotia Sea

Sampling Device	Area (Fig 2)	No. of Deployments
SIO[1] style Deep Sea Rock Dredge	A	3
or		
USAP Improved Basket Dredge	B	3

[1] SIO means Scripps Institute of Oceanography

The Government of South Georgia and South Sandwich Islands (GSGSSI) has established a large sustainable use Marine Protected Area (MPA) covering over 1 million km^2 of the South Georgia and South Sandwich Islands (SGSSI) Maritime Zone. Activities conducted within the MPA are subject to the requirements of the current Management Plan (Attachment C). Research activities, including trawling and sampling of the seafloor, require application for permit issued by GSGSSI.

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) has adopted conservation measures (22-06, 22-07, and 22-09) to protect vulnerable marine ecosystems (VME). VME include seamounts, hydrothermal vents, cold water corals and sponge fields. These measures apply to the entire study area. Additionally, the area surrounding South Georgia Island was designated by CCALMR as an Integrated Study Area to assist with the collection and management of information relating to the CCAMLR Ecosystem Monitoring Program (CEMP).

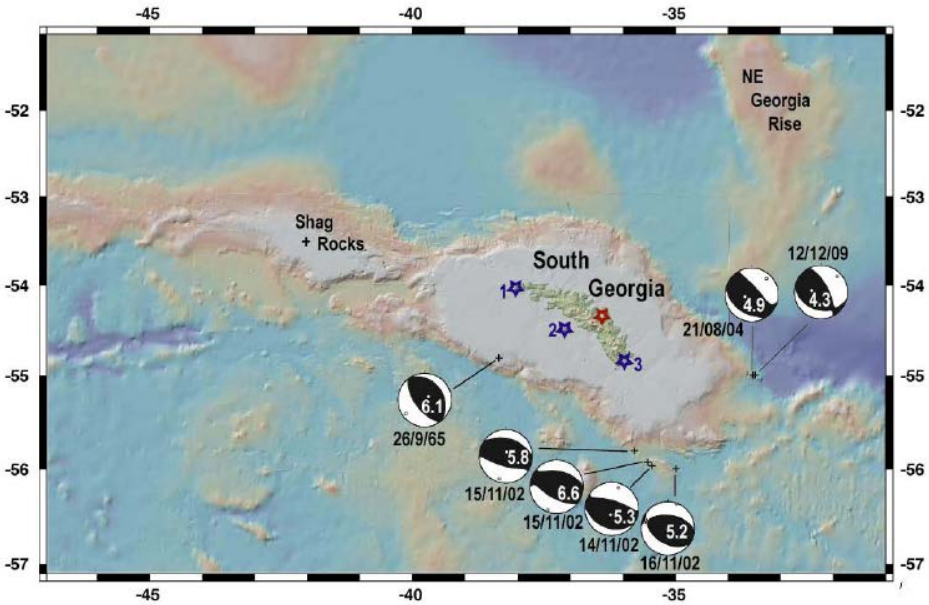
Conservation measure 22-07 includes mitigation and reporting requirements if VME are encountered. The science team would follow these requirements (Attachment C) if VMEs are encountered while sampling the sea bottom; however, the specific intent of the dredging activities is to avoid obtaining material from the tops of seamounts.

Geodetic Measurements

Researchers would install three continuous Global Navigation Satellite System (cGNSS) stations on the South Georgia microcontinent (Figure 4). The cGNSS systems would collect GPS and meteorological data with daily data recovery using IRIDIUM-based communications. These stations would complement the cGNSS station installed at King Edward Point in Cumberland Bay on the northeastern side of the island (red star in Figure 4). A station would be installed

near Cooper Bay on the southeastern extremity of the island (Figure 4; star 3). The second station would be installed on a reef or islet between Cooper Bay and Annenkov Island (Figure 4; star 2) and the third station would be installed on Bird Island (Figure 3; star 1). The stations would be removed after three years of operation.

Figure 4. Location of cGNSS stations on the South Georgia Islands.



Note: Star 1 = Bird Islet; Star 2 = Annenkov Island; Star 3 = Cooper Bay

3.0 TYPE AND ABUNDANCE OF MARINE MAMMALS IN PROJECT AREA

NOAA NMFS Requirement: The species and numbers of marine mammals likely to be found within the activity area

3.1 Number of Animals

The Scotia Sea and South Atlantic Ocean is a feeding ground for a variety of marine mammals, including cetaceans (whales), both baleen (mysticetes) and toothed whales (odontocetes) and pinnipeds (seals). A cross-reference of species names used in this document to their common names appears in Attachment A.

The PEIS examines the potential impacts that may result from geophysical exploration and scientific research using seismic surveys that are funded by NSF or conducted by the USGS. Due to the potential for NSF-funded marine seismic cruises to occur across the world's oceans, it was necessary to narrow the focus of the impact analysis presented in the PEIS to a number of representative or exemplary analysis areas. Thirteen such areas were selected for analysis in the PEIS, including 5 areas subject to detailed analyses (Detailed Analysis Areas [DAAs]) and 8 subject to qualitative analysis (Qualitative Analysis Areas [QAAs]). One of the QAAs, designated Sub-Antarctic and defined as the region between 42°S and 60°S (NSF, 2011) is

particularly relevant to the proposed action described in this request for IHA, as it includes the Scotia Sea.

Functionally, this document will use the impact assessment data presented in the PEIS for the Sub-Antarctic QAA as a basis for the evaluation. In general, the species present in the Sub-Antarctic QAA may be present or migrating through the Scotia Sea during the proposed marine seismic research activities. However, historical sightings data and estimated densities from previous cruises and other research in the proposed study areas will be used to provide a more accurate representation of the species that may be encountered in the Scotia Sea and South Atlantic Ocean, and provide quantitative estimates of species population density. Because the species identified in the PEIS cover a wide area of the Southern Ocean, population data and marine mammal sightings data and density data specific to the Scotia Sea region were reviewed and compiled to characterize marine mammals expected to be present in the Scotia Sea and South Atlantic Ocean. The listing of the data sources, observational characteristics associated with sightings data, species observed within the data sets, correction factors, and population density estimates by data source for cetacean and pinniped species that would be present in the proposed study area are summarized in Attachment D.

Following the review of available data (see Attachment D) and consultation with NOAA, population density estimates considered suitable for the proposed study area during the proposed study period (September-October) for cetaceans and pinnipeds were selected for the purposes of estimating acoustic harassment, and are presented in Tables 4 and 5, respectively.

The population density estimates based on sightings data take into account for animals that may be in the water but were not sighted and reported. For cetaceans, a correction factor of 5 was used, (i.e., assumes that only 20 percent of animals present were reported). For pinnipeds, a correction factor of 1.66 was used, and assumes that only 40 percent of the animals present were reported.

The densities used for purposes of estimating acoustic harassment takes do not take into account the patchy distributions of marine mammals in an ecosystem, at least on the moderate to fine scales over which they are known to occur. Instead, animals are considered evenly distributed throughout the assessed area and seasonal movement patterns are not taken into account. For example, Southern Right Whale Dolphins (*Lissodelphis peronii*) are known to congregate in large groups (e.g., dozens of animals).

Table 4. Cetacean Densities in the Scotia Sea and South Atlantic Ocean

Common Name	Area Surveyed (km)	Animals (#)	Animals (# including unidentified)	Corrected Sightings (assume only 20% reported) Note 1	Estimated Linear Density (#/km)	Half Strip-Width (km) Note 2	Visual Transect Width (km) Note 3	Areal Density (#/ km^2) Note 4	Data Source	Year/Season/Area	Comments
Mysticetes											
Blue whale								0.0000510	NMSDD, Kaschner model	Maximum, year-round for the area	
Fin whale								0.0182040	NMSDD, SMRU Ltd. model	Fall, maximum range in the area	
Humpback whale								0.0006610	NMSDD, Kaschner model	Fall, maximum range in the area	
Minke whale								0.1557920	NMSDD, SMRU Ltd. model	Fall, maximum range in the area	
Dwarf minke whale								0.1557920[5]	NMSDD, SMRU Ltd. model	Fall, maximum range in the area	
Sei whale								0.0063590	NMSDD, SMRU Ltd. model	Fall, maximum range in the area	
Southern right whale	4,143	33	33	165	0.0398262	2.5	5.00	0.0079652	Sirovic, BAS	2003 Jan-Feb, area and 400 km WSW	220 hrs observation 7,560 km
Odontocetes											
Arnoux's beaked whale								0.0113790	NMSDD, SMRU Ltd. model	Fall, maximum range in the area	
Cuvier's beaked whale								0.000548	NMSDD, SMRU Ltd. model	Fall, maximum range in nearest area	
Gray's beaked whale								0.0018850	NMSDD, SMRU Ltd. model	Fall, maximum range in the area	
Hourglass dolphin	4,143	58	64	320	0.0772387	2.50	5.00	0.0154477	Sirovic, BAS	2003 Jan-Feb, area and 400 km WSW	220 hrs observation 7,560 km
Killer whale								0.0153800	NMSDD, SMRU Ltd. model	fall, in the area	
Layard's beaked whale	1,296	1	1	5	0.0038580	2.50	5.00	0.0007716	Rossi-Santos	2005 Jan-Mar, in area and 880 km N	110 hr observation 700 nm (1,296 km)
Long-finned pilot whale								0.2145570	NMSDD, SMRU Ltd. model	Fall, maximum range in the area	
Peale's dolphin	4,143	5	11	55	0.0132754	2.50	5.00	0.0026551	Sirovic, BAS	2003 Jan-Feb, area and 400 km WSW	220 hrs observation 7,560 km
Shepherd's beaked whale								0.0092690	NMSDD, SMRU Ltd. model	Fall, maximum range in the area	
Southern bottlenose whale	4,143	31	37	185	0.0446536	2.50	5.00	0.0089307	Sirovic, BAS	2003 Jan-Feb, area and 400 km WSW	220 hrs observation 7,560 km
Southern right whale dolphin								0.0061610	NMSDD, SMRU Ltd. model	Fall, maximum range in the area	
Spectacled porpoise								0.0015000	SWFSC LOA 2013	Jan 2009, ~1,500 km SW of area	70 survey days
Sperm whale								0.0020690	NMSDD, SMRU Ltd. model	Fall, maximum range in the area	
Beaked whale (unidentified)	4,143	37						Note 6	Sirovic, BAS	2003 Jan-Feb, area and 400 km WSW	220 hrs observation 7,560 km

Notes:

NMSDD = Naval Marine Species Density Database; Sirovic, BAS (BAS RRS James Clark Ross Cruise JR82); SWFSC LOA 2013 (based on Santora, et.al., 2009)

[1] Sightings data accounts for all individuals observed in groups; corrected sightings assumes only 20% of animals present were observed and reported.

[2] Assumes 2.5 km half strip-width on each side of the vessel.

[3] Visual transect width = half strip-width x 2, representing the total width of observations.

[4] Density values (#/km^2) directly from NMSDD or SWFSC LOA as indicated; density values derived from other references calculated by multiplying the linear density (#/km) times 1/visual transect width (km)

[5] Density for minke whale used as a as a conservative density estimate for dwarf minke whale per NOAA recommendation

[6] Unidentified beaked whales used to estimated numbers of hourglass dolphins, Peale's dolphin, and Southern bottlenose whales

Table 5. Pinniped Densities in the Scotia Sea and South Atlantic Ocean

Common Name	Area Surveyed (km)	Animals (#)	Animals (# including unidentified)	Correction Factor Note 1	Estimated # in the Water Note 2	Estimated Linear Density (#/km)	Half Strip-Width (km) Note 3	Visual Transect Width (km) Note 4	Areal Density (#/ km^2)	Data Source	Year/Season/Area	Comments
Antarctic Fur Seal	4,143	1,019	1,019	1.66	1,692	0.408289	0.40	0.80	0.5103608	Sirovic, BAS	2003 Jan-Feb, area and 400 km	220 hrs observation 7,560 km
Sub-Antarctic Fur Seal									0.5103608[5]	Sirovic, BAS		
Crabeater	4,143	27	37	1.66	61	0.014825	0.40	0.80	0.0185313	Sirovic, BAS	2003 Jan-Feb, area and 400 km	220 hrs observation 7,560 km
Leopard	4,143	13	23	1.66	38	0.009216	0.40	0.80	0.0115194	Sirovic, BAS	2003 Jan-Feb, area and 400 km	220 hrs observation 7,560 km
Ross		--			--				0.0000000	[no reported sightings]		
Weddell	4,143	5	10	1.66	17	0.002196	0.40	0.80	0.0027447	Sirovic, BAS	2003 Jan-Feb, area and 400 km	220 hrs observation 7,560 km
Elephant									0.0003000	SWFSC LOA 2013	Jan 2009, ~1,500 km SW of area	26 survey days, 3,301 km
Unidentified phocid	4,143	25							Note 6	Sirovic, BAS	2003 Jan-Feb, area and 400 km	220 hrs observation 7,560 km

Notes:

Sirovic, BAS (RRS James Clark Ross Cruise JR82); SWFSC LOA 2013 (based on Santora, et.al., 2009)

[1] Correction factor for pinnipeds recommended by NOAA; accounts for animals that may be in the water but were not sighted and reported.

[2] Number of animals x correction factor.

[3] Assumes 400 m half strip-width on each side of the vessel.

[4] Visual Transect Width = visual range x 2, representing the total width of observations.

[5] Density for Antarctic fur seal used as a conservative density estimate for sub-Antarctic fur seal dwarf per NOAA recommendation

[6] Unidentified phocids used to estimated numbers of crabeater, leopard, and Weddell seals observed by Sirovic

3.2 Endangered Species

Marine organisms inhabiting the South Atlantic Ocean and adjacent Southern Ocean are included in the International Union for Conservation of Nature (IUCN) Red List, a comprehensive inventory of the global status of plant and animal species. The Red List uses established criteria to evaluate the extinction risk of thousands of species and subspecies. Table 6 identifies the status of species in the Southern Ocean including blue, fin, and sei whales which are identified as endangered.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between governments, whose purpose is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Roughly 5,000 species of animals and 29,000 species of plants are protected by CITES against over-exploitation through international trade. These species are listed in the three CITES Appendices, with data compiled and provided by the UNEP World Conservation Monitoring Centre. Table 6 indicates those species that are included in one of the CITES Appendices.

Table 6. IUCN Red List and CITES Species – Southern Ocean

Common Name(s)	Red List Category	CITES
Emperor penguin	NT ver 3.1 (2012)	
King penguin	LC ver 3.1 (2012)	
Antarctic fur seal, Subantarctic fur seal	LC ver 3.1 (2008)	App II
Antarctic minke whale	DD ver 3.1 (2008)	App I
Sei whale	EN A1d ver 3.1 (2008)	
Blue whale, sibbald's rorqual, sulphur-bottom whale	EN A1d ver 3.1 (2008)	App I
Common rorqual, fin whale, fin-backed whale, finback, finner, herring whale, razorback	EN A1d ver 3.1 (2008)	App I
Arnoux's beaked whale	DD ver 3.1 (2008)	App I
Cuvier’s beaked whale	LC ver 3.1 (2008)	
Pygmy right whale	DD ver 3.1 (2008)	
Southern right whale	LC ver 3.1 (2008)	App I
Long-finned pilot whale	DD ver 3.1 (2008)	
Leopard seal	LC ver 3.1 (2008)	
Flatheaded bottlenose whale, southern bottlenose whale	LC ver 3.1 (2008)	
Hourglass dolphin	LC ver 3.1 (2008)	App I
Weddell seal	LC ver 3.1 (2008)	
Southern right whale dolphin	DD ver 3.1 (2008)	App I
Crabeater seal	LC ver 3.1 (2008)	
Humpback whale	LC ver 3.1 (2008)	App I

Table 6. IUCN Red List and CITES Species – Southern Ocean

Common Name(s)	Red List Category	CITES
Gray's beaked whale, southern beaked whale	DD ver 3.1 (2008)	
Layard's beaked whale, strap-toothed whale	DD ver 3.1 (2008)	
Southern elephant seal	LC ver 3.1 (2008)	App II
Ross seal	LC ver 3.1 (2008)	
Killer whale, orca	DD ver 3.1 (2008)	App I
Spectacled porpoise	DD ver 3.1 (2008)	App II
Sperm whale	VU A1d ver 3.1 (2008)	
Adelie penguin	NT ver 3.1 (2012)	
Chinstrap penguin	LC ver 3.1 (2012)	
Gentoo penguin	NT ver 3.1 (2012)	

Note: IUCN Red List Categories: EX - Extinct, **EW** - Extinct in the Wild, **CR** - Critically Endangered, **EN** - Endangered, **VU** - Vulnerable, **LR/cd** - Lower Risk/conservation dependent, **NT** - Near Threatened (includes **LR/nt** - Lower Risk/near threatened), **DD** - Data Deficient, **LC** - **Least** Concern (includes LR/lc - Lower Risk, least concern); **CITES** = Convention on International Trade in Endangered Species of Wild Fauna and Flora (www.cites.org); **APP** – Appendix I or II

The National Marine Fisheries Service (NMFS) is responsible for listing marine species under the Endangered Species Act (ESA) and implementing conservation and recovery efforts under its Protected Resource Program. The ESA listings include species inhabiting the Southern Ocean around Antarctica. The seismic survey, as a proposed Federal action funded by NSF, has the potential to affect these species. Table 7 identifies the ESA-listed species that may be present during the proposed action, including in the study areas and transit to and from the study areas.

Table 7. Status of ESA-listed Species Found in the Southern Ocean

ESA-listed Species	Year Listed	Status	Critical Habitat	Recovery Plan
Cetaceans				
Blue whale	1970	E	n/a	final
Fin whale	1970	E	n/a	final
Humpback whale	1970	E	n/a	final
Sei whale	1970	E	n/a	final
Southern right whale	1970	E (F)	n/a	n/a
Sperm whale	1970	E	n/a	final
Pinnipeds				
None identified in the study area				
Sea Turtles				
None identified in the study area; expected to be present in the transit to and from the study area.				

Note: E = endangered; **F**= foreign species that occur entirely outside of U.S. territory; Critical habitat and recovery plans are not required for foreign species; critical habitat is also not required for species listed prior to the 1978 ESA amendments that added critical habitat provisions.
Source: NOAA, January 2014. NSF consulted the published FWS listing of foreign species and noted that no listed species occur on or near South Georgia Island, or in the Scotia Sea Region
http://ecos.fws.gov/tess_public/SpeciesReport.do?lead=10&listingType=L

3.3 Protected Area Status

The entire Scotia Sea is a designated sustainable use Marine Protected Area (MPA) by the Government of South Georgia and South Sandwich Islands (GSGSSI). The MPA (IUCN Category VI) covers over 1 million km^2 of the South Georgia and South Sandwich Islands (SGSSI) Maritime Zone. Activities conducted within the MPA are subject to the requirements of the Management Plan (Attachment C). The area was designated as an MPA to ensure the protection and conservation of the resources and biodiversity and support important ecosystem roles, such as feeding areas for marine mammals, penguins and other seabirds.

4.0 DESCRIPTION OF MARINE MAMMALS IN PROJECT AREA

NOAA NMFS Requirement: A description of the status, distribution, and seasonal distribution of the affected species or stocks of marine mammals likely to be affected by such activities.

4.1 Cetaceans

Mysticetes

The following provides general information on mysticetes that may feed or migrate in the study area and may be present during the proposed action.

Blue Whale/Pygmy Blue Whale

The Antarctic blue whale occurs as a subspecies in the Antarctic (*Balaenoptera musculus intermedia*) mainly in relatively high latitudes south of the "Antarctic Convergence" and close to the ice edge. It is relatively rare in the Southern Ocean, with an abundance estimate of 1,700 animals (Academic Press, 2009). The population structure in the Southern Ocean is not well understood. Blue whales arrive in the Antarctic feeding grounds each austral summer and some probably migrate past 60° S during early austral summer (October-November). Visual and acoustic surveys conducted by the IWC in Antarctic waters recorded 710 blue whale calls in January and 2,559 calls in February 2002. Blue whales begin migrating north out of the Antarctic to winter breeding grounds earlier than fin and sei whales.

The pygmy blue whale (*musculus brevicauda*) is also found in the southern hemisphere, typically north of the Antarctic Convergence, approximately 55°S.

Fin Whale

Fin whales (*Balaenoptera physalus*) are found throughout the world's oceans and likely migrate south beyond 60° S during the early to mid-austral summer, arriving on more southern feeding grounds after blue whales. The distribution of fin whales during the austral summer ranges from

40 to 60° S in the southern Indian and South Atlantic oceans and 50° to 65° S in the South Pacific. The New Zealand stock summers from 170° E to 145° W. Fin whales migrate north before the end of austral summer toward breeding grounds in and around the Fiji Sea.

Humpback Whale

All Southern Hemisphere humpback whales (*Megaptera novaeangliae*) share feeding grounds in the Antarctic south near 60°S and between 120°E and 110°W during the austral summer (December-March). The current population in the Scotia Sea and Antarctic Peninsula region (CCAMLR survey area) was estimated to be 9,484 animals (Reilly *et al.*, 2004).

A small number of late- or early-migrating whales may pass further south of the area during early or late austral summer based on the species typical migration patterns. Animals using this region are likely part of the Area V stock that breeds in and around French Polynesia, the Cook Islands, and Tonga. Humpbacks that winter off New Caledonia and Tonga are estimated to number only in the few hundreds.

Minke Whales (Antarctic Minke, Dwarf Minke)

Two species of Minke whales are found in the southern hemisphere: the Antarctic Minke (*Balaenoptera bonaerensis*), and the dwarf Minke (*Balaenoptera acutorostrata*). In the southern Atlantic Ocean, the Antarctic minke whale is usually found between 20°-65° S and has been reported as far south as 78° S in the Ross Sea during the austral summer.

The Antarctic Minke whales begin their southern migration from breeding grounds in the north in November (austral spring) and arrive in Antarctic feeding grounds by early summer (January), where they are abundant from 60^0S to the edge of the pack ice. The current population in the Scotia Sea and Antarctic Peninsula region (CCAMLR survey area) was estimated to be 18,125 animals (Reilly *et al.*, 2004).

Dwarf minke whales have a circumpolar distribution in the Southern Hemisphere (reported as far south as 60-65° S), especially during the summer months, overlapping that of the Antarctic minke, but are more common in temperate and warmer waters of middle and lower latitudes.

Sei Whale

Sei whales (*Balaenoptera borealis*) arrive in the Southern Ocean during the austral summer. Their main summer feeding concentration occurs between 40° and 50° S.

Populations of sei whales, like other rorquals, may seasonally migrate toward the lower latitudes during the winter and higher latitudes during the summer. The population in the Southern Ocean has not been estimated but remains greatly depleted.

Southern Right Whale/Pygmy Right Whale

Small numbers of feeding southern right whales (*Eubalaena australis*) could be present in the Scotia Sea during the austral summer. Summer feeding grounds have not been fully characterized for this species, but the International Whaling Commission (IWC) has identified South Georgia and Shag Rocks (53°S) and the Antarctic Peninsula (60 -70° S.) as two feeding

areas. Worldwide abundance of southern right whales in 1997 was estimated at about 7,000 (IWC, 2001), but other population estimates range from 8,000 (Jefferson, *et al.* 2008) to 15,000 (Academic Press, 2009).

Historic whaling data suggest that this species migrates south past New Zealand during the austral spring, arriving in feeding waters near approximately 40°S 140°W by November and December. Southern right whales have been observed moving south and east from the Kermadec Islands beginning in November, continuing across 40°S, and reaching 50°S in January. The migration followed the line of the Louisville Ridge, where the whales may have fed on copepod and krill populations stimulated by upwelling from the ridge.

Abundance in the CCAMLR survey area during 2000, which included the Scotia Sea and Antarctica Peninsula, was estimated to be 1,755 right whales (Reilly, *et al.*, 2004). This species has been sighted as recently as 2010 during AMLR visual surveys.

Pygmy right whales (*Caperea marginata*) are not well described and their feeding, breeding, and migration strategies are largely unknown. They are known to inhabit coastal and pelagic waters in the southern hemisphere between 30°S and 55°S. They are rarely seen in the open ocean.

Odontocetes

The following provides general information on odontocetes that may feed or migrate in the study area and may be present during the proposed action. Certain species of odontocetes have a stratified distribution within the Southern Ocean relative to the polar front and edge of the pack ice.

Arnoux's Beaked Whale

Arnoux's beaked whales (*Berardius arnuxii*) inhabit vast areas of the Southern Hemisphere outside the tropics, as far south as the Ross Sea at approximately 78°S (Academic press, 2009). Habitat preferences are not well known but likely are similar to those of Baird's beaked whales, which prefer deep waters over the continental slopes. Arnoux's beaked whales feed primarily on deep-water bottom fish. They have been sighted in waters near New Zealand and Antarctica during January-March. No abundance estimates are available.

Cuvier's Beaked Whale

Cuvier's beaked whale (*Ziphius cavirostris*) is one of the most common and abundant beaked whales, with worldwide abundance likely well over 100,000 individuals. There is no information on trends in the global abundance of this species (IUCN, 2006). Cuvier's beaked whales can be found nearly anywhere in deep (>200 m) waters, although, they seem to prefer waters near the continental slope, especially those with a steep sea bottom. Based on stomach content studies, this species appears to feed both near the bottom and in the water column.

Gray's Beaked Whale

Gray's beaked whale (*Mesoplodon grayi*), also known as Haast's beaked whale, the scamperdown whale, or the southern beaked whale, typically lives in the Southern Hemisphere between 30° and 45°S. Many strandings have occurred off New Zealand, but others have

occurred off South America and the Falkland Islands. This species has been sighted in groups in the Antarctic area. No abundance estimates are available.

Hourglass Dolphins

Hourglass dolphins (*Lagenorhynchus cruciger*) are found throughout the southern hemisphere, in both Antarctic and subantarctic waters, from south of 45°S to pack ice. It feeds at high latitudes in summer, exploiting biologically productive areas.

Hourglass dolphins are often seen near islands and banks, especially in turbulent waters. They are often seen in the Drake Passage and at South Georgia. One abundance estimate for the month of January south of the Antarctic convergence was 144,300 individuals (Academic Press, 2009).

Killer Whales

Orca or killer whales (*Orcinus orca*) are present in all oceans and are commonly found in coastal and temperate waters of high productivity. It is estimated that 25,000 killer whales are found in the Southern Ocean (Academic Press, 2009), although another source estimates a total of 80,000 animals south of the Antarctic Convergence (Jefferson, *et al.* 2008).

Layard's Beaked Whale (Strap-toothed whale)

Layard's beaked whale (*Mesoplodon layardii*), also known as the strap-toothed whale due to its unusual tooth configuration, is distributed in cool temperate waters of the Southern Hemisphere between 30° S and the Antarctic Convergence. There have been reports of strandings of this species from New Zealand, Australia, southern Argentina, Tierra del Fuego, southern Chile, and the Falkland Islands. No abundance estimates are available.

Long-finned Pilot Whales

Millions of long-finned pilot whales (*Globicephala melas*) are found throughout the mid-latitude waters of the North Atlantic and Southern hemisphere. They are pelagic, feeding on squid and some fish.

In the Southern Hemisphere, their range extends from 19° to 60° S but they have been regularly sighted in the Antarctic Convergence Zone (47°- 62° S) and in the Central and South Pacific as far south as 68° S. Their distribution is considered circumpolar, and they have been documented near the Antarctic sea ice.

In the Southern Hemisphere, there are an estimated 200,000 long-finned pilot whales in Antarctic waters (NOAA, 2014).

Peale's Dolphin

Peale's dolphins is common in South American waters, and is found over the shallow continental shelf east of Patagonia and off Tierra del Fuego, and may also be found south to 60°S (Academic Press, 2009). No abundance estimates are available.

Southern Bottlenose Whale

The southern bottlenose whale (*Hyperoodon planifrons*) is a large, robust beaked whale distinguished by its large, bulbous forehead and short, dolphin-like beak (Academic Press, 2009). It can be 6 to 9 m long. The southern bottlenose whale has a circumpolar distribution in the Southern Ocean, from ice edges to 30° S. There is no information on population status, trends or known areas of concentration in the Southern Hemisphere, but it is estimated that 500,000 animals are found south of the Antarctic Convergence (Jefferson, *et al.* 2008).

Southern Right Whale Dolphin

Southern right whale dolphins (*Lissodelphis peronei*) are the only dolphins without dorsal fins in the southern hemisphere. The distribution range of the species is subtropical to subantarctic oceans of the southern hemisphere. The range and total population have not been estimated or closely studied. The southern right whale dolphin is known to travel in groups of up to 1,000 individuals.

Spectacled Porpoises

Spectacled porpoises (*Phocoena dioptrica*) are rare throughout their range, and are found in deep oceanic waters. They are known to be circumpolar in their range, in colder temperate to Antarctic waters. Few observations of live animals have been recorded. Most of what is known is based on examination of stranded animals, mostly from Tierra del Fuego.

Sperm Whales

Sperm whales (*Physeter macrocephalus*), consisting of solitary males and mixed sex/age classes, are likely to occur in the Southern Ocean during the austral summer. Young calves could also be present during summer. A single group of four sperm whales was sighted in February 2005 during an NSF-funded SIO academic seismic survey in the southwest Pacific Ocean. Female and immature sperm whales generally occur at tropical and temperate latitudes of 50° N to 50° S, while solitary adult males are found to 75° N and 75° S. Home ranges of individual females span distances of up to 620 mi (1,000 km); however, some females travel several thousand miles across large parts of an ocean basin. Sperm whales generally occur in waters more than 180 m deep; waters in the sub-Antarctic to the Antarctic coastal shelf are more than 1,000 m deep.

Pygmy sperm whales (*Kogia breviceps*) may be present in the sub-Antarctic but are rarely sighted at sea due to avoidance of vessels, inconspicuous surfacing, and logging (lying still at the water surface) behaviors. Their distribution in more temperate regions of the Southern Ocean is mostly known from strandings. The pygmy sperm whale is a frequently stranded cetacean species in New Zealand (Brabyn, 1991).

4.2 Pinnipeds

There are six species of seals that live in the Southern Ocean and are expected to be present in the sub-Antarctic study area. These six species belong to two families. The first family is called the Phocidae, or true seals, of which there are five Antarctic species: the crabeater, leopard,

Weddell, elephant, and Ross seals. The second family is the Otariidae, or eared seals, which includes the Antarctic fur seal.

Crabeater Seals

Crabeater seals (*Lobodon carcinophaga*) are found throughout Antarctica but are almost never spotted on land because they breed and rest on pack ice. Crabeaters account for over half of the world's seal population. Worldwide population estimates have ranged widely but a reasonable range is 5 to 15 million (Academic Press, 2009). Crabeater seals have a circumpolar Antarctic distribution, spending the entire year in the pack ice zone. Occasionally, they can be found along the southern fringes of South America (Academic Press 2009). Crabeaters migrate over large distances in association with the annual advance and retreat of pack ice and it is typical to find higher densities of crabeater seals over and at the edge of the continental shelf as well as the marginal ice zone.

Crabeater is actually a misnomer as 90% of this seal's diet is krill. Female crabeaters can reach 2.5 and weigh 225 kg while males are smaller. Crabeater seals sometimes congregate in large groups.

Functional hearing range for crabeater seals is an estimated auditory bandwidth of 75 Hz to 75 kHz (Southall et al. 2007). Vocalizations range from less than 4 to 120 kHz (Department of Navy [DON], 2008).

Elephant Seals

Southern elephant seals (*Mirounga leonine*) are the largest of all pinnipeds. Their name comes from their size and from the males' inflatable nose, or "trunk." Males can weigh up to 3600 kg and grow to a length of fifteen feet (four and a half meters); females are much smaller, at about 900 kg and nine feet (2.8 m). Southern Elephant seals spend most of their time at sea feeding on squid and fish, but in September they come ashore to breed in three large groups in the Sub-Antarctic Islands. The southern elephant seal population is estimated at 640,000 while the population at South Georgia alone is estimated at 470,000 (Academic Press, 2009). Southern elephant seals utilize the Southern Ocean ranging from the Antarctic Convergence to the Antarctic pack ice.

Elephant seals are fiercely territorial. The males use their inflatable nose during breeding, to stake out claims and intimidate other males by erupting into resonating bellows. Male elephant seals often scar each other violently during breeding season, and they also scar the females' necks during intercourse. Elephant seals are highly polygynous, with large dominant males presiding over large aggregations of females, known as harems consisting of up to 100 animals (Academic Press, 2009).

Males tend to feed in shallower water over the shelf while females forage in deep water. In the Antarctic, juvenile males remain in the pack ice to forage (Academic Press, 2009). Elephant seals prey on deepwater and bottom dwelling organisms, including fish, squid, crab, and octopus. They are extraordinary divers with some dive depths exceeding 1,500 m and 120 minutes (Academic Press, 2009).

The breeding population on South Georgia is reported to remain stable (McMahon et al. 2005). During the 2008/2009 AMLR surveys (in waters encircling Antarctica south of 60°S latitude) to estimate abundance and map krill and fish, marine mammal observers recorded a density of 0.0003 elephant seals/km within the survey area (NMFS, 2013).

Like other pinnipeds, functional hearing range for elephant seals is an estimated auditory bandwidth of 75 Hz to 75 kHz (Southall et al. 2007). Vocalizations range from less than 4 to 120 kHz (DON, 2008).

Leopard Seals

The leopard seal (*Hydrurga leptonyx*) name comes from its spotted coat. Leopard seals hunt and travel alone on the northern edge of the pack ice and move north to the Sub-Antarctic islands in the winter. Population estimates range between 220,000 and 440,000 (Jefferson *et al.*, 2008; Academic Press, 2009). The strong jaws and highly developed teeth of leopard seals allow them to consume a variety of prey including krill, fish, cephalopods, penguins, seabirds, and seals (Kooyman 1981b). Female leopard seals measure about eleven and a half feet (nearly three meters) and weigh on average 540 kg. Males are smaller.

Leopard seals breed on the outer fringes of the pack ice where females give birth during October to mid-November, with mating occurring in December and early January (Academic Press, 2009). Lactation lasts about 4 weeks.

There have been no systematic, large-scale population census studies for this species but it is known that leopard seal are abundant, with the estimated population ranging from 220,000 to 440,000 seals (Academic Press, 2009). Population densities are greatest in areas of abundant cake ice and least in areas with larger floes; densities range from 0.003 to 0.051 seals/square km (Academic Press, 2009). During the 2008/2009 AMLR surveys to estimate abundance and map krill and fish, marine mammal observers recorded a density of 0.0003 leopard seals/km within the survey area (Santora et al. 2009).

Acoustics play an important role in the mating system for the leopard seal and they become highly vocal prior to and during breeding. Leopard seals are assigned to functional hearing groups based on the medium (air or water) through which they are detecting the sounds, for an estimated auditory bandwidth of 75 Hz to 75 kHz (Southall et al. 2007). Vocalizations range from less than 4 to 120 kHz (DON, 2008).

Ross Seals

Ross seals (*Ommatophoca rossii*) are considered the rarest of the Antarctic seals. They are the least documented because they are spotted infrequently. Ross seals have a short snout, big eyes, long flippers, and hooked teeth. They are widely distributed but are generally solitary (Costas and Crocker, 1996). Ross seals breed on the pack ice in the austral spring and early austral summer, and feed on squid, fish, and krill. From late summer through the austral winter they are in open water. On occasion, single seals are observed in the South Sandwich and South Orkney Islands (Academic Press, 2009). Their population has been estimated from 20,000-50,000 (Scheffer, 1958) to 220,000 (Erikson et al., 1971) per Academic Press (2009). They are the

smallest of the five species of true seals in the Antarctic. The females grow to seven feet (slightly more than two meters) and weigh 185 kg. The males are slightly smaller.

Weddell Seals

The Weddell seal (*Leptonychotes weddellii*) has a circumpolar distribution around Antarctica, preferring land-fast ice habitats that have access to open water. Seals haul out through cracks in the ice. Their range is further south than that of the rest of the Antarctic seals. Occasionally, they are seen at subantarctic islands (Academic Press, 2009).

There have been no systematic, large-scale population census studies but it is known that the Weddell seal is abundant with the estimated number of seals ranging from 500,000 to 1 million (Academic Press, 2009). There are no estimates of abundance within the sub-Antarctic.

Since they do not migrate north, Weddell seals live under the vast coating of sea ice during the coldest months, keeping breathing holes open with their teeth. They may suffer shortened lives due to damage sustained by their teeth and gums. Weddell seals can remain underwater for more than one hour, diving to 600 m. Weddell seals use sonar to hunt and navigate and feed on fish, krill, and squid. The females can grow longer than three metersand weigh nearly 450 kg.

The fur covers the entire body except a small portion of the underside of the fore and hind flippers; they are black with grayish silver streaks; they do not have an under-fur. The canine and incisor teeth are robust and project forward, used perhaps as an ice ream, which allows the animal to maintain breathing holes and remain in the ice year-round (Kooyman 1981a).

Weddell seals breed and pup on the fast ice. Mating takes place in the water. Males establish underwater territories and exhibit a variation of harem defense polygamy (Kooyman 1981a; Academic Press, 2009). Females give birth on the fast ice in late September to early November. There is no predictable migration. Weddell seals diet includes Antarctic cod and smaller fish. They forage in the upper water column but may dive to 600 m for up to 82 minutes, although shallow dives are more typical (Kooyman 1981a; Academic press, 2009). They may range out to 5 km from a breathing hole and return on a single dive. Type B or ‘pack ice’ ecotype killer whales are known to consume Weddell seals off the western Antarctic Peninsula (Pitman and Durban 2012).

Males patrol their territories using loud trills (up to 193 dB re 1 μPa) to advertise and defend their underwater territories (Academic press, 2009). Like other pinnipeds, Weddell seals utilize an estimated auditory bandwidth of 75 Hz to 75 kHz (Southall et al. 2007). Vocalizations range from less than 4 to 120 kHz (DON, 2008).

Antarctic Fur Seal

The sole Antarctic representative of the Otariids is the Antarctic fur seal (*Arctocephalus gazella*). Its coat consists of two layers of fur – a coarse outer layer and a fine inner layer – which provides insulation in lieu of thick blubber. Fur seals also have exposed flippers to provide temperature regulation. Pelage color is generally uniform dark brown to dark gray on the dorsal surface with a grizzled appearance caused by the tips of guard hairs being pale or white. Some individuals on South Georgia Island have a white (not albino) pelage.

Population estimates range up to 3 million (Jefferson, *et al.*, 2008) and the estimated population at South Georgia is 2.7 million (Academic Press, 2009). Other researchers have estimated that 95 percent of the species breed on South Georgia Island (Costas and Crocker, 1996). Antarctic fur seals breed on the Sub-Antarctic Islands, including South Georgia, returning to the same place each year. During breeding seasons, the territorial males can inflict fierce wounds upon one another. Fur seals survive on krill, fish, squid, and the occasional bird. Males are larger than females; they can grow two meters and weigh 90-110 kg. Fur seals reach sexual maturity at 3-5 years of age, though males are unable to attain reproductive status (obtain a reproductive territory) until 7-10 years of age. Timing of pupping for Antarctic fur seals is November-January.

Most southern fur seals forage in upwelling zones, oceanic fronts, or continental shelf-edge region. Species in this genus forage mainly in the surface mixed 105 layer (<50-60 m) at night. The species now breeds at colonies from South Georgia to Macquarie Island off New Zealand. The SWFSC maintains a research site at Cape Shirreff, Livingston Island, where it monitors Antarctic fur seal status and trends. Antarctic fur seals at Cape Shirreff feed mainly on krill, cephalopods, and fish; females there have feeding trips that last about 2-4 days and dive to less than 100 m.

Sub-Antarctic Fur Seal

The Sub-Antarctic fur seal, *Arctocephalus tropicalis*, is widely-distributed in the southern Hemisphere and found on temperate islands in the South Atlantic and Indian Oceans north of the Antarctic Polar Front (IUCN, 2006). Approximately 95% of the population breed on Amsterdam, Gough, and the Prince Edward Islands. However, breeding also occurs on Macquarie, the Crozets, Saint Paul, and Tristan da Cunha Islands. Individuals have been recorded on the coasts of Antarctica, southern South America, southern Africa, Madagascar, Australia, and New Zealand, and on Bouvetøya, the Comores, the Juan Fernandez Islands, Îles Kerguelen, Mauritius and South Georgia. The total population was estimated to be greater than 310,000 animals in 1987 and all indications are that it has been steadily growing since that time. The total population is estimated between 277,000 and 356,000 (Seal Conservation Society).

Sub-Antarctic fur seals are opportunistic and pelagic foragers (IUCN, 2006). They feed on myctophid and notothenid fish, cephalopods, and small numbers of crustaceans at the Prince Edward Islands and at Macquarie Island; however, they have also been reported to take rockhopper penguins.

5.0 REQUESTED TYPE OF INCIDENTAL TAKE AUTHORIZATION

NOAA NMFS Requirement: The type of incidental taking authorization that is being requested (i.e., takes by harassment only, takes by harassment, injury and/or death), and the method of incidental taking.

The NSF Division of Polar Programs (PLR) requests an IHA pursuant to Section 101(a)(5)(D) of the MMPA for incidental take by harassment during its planned seismic survey in the Scotia Sea during a 30-day cruise in 2014.

Some of the research activities described in Section 2 may have the potential to "take" marine mammals by harassment. Takes by harassment may result when marine mammals near the activities are exposed to, and behaviorally disturbed by, pulsed sounds generated from acoustic sources, mainly airguns, during seismic surveying. The potential impacts may depend on the species of marine mammal, the behavior of the animal at the time of exposure to the acoustic release, the received sound level (see Section 7), and the environmental conditions in the proposed study areas. Marine mammals in the general vicinity of the seismic surveying source tracklines may display disturbance reactions to the airguns (Level B Harassment). No takes by serious injury (Level A) are anticipated, given the nature of the planned operations, the use of low-energy sources, and implementation of related mitigation measures (see Section 11). Similarly, no takes or injury by physical strike or entanglement are anticipated given the implementation of mitigating measures during the seismic survey.

Although Level A takes are not anticipated, NOAA has directed that Level A takes be requested. That request is provided in Addendum A.

6.0 NUMBER OF INCIDENTAL TAKES BY ACTIVITY

***NOAA NMFS Requirement:* By age, sex, and reproductive condition (if possible), the number of marine mammals (by species) that may be taken by each type of taking identified in paragraph (a)(5) of this section, and the number of times such takings by each type of taking are likely to occur**

Detailed data characterizing the age, sex, and reproductive condition for marine mammals in the Scotia Sea and nearby Southern Ocean is extremely limited. Available information for these parameters was presented in Section 4.0. Due to the use of low-energy acoustic sources, all potential takes due to the proposed action would be anticipated to be "takes by harassment", involving temporary changes in behavior. The mitigation measures to be applied (see Section 11) would further minimize the possibility of injurious takes. The following paragraphs describe methods to estimate the number of potential exposures to various received sound levels and presents estimates of the density of marine mammals and the number of individuals that could be affected during the proposed seismic survey. The estimates are based on the density of marine mammals expected to be present in the Scotia Sea region using data from visual surveys conducted in the region and applied to strip transect methods.

It should be noted that critical habitat and recovery plans are not required for foreign species and critical habitat is not required for species listed prior to the 1978 ESA amendments that included those provisions. The marine mammals inhabiting the Scotia Sea Region and Antarctic Region are considered foreign species by the U.S. Fish and Wildlife Service (FWS). NSF consulted the published FWS listing of foreign species and noted that no species under FWS jurisdiction are on the list. There are several cetacean species that fall under NOAA's jurisdiction which are currently listed under the ESA (see Table 7 above).

Potential Number of Marine Mammals Exposed

The number of different individuals that could be exposed to airgun sounds on one or more occasions was estimated by considering the volumetric density (# per km^3) and the total volume

of ocean expected to be transited during the 325-hour seismic survey and conservatively assuming all animals sighted within 670 m would be exposed to sound levels large than or equal to 160 dB re 1 μPa (rms), resulting in Level B Harassment. The 670 m radius is based on acoustic modeling data for the airguns that may be used during the proposed action (Attachment B).

As summarized in Table 8, the modeling results for the proposed low-energy airguns indicate that the received sound levels are dependent on the water depth. Table 8 also presents the proposed mitigation zone (MZ) and full mitigation zone (FMZ) criteria based on modeling data and the PEIS. Since the entire portion of the proposed seismic survey would be conducted in waters more than 1,000 m deep, the FMZ criteria of 670 m would be used for the 2 x 105 in^3 GI guns.

Table 8. Proposed Mitigation Zone (MZ) and Full Mitigation Zone (FMZ) for the Seismic Survey

Source and volume	Water depth	Predicted RMS radius (m) based on modeling and empirical measurements			Proposed MZ and FMZ based on modeling/empirical measurements and the PEIS	
		190 dB	180 dB	160 dB	MZ (190/180 dB)	FMZ (160 dB) [1]
2 x 105 in^3 GI guns	>1000 m	20	69	670	100/100	670

Table 9 summarizes the estimated density of cetaceans and pinnipeds that would be exposed to underwater sounds during the 325-hr seismic survey, based upon the estimated density for each species multiplied by the 3,953 km^2 area ensonified to 160 dB (rms) around the planned seismic lines (0.670 km x 2 x 2,950 km).

The estimated takes are likely to be a very small percentage of the population for each species and within the small number of takes definition in the MMPA.

For mysticetes species, auditory impairment or other non-auditory physical effects would be unlikely, and limited to exposures within short distances from the acoustic sources, since this group of whales typically avoid seismic vessels (Richardson et al. 1995). Level B disturbances may occur, but are not expected to result in long-term or significant consequences to disturbed individuals or their populations. No exposures resulting in injury or mortality are expected.

Odontocetes species display variable reactions to seismic surveys, but can be generally tolerant and show some disruption of foraging; therefore, short-term Level B exposures may occur. Injuries may occur at a received level from a single seismic pulse; however, similar to mysticetes, potential injuries (Level A exposures) are not likely due to behavioral avoidance.

Several of the cetacean species that may be taken during the proposed action, including sei, fin, blue, humpback, and sperm whales are listed as Endangered under the ESA. The number of possible exposures may include repeated exposures of the same individuals; however, these would be minimal over the short duration of the survey (325 hours over the entire cruise duration) and it is unlikely that a particular animal would remain in the vicinity of the ship for

the entire cruise. In addition, the monitoring and mitigating measures that would be used to protect marine mammals during the seismic survey include immediately shutting down the airguns if an animal (including species protected under the ESA and MMPA) is observed in, or entering, the MZ (that would result in a Level A exposure).

Table 9. Projected Number of Cetacean and Pinniped Takes in the Proposed Study Areas

Common Name	Areal Density (No. /km^2)	Estimated Level B Harassment/Take (No. of animals) [Note 1]
Mysticetes		
Blue whale	0.0000510	1
Fin whale	0.0182040	72
Humpback whale	0.0006610	3
Minke whale	0.1557920	616
Dwarf minke whale	0.1557920	616
Sei whale	0.0063590	25
Southern right whale	0.0079652	31
Odontocetes		
Arnoux's beaked whale	0.0113790	45
Cuvier's beaked whale	0.000548	3
Gray's beaked whale	0.0018850	7
Hourglass dolphin	0.0154477	61
Killer whale	0.0153800	61
Layard's beaked whale	0.0007716	3
Long-finned pilot whale	0.2145570	848
Peale's dolphin	0.0026551	10
Shepherd's beaked whale	0.0092690	37
Southern bottlenose whale	0.0089307	35
Southern right whale dolphin [Note 1]	0.0061610	24
Spectacled porpoise	0.0015000	6
Sperm whale	0.0020690	8
Pinnipeds		
Antarctic fur seal	0.5103608	2,017
Sub-Antarctic fur seal	0.5103608	2,017
Crabeater seal	0.0185313	73
Elephant seal	0.0003000	1
Leopard seal	0. 0115194 0000000	46
Ross seal	0.000000	0
Weddell seal	0. 0027447	11

Notes:
[1] Calculated take is estimated density multiplied by the 3,953 km^2 area ensonified to 160 dB (rms) around the planned seismic lines (670 m x 2 x 2,950 km).
[2] Southern right whale dolphins are known to congregate in large groups which may be a greater number of animals than projected using estimated areal density.

Based on the wide range distribution of pinnipeds in the Southern Ocean with over 1 million crabeater seals alone, the estimated number of takes would affect significantly less than 20% of the local population for each pinniped species and would be within the small number of takes

defined by the MMPA. The effects of exposure are expected to be limited to behavioral disturbance and, in some cases, localized avoidance of the area near the active airguns.

Possible Effects of Multibeam Echosounder and Sub-bottom Profiler Signals

It is assumed that, during simultaneous operations of the airgun array and the other sources, any marine mammals close enough to be affected by the MBES, SBP, and acoustic release transponders would already be affected by the airguns. However, whether or not the airguns are operating simultaneously with the other sources, marine mammals are expected to exhibit no more than short-term and inconsequential responses to the MBES, SBP, and acoustic release transponders, given their characteristics (e.g., narrow downward-directed beam) and other considerations described in Sections 3.6.4.3, 3.7.4.3, and Appendix E of the PEIS. Such reactions are not considered to constitute "taking" (NMFS 2001).

Although they are not anticipated, NOAA has directed that Level B takes be requested for the operation of multibeam and similar non-seismic acoustic devices. That request is provided in Addendum B.

Conclusions

The proposed seismic survey would involve towing an airgun array that introduces pulsed sounds into the ocean, along with simultaneous operation of an MBES and SBP and other transducer-based instruments. The survey would employ a 2-airgun array similar to the airgun arrays used for typical low-energy seismic surveys that were evaluated in the PEIS (NSF, 2011). The total airgun discharge volume would be ~210 in^3 (~3,440 cm^3). Routine vessel operations, other than the proposed airgun operations, are conventionally assumed not to affect marine mammals sufficiently to constitute "taking".

In Sections 3.6.7 and 3.7.7, the PEIS concluded that low-energy airgun operations with implementation of the proposed monitoring and mitigation measures may result in a small number of Level B behavioral effects in some mysticete and odontocete species; that Level A effects were highly unlikely; and that operations were unlikely to adversely affect ESA-listed species. In this IHA application, estimates of the numbers of marine mammals that could be exposed to low-energy airgun sounds during the proposed program have been presented, together with the requested "take authorization". In addition, "take authorization" has been requested for Level A takes in Addendum A and for operation of multibeam and other non-seismic, acoustic equipment in Addendum B. Because of the limited, site-specific quantitative population density data, sightings reported during previous research cruises and conservative correction factors were used to estimate the number of takes. It is possible the estimated number of pinniped takes overestimates the actual number of animals that would be exposed to and react to the seismic sounds because many pinnipeds may not be in the water or would leave the affected area when the disturbance is first recognized. The relatively short-term exposures that may occur would be unlikely to result in any long-term negative consequences for the individuals or their populations.

No "taking" of marine mammals is expected in association with echosounder or other transducer-based equipment operations given the considerations discussed in Section 3.6.4.3, 3.7.4.3, and Appendix E of the PEIS.

7.0 DESCRIPTION OF IMPACT ON MARINE MAMMALS

NOAA NMFS Requirement: The anticipated impact of the activity upon the species or stock of marine mammal.

Summary of Potential Effects of Airgun Sounds

A significant portion of the analysis for the potential effects of airgun sounds below was based on information contained in the Environmental Analysis of a Marine Geophysical Survey by the R/V Marcus G. Langseth on the mid-Atlantic Ridge, April–May 2013 prepared by LGL Ltd., (LGL, 2013).

The effects of sounds from airguns could include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, and at least in theory, temporary or permanent hearing impairment, or non-auditory physical or physiological effects (Richardson et al. 1995; Southall et al. 2007). Permanent hearing impairment (PTS), in the unlikely event that it occurred, would constitute injury, but temporary threshold shift (TTS) is not an injury (Southall et al. 2007). Although the possibility cannot be entirely excluded, it is unlikely that the project would result in any cases of temporary or permanent hearing impairment, or any significant non-auditory physical or physiological effects. If marine mammals encounter the survey while it is underway, some behavioral disturbance could result, but this would be localized and short-term.

Tolerance

Numerous studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers. Several studies have shown that marine mammals at distances more than a few kilometers from operating seismic vessels often show no apparent response. That is often true even in cases when the pulsed sounds must be readily audible to the animals based on measured received levels and the hearing sensitivity of that mammal group. Although various mysticetes and odontocetes, and (less frequently) pinnipeds have been shown to react behaviorally to airgun pulses under some conditions, at other times mammals of all three types have shown no overt reactions. The relative responsiveness of whales is quite variable.

Masking

Masking effects of pulsed sounds (even from large arrays of airguns) on marine mammal calls and other natural sounds are expected to be limited, although there are very few specific data on this.

The proposed airguns for the seismic survey have dominant frequency components of 2-188 Hz. This frequency range fully overlaps the lower part of the frequency range of odontocete calls and/or functional hearing (full range about 150 Hz to 180 kHz). Airguns also produce a small proportion of their sound at mid- and high frequencies, which overlap most, if not all, frequencies produced by odontocetes. While it is assumed that all mysticetes can detect acoustic impulses from airguns and vessel sounds (Richardson et al. 1995), SBPs, pingers, and most of the MBESs, would likely be detectable only by some mysticetes based on presumed mysticete hearing sensitivity. Odontocetes are presumably more sensitive to the mid- to high frequencies produced by the MBESs, SBPs, and pingers than to the dominant low frequencies produced by

the airguns and vessel. A more comprehensive review of the relevant background information for odontocetes appears in Sections 3.6.4.3, 3.7.4.3, and Appendix E of the PEIS.

Because of the intermittent nature and low duty cycle of seismic pulses, animals can emit and receive sounds in the relatively quiet intervals between pulses. However, in exceptional situations, reverberation occurs for much or all of the interval between pulses (e.g., Simard et al. 2005; Clark and Gagnon 2006), which could mask calls. GI airguns used in this survey are specifically designed to reduce reverberations in the water column and thus could mitigate this risk, although no studies have been undertaken to examine this issue. Some mysticetes and odontocetes are known to continue calling in the presence of seismic pulses and their calls usually can be heard between the seismic pulses. The sounds important to small odontocetes are predominantly at much higher frequencies than are the dominant components of airgun sounds, thus limiting the potential for masking. In general, masking effects of seismic pulses are expected to be minor, given the normally intermittent nature of seismic pulses.

Disturbance Reactions

Disturbance includes a variety of effects, including subtle to conspicuous changes in behavior, movement, and displacement. Based on NMFS (2001, p. 9293), NRC (2005), and Southall et al. (2007), exposure to sound, or brief reactions that do not disrupt behavioral patterns in a potentially significant manner, do not constitute harassment or "taking", and would not have deleterious effects to the well-being of individual marine mammals or their populations.

Reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, and many other factors (Richardson et al. 1995; Wartzok et al., 2004; Southall et al., 2007; Weilgart, 2010). If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or population. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and populations could be significant (e.g., Lusseau and Bejder, 2007; Weilgart, 2010). Given the many uncertainties in predicting the quantity and types of impacts of sound on marine mammals, and the lack of abundance estimates and population trend data for marine mammals in the southern hemisphere, the conservative approach used in this Application is to estimate how many marine mammals would be encountered during the 325-hr survey period and/or exposed to the acoustic outputs generated by the seismic source. This approach likely overestimates the numbers of marine mammals that would be affected in a biologically important manner. The sound criteria used to estimate how many marine mammals might be disturbed to some biologically important degree by a seismic program are based primarily on behavioral observations of a few species. Detailed studies have been done on humpback, gray, bowhead, and sperm whales. Less detailed data are available for some other whale species, but for many there are no data on responses to marine seismic surveys.

A description of the disturbance reactions observed for different types of cetaceans is presented below.

Mysticetes - These whales generally tend to avoid airguns that are in operation, but avoidance radii are quite variable. Whales are often reported to show no overt reactions to pulses from

large arrays of airguns at distances beyond a few kilometers, even though the airgun pulses remain well above ambient noise levels out to much longer distances. However, mysticetes exposed to strong noise pulses from airguns often react by deviating from their normal migration route and/or interrupting their feeding and moving away. In the cases of migrating gray and bowhead whales, the observed changes in behavior appeared to be of little or no biological consequence to the animals. They simply avoided the sound source by displacing their migration route to varying degrees but within the natural boundaries of the migration corridors.

Responses of humpback whales to seismic surveys have been studied during migration, on summer feeding grounds, and on Angolan winter breeding grounds; there has also been discussion of effects in the Brazilian wintering grounds. Off western Australia, avoidance reactions began at 5–8 km from the array, and those reactions kept most pods at about 3–4 km from the operating seismic boat; there was localized displacement during migration of 4–5 km by traveling pods and 7–12 km by more sensitive resting pods of cow-calf pairs. However, some individual humpback whales, especially males, approached within distances of 100–400 m.

In the Northwest Atlantic, sighting rates were significantly greater during non-seismic periods compared with periods when a full array was operating, and humpback whales were more likely to swim away and less likely to swim towards a vessel during seismic as opposed to non-seismic periods. On their summer feeding grounds in southeast Alaska, there was no clear evidence of avoidance, despite the possibility of subtle effects, at received levels up to 172 re 1 μPa on an approximate rms basis. It has been suggested that South Atlantic humpback whales wintering off Brazil may be displaced or even strand upon exposure to seismic surveys, but data from subsequent years indicated that there was no observable direct correlation between strandings and seismic surveys.

There is no data on reactions of right whales to seismic surveys, but results from the closely related *bowhead whale* show that their responsiveness can be quite variable depending on their activity (migrating vs. feeding). Bowhead whales migrating west across the Alaskan Beaufort Sea in autumn, in particular, are unusually responsive, with substantial avoidance occurring out to distances of 20–30 km from a medium-sized airgun source. However, more recent research on bowhead whales corroborates earlier evidence that, during the summer feeding season, bowheads are not as sensitive to seismic sources. Reactions of migrating and feeding (but not wintering) *gray whales* to seismic surveys have been studied off St. Lawrence Island in the northern Bering Sea. It was estimated, based on small sample sizes, that 50% of feeding gray whales stopped feeding at an average received pressure level of 173 dB re 1 μPa on an (approximate) rms basis, and that 10% of feeding whales interrupted feeding at received levels of 163 dB re 1 μPa (rms). Those findings were generally consistent with the results of experiments conducted on larger numbers of gray whales that were migrating along the California coast, and western Pacific gray whales feeding off Sakhalin Island, Russia.

Various species of *Balaenoptera* (blue, sei, fin, and minke whales) have occasionally been seen in areas ensonified by airgun pulses; sightings by observers on seismic vessels off the United Kingdom from 1997 to 2000 suggest that, during times of good sightability, sighting rates for mysticetes (mainly fin and sei whales) were similar when large arrays of airguns were either

shooting or silent, although there was localized avoidance. Singing fin whales in the Mediterranean moved away from an operating airgun array.

Data on short-term reactions by cetaceans to impulsive noises are not necessarily indicative of long-term or biologically significant effects. It is not known whether impulsive sounds affect reproductive rate or distribution and habitat use in subsequent days or years. However, gray whales have continued to migrate annually along the west coast of North America with substantial increases in the population over recent years, despite intermittent seismic exploration (and much ship traffic) in that area for decades. The western Pacific gray whale population did not seem affected by a seismic survey in its feeding ground during a previous year, and bowhead whales have continued to travel to the eastern Beaufort Sea each summer. Bowhead whale numbers have increased notably, despite seismic exploration in their summer and autumn range for many years.

Odontocetes- Little systematic information is available about reactions of toothed whales to sound pulses. However, there are recent systematic studies on sperm whales and there is an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies. Seismic operators and marine mammal observers on seismic vessels regularly see dolphins and other small toothed whales near operating airgun arrays, but in general there is a tendency for most delphinids to show some avoidance of operating seismic vessels. In most cases, the avoidance radii for delphinids appear to be small, on the order of one km or less, and some individuals show no apparent avoidance. The beluga, however, is a species that (at least at times) shows long-distance (tens of km) avoidance of seismic vessels. Captive bottlenose dolphins and beluga whales exhibited changes in behavior when exposed to strong pulsed sounds similar in duration to those typically used in seismic surveys, but the animals tolerated high received levels of sound before exhibiting aversive behaviors.

Most studies of *sperm whales* exposed to airgun sounds indicate that the sperm whale shows considerable tolerance of airgun pulses; in most cases the whales do not show strong avoidance, and they continue to call, but foraging behavior can be altered upon exposure to airgun sound. There are almost no specific data on the behavioral reactions of *beaked whales* to seismic surveys. However, some northern bottlenose whales remained in the general area and continued to produce high-frequency clicks when exposed to sound pulses from distant seismic surveys. Most beaked whales tend to avoid approaching vessels of other types, and may also dive for an extended period when approached by a vessel. It is likely that most beaked whales would also show strong avoidance of an approaching seismic vessel, although this has not been documented explicitly. Most odontocete reactions to large arrays of airguns are variable and, at least for delphinids, seem to be confined to a smaller radius than has been observed for the more responsive of the mysticetes and some other odontocetes. An equal to or greater than 170 dB disturbance criterion (rather than 160 dB) is considered appropriate for delphinids, which tend to be less responsive than other cetaceans.

Hearing Impairment and Other Physical Effects

Temporary (TTS) or permanent (PTS) hearing impairment is a possibility when marine mammals are exposed to very strong sounds. TTS has been demonstrated and studied in certain captive odontocetes and pinnipeds exposed to strong sounds. However, there has been no

specific documentation of TTS, let alone permanent hearing damage, i.e., PTS, in free-ranging marine mammals exposed to sequences of airgun pulses during realistic field conditions. Current NMFS policy regarding exposure of marine mammals to high-level sounds is that cetaceans and pinnipeds should not be exposed to impulsive sounds with received levels equal to or greater than 180 dB and 190 dB re 1 μPa (rms), respectively (NMFS 2000). These criteria have been used in establishing the mitigation (i.e., shutdown) zones planned for the proposed seismic survey. However, they were established before there was any information about minimum received levels of sounds necessary to cause auditory impairment in marine mammals.

Recommendations for science-based noise exposure criteria for marine mammals, frequency weighting procedures, and related matters were published by Southall et al. (2007). Those recommendations have not, as of early 2013, been formally adopted by NMFS for use in regulatory processes and during mitigation programs associated with seismic surveys. However, some aspects of the recommendations have been taken into account in certain environmental impact statements and small-take authorizations.

As presented in the *Supplemental Draft Environmental Impact Statement for the Effects of Oil and Gas Activities in the Arctic Ocean* (NMFS, 2013), NMFS is in the process of revising and updating acoustic thresholds to incorporate newer science and utilize improved methods. NMFS is proposing to modify the criteria using more recent data suggesting that: 1) hearing impairment effects to phocids differ from otariids, because of their inner ear anatomy, and; 2) cetaceans are more likely to incur TTS and subsequent PTS within the frequency ranges of their best hearing sensitivity. NMFS is using a phased approach to conduct these updates. The thresholds currently being revised include: 1) the injury (Level A Harassment) thresholds to be applied to all sound sources and; 2) the behavioral (Level B Harassment) thresholds to be applied only to seismic activities and seismic-like sound sources (e.g., primarily mobile and impulsive sources). NMFS will provide a full description of the derivation of the revised acoustic thresholds once the internal review is complete and the revised acoustic thresholds are released for public comment through a separate process. Depending on the timing and implementation of revisions to the acoustic thresholds, changes to the distances from sound sources within which impacts are quantified would be revised for the proposed action.

NMFS' preliminarily plans include exploring the use of dose-response or risk function-like curves to characterize the relationship between received sound level and behavioral responses. Additionally, it has become increasingly evident that the context in which marine mammals are exposed to sound (e.g., the behavioral state of the animal, whether a sound source is approaching and how fast, etc.) can affect both how an animal initially responds to a sound and the ultimate impacts of the sound exposure on that individual. NMFS is also exploring additional methods of augmenting the use of a dose-response-like curve to address contextual factors beyond received level (such as distance from the sound or behavioral state of the animal), as well as the more chronic effects of sound sources operated over longer periods of time.

NMFS has conducted preliminary evaluation and suspects that the distances from the source within which animals would be potentially exposed to injurious levels would primarily fall within the distances to the current 180-dB SPL rms threshold for cetaceans. However, for phocids, the distances within which received levels may exceed the new thresholds could be

somewhat larger than the distances to the current 190-dB threshold. Depending on the timing and implementation of revisions to the acoustic thresholds, changes to the distances from sound sources within which impacts are quantified would be revised for the proposed action.

Several aspects of the planned monitoring and mitigation measures for this project are designed to detect marine mammals occurring near the airgun array, and to avoid exposing them to sound pulses that might, at least in theory, cause hearing impairment. Also, many marine mammals show some avoidance of the area where received levels of airgun sound are high enough such that hearing impairment could potentially occur. In those cases, the avoidance responses of the animals themselves would reduce or (most likely) avoid any possibility of hearing impairment.

Non-auditory physical effects may also occur in marine mammals exposed to strong underwater pulsed sound. Possible types of non-auditory physiological effects or injuries that might (in theory) occur in mammals close to a strong sound source include stress, neurological effects, bubble formation, and other types of organ or tissue damage. It is possible that some marine mammal species (i.e., beaked whales) are especially susceptible to injury and/or stranding when exposed to strong transient sounds. However, there is no definitive evidence that any of these effects occur even for marine mammals in close proximity to large arrays of airguns. Such effects, if they occur at all, would presumably be limited to short distances and to activities that extend over a prolonged period. Marine mammals that show behavioral avoidance of seismic vessels, including most mysticetes, some odontocetes, and some pinnipeds, are especially unlikely to incur non-auditory physical effects. The brief duration of exposure of any given mammal, the deep water in the study area, and the planned monitoring and mitigation measures would further reduce the probability of exposure of marine mammals to sounds strong enough to induce non-auditory physical effects.

Possible Effects of Multibeam Echosounders (MBES) and Sub-bottom Profilers (SBPs)

The PEIS found in Sections 3.6.4.3 and 3.7.4.3 that operation of MBES and SBPs is not likely to impact mysticetes or odontocetes because the intermittent and narrow, downward-directed nature of these acoustic sources would result in no more than one or two brief ping exposures of any individual animal, given the movement and speed of the vessel. Similarly, the intermittent nature of ADCPs and other pingers would, at most, result in short-term, localized behavioral changes. However, as directed by NOAA, Addendum B includes Level B take requests derived from operation of MBES and SBP for species that may be encountered during the cruise.

Summary of Potential Effects from Dredging Activities

During dredging, the noise created by the mechanical action of the devices on the seafloor is expected to be perceived by nearby fish and other marine organisms and deter them from swimming towards the source. Dredging activities would be highly localized and short-term in duration, and would not be expected to significantly interfere with marine mammal behavior. The PEIS identified potential direct effects to include temporary localized disturbance or displacement from associated sounds and/or physical movement/actions of the operations. Additionally, the potential indirect effects to mysticetes were identified to consist of very localized and transitory/short-term disturbance of bottom habitat and associated prey in shallow-water areas as a result of dredging and sediment sampling.

8.0 DESCRIPTION OF IMPACT ON SUBSISTENCE USES

NOAA NMFS Requirement: The anticipated impact of the activity on the availability of the species or stocks of marine mammals for subsistence uses.

There are no indigenous or native people in the Sub-Antarctic, and subsequently there is no subsistence hunting of marine mammals near the survey areas. Therefore, the proposed action would not have an adverse impact on the availability of the species or stocks used as a food source.

9.0 DESCRIPTION OF IMPACT ON MARINE MAMMAL HABITAT

NOAA NMFS Requirement: The anticipated impact of the activity upon the habitat of the marine mammal populations, and the likelihood of restoration of the affected habitat.

The proposed seismic survey would not result in any permanent impact on habitats used by marine mammals or to the food sources they use, such as fish and invertebrates. The main impact issue associated with the proposed activity would be temporarily elevated noise levels and the associated direct effects on marine mammals, as discussed in Section 7. Effects of airguns on fish and invertebrates are reviewed in Section 3.2.4.3, Section 3.3.4.3, and Appendix D of the PEIS.

10.0 DESCRIPTION OF IMPACT FROM LOSS OR MODIFICATION TO HABITAT

NOAA NMFS Requirement: The anticipated impact of the loss or modification of the habitat on the marine mammal populations involved.

The effects of the planned activity on marine mammal habitats and food resources are expected to be negligible, as described above. Some marine mammals present near the proposed action may be temporarily displaced as much as a few kilometers by the planned research activities.

During the proposed survey, marine mammals would be distributed according to their habitat preferences, in pelagic waters in depths 100 to 1,000 m (cetaceans) or on or near sea ice (pinnipeds). While some marine mammals may be encountered feeding in the proposed survey areas, the proposed activity would not be expected to have any habitat-related effects that could cause significant or long-term consequences for individual marine mammals or their populations, because operations would be limited in duration.

11.0 MEASURES TO REDUCE IMPACTS TO MARINE MAMMALS

NOAA NMFS Requirement: **The availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks, their habitat, and on their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance**

Marine mammals are known to be present in the proposed study area. To minimize the likelihood that impacts would occur to the species and stocks, airgun operations would be conducted in accordance with the MMPA and the ESA, including obtaining permission for incidental harassment or incidental 'take' of marine mammals and other endangered species. The following provides more detailed information about the mitigation measures that would be an integral part of the planned activities, including the use of a mitigation zone (MZ) and procedures for ramp-up, power-down, and shut-down.

Mitigation measures for the low-energy seismic survey would include:

- Pre-planning of the cruise to identify the smallest airgun array that could be used and still meet the geophysical scientific objectives.
- Employing three Protected Species Observer (PSO) consistent with NMFS requirements, including a marine mammal expert familiar with species in the Southern Ocean to serve as the lead PSO.
- Establishing the MZ and FMZ
- Minimum of one observer maintaining a visual watch for marine mammals during all airgun operations.
- Two observers maintaining a visual watch for marine mammals from 30 minutes before the start of ramp ups through the duration of the ramp ups (and when possible at other times) during the day.
- Shutdowns when marine mammals are detected in or about to enter the designated MZ. Following a shutdown, airgun activity would not resume until the PSO has visually observed the marine mammal(s) exiting the mitigation zone and concluded that it is not likely to return or has not been seen within the mitigation zone for 15 minutes for species with shorter dive durations (small odontocetes) or 30 minutes for species with longer dive durations (mysticetes and large odontocetes). Although power-down procedures are often standard operating practice for seismic surveys, they are not proposed to be used during this planned seismic survey because powering-down from two airguns to one airgun would make only a small difference in the mitigation zone(s) - but probably not enough to allow continued one-airgun operations if a marine mammal came within the mitigation zone for two airguns.

Based on modeling data, the outputs from a pair of 105/105 in^3 GI airguns such as those being used in the proposed action are considered a low-energy acoustic source in the PEIS for marine seismic research (NSF, 2011). A low-energy source was defined in the PEIS as an acoustic source whose received level at 100 m is less than 180 decibels re 1 microPascal (dB re 1µPa). The PEIS also established for these low-energy sources, a standard MZ of 100 m for all low-energy sources in water depths >100 m. This 100 m standard MZ would be used during the proposed activity.

The PEIS did not define a standard FMZ for low-energy acoustic sources, therefore L-DEO model results are proposed to be used during the proposed action for the region in which NMFS estimates behavioral disturbance (≥160 dB re 1 µPa [rms]) might occur (Level B Harassment). The FMZ is dependent on the array used and the water depth (see Table 8) and would be used

accordingly to identify and report an event that could be interpreted as behavioral disturbance of marine mammals.

To implement these measures, PSOs would monitor for the visual presence of cetaceans and pinnipeds prior to and during seismic survey operations. Monitoring procedures and resources are described in detail in Section 13. During seismic operations, three PSOs would be based aboard the NBP. The PSOs would be approved by NMFS and the lead PSO would be experienced with species in the Southern Ocean. The other PSOs would receive additional specialized training from the PSO to ensure that they can identify Southern Ocean species. During the majority of seismic operations, one PSO would monitor for marine mammals around the seismic vessel.

Seismic operations would be conducted during the day and night and up to 40 continuous hours during the survey. The PSOs would be on duty in 4-hour shifts and each PSO would not work more than two shifts per day; however during off hours, the resting PSO may be called for consultation should a second opinion be needed. Other crew would also be instructed to assist in detecting marine mammals and implementing mitigation requirements (if practical). Before the start of the seismic survey, the crew would be given additional instruction regarding how to do so. PSOs will have direct radio contact with the bridge and chief scientist during the seismic surveys. The vessel operator, science support personnel, and the science party must comply immediately with the observer's call to shut down any/all the airguns.

For at least 30 minutes prior to the seismic survey, two PSOs would scan the surface looking for animals within the MZ from the ship. If no animals are in or approaching the 100-m MZ, the airguns would be ramped up (gradually increasing the output sound level by first using one GI gun and then adding the second) to provide time for undetected animals to vacate the area. During ramp-up, the time between airgun shots would be five minutes. The observations would continue during the seismic survey and if a marine mammal is sighted within the FMZ, the crew would be notified of a possible shutdown if the animal approaches the inner MZ. Observations within the FMZ would also include searching for pinnipeds that may be present on the surface of the sea ice (i.e., hauled out) and that could potentially dive into the water as the vessel approaches. The ship may use evasive maneuvers (altering vessel course and speed) to avoid intercepting the path of an approaching marine mammal if the maneuver can be implemented safely and without damaging the deployed equipment

Seismic survey activities would only be initiated during periods of optimum visibility when marine mammal observers could see the MZ without compromise by adverse weather or diminishing ambient light levels. During periods of reduced visibility, seismic survey activities would cease if observers cannot delineate the MZ.

12.0 MEASURES TO REDUCE IMPACTS TO SUBSISTENCE USERS

NOAA NMFS Requirement: Where the proposed activity would take place in or near a traditional Arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammal for Arctic subsistence uses, the applicant must submit either a "plan of cooperation" or information that identifies what measures have been taken and/or will be

taken to minimize any adverse effects on the availability of marine mammals for subsistence uses.

The activity would not take place in the Arctic; therefore, the proposed activities would not have any impact on the availability of the species or stocks for subsistence users under this requirement.

13.0 MONITORING AND REPORTING

NOAA NMFS Requirement: The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities and suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such activity. Monitoring plans should include a description of the survey techniques that would be used to determine the movement and activity of marine mammals near the activity site(s) including migration and other habitat uses, such as feeding.

NSF proposes to sponsor marine mammal monitoring during the present project, in order to implement the proposed mitigation measures that require real-time monitoring, and to satisfy the anticipated monitoring requirements of the IHA.

NSF's proposed Monitoring Plan is described below. NSF understands that this Monitoring Plan is subject to review by NMFS and that refinements may be required. The monitoring work described here has been planned as a self-contained project independent of any other related monitoring projects that may be occurring simultaneously in the same regions. NSF is prepared to discuss coordination of its monitoring program with any related work that might be done by other groups insofar as this is practical and desirable.

Vessel-based Visual Monitoring

PSO observations (described in Section 11) would take place during airgun operations as described in detail below.

The NBP is a suitable platform for marine mammal observations. When stationed on the bridge, the eye level would be about 16.5 m above sea level for an approximate view of 270 degrees around the vessel, and the observer would have a good view around the vessel. In addition, there is an aloft observation tower at approximately 24.4 m above sea level that is protected from the weather and affords observers a 360 degree view around the entire vessel. The PSVO would scan the area around the vessel systematically with reticle binoculars and with the naked eye. The reticular binoculars are equipped with built-in daylight compass and range reticle and would be used to measure distances to animals directly.

Protected Species Observers (PSOs)

- NSF will utilize three NMFS-qualified vessel-based PSOs to visually watch for and monitor marine mammals near the vessel during daytime airgun operations (from nautical

twilight-dawn to nautical twilight-dusk) and before and during ramp-ups of airguns day or night.

- The *NBP* vessel crew will also assist in detecting marine mammals, when practicable.

- PSO(s) will have access to reticle binoculars (7 x 50 Fujinon or equivalent) equipped with a built-in daylight compass and range reticle

- PSO(s) shifts will last no longer than 4 hours at a time.

- When feasible, PSO(s) will also make observations during daytime periods when the seismic airguns are not operating for comparison of animal abundance and behavior.

- PSO(s) will conduct monitoring while the airgun array and streamer(s) are being deployed or recovered from the water.

Visual Monitoring at the Start of the Airgun Operations

- PSO(s) will visually observe the entire extent of the mitigation zones (180 dB re 1 μPa [rms] for cetaceans and 190 dB re 1 μPa [rms] for pinnipeds (reference Table 8) for at least 30 minutes prior to starting the airgun array (day or night).

- If the PSO(s) sees a marine mammal within the mitigation zone, NSF and ASC must delay the seismic survey until the marine mammal(s) has left the area. If the PSO(s) sees a marine mammal that surfaces, then dives below the surface, the PSO(s) shall wait 15 minutes for species with shorter dive durations (small odontocetes) or 30 minutes for species with longer dive durations (mysticetes and large odontocetes). If the PSO(s) sees no marine mammals during that time, they should assume that the animal has moved beyond the mitigation zone.

- If for any reason the entire radius cannot be seen for the entire 30 minutes (i.e., rough seas, fog, darkness), or if marine mammals are near, approaching, or in the mitigation zone, the airguns may not be ramped-up. If one airgun is already running at a source level of at least 180 dB re 1 μPa (rms), NSF and ASC may start the second airgun without observing the entire mitigation zone for 30 minutes prior, provided no marine mammals are known to be near the mitigation zone.

Ramp-up Procedures

- Implement a “ramp-up” procedure when starting up at the beginning of seismic operations or any time after the entire array has been shut-down for more than 15 minutes, which means starting with a single GI airgun and adding a second GI airgun after five minutes. During ramp-up, the two PSOs shall monitor the mitigation zone, and if marine mammals are sighted, a shut-down shall be implemented as though the full array (both GI airguns) were operational. Therefore, initiation of ramp-up procedures

from shut-down requires that the two PSOs be able to view the full mitigation zone as described above.

Shut-down Procedures

- Shut-down the airgun(s) if a marine mammal is detected within, approaches, or enters the relevant mitigation zone (reference Table 8). A shut-down means all operating airguns are shut-down (i.e., turned off).

- Following a shut-down, the airgun activity shall not resume until the PSO(s) has visually observed the marine mammal(s) exiting the mitigation zone and is not likely to return, or has not been seen within the mitigation zone for 15 minutes for species with shorter dive durations (small odontocetes) or 30 minutes for species with longer dive durations (mysticetes and large odontocetes, including sperm, killer, and beaked whales).

- Following a shut-down and subsequent animal departure, airgun operations may resume following ramp-up procedures described above.

Speed or Course Alteration

- Alter speed or course during seismic operations if a marine mammal, based on its position and relative motion, appears likely to enter the relevant mitigation zone. If speed or course alteration is not safe or practicable, or if after alteration the marine mammal still appears likely to enter the mitigation zone, further mitigation measures, such as a shut-down, shall be taken.

Survey Operations at Night

- Marine seismic surveys may continue into night and low-light hours if such segment(s) of the survey is initiated when the entire relevant mitigation zones are visible and can be effectively monitored.

- No initiation of airgun array operations is permitted from a shut-down position at night or during low-light hours (such as in dense fog or heavy rain) when the entire relevant mitigation zone cannot be effectively monitored by the PSO(s) on duty.

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

PSO Data and Documentation

PSOs would record data to estimate the numbers of marine mammals exposed to various received sound levels and to document apparent disturbance reactions or lack thereof. Data would be used to estimate numbers of animals potentially taken by harassment (as defined in the MMPA). PSOs would also provide information needed to order a power down or shutdown of the airguns when a marine mammal is within or near the MZ.

When a sighting is made, the following information about the sighting would be recorded:

1. 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 behavioral pace.
2. Time, location, heading, speed, activity of the vessel (including number of airguns operating and whether in state of ramp-up or shut-down), sea state and wind force, visibility, and sun glare. This data will also be recorded 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.

All observations and shut downs would be recorded in a standardized format. Data would be entered into an electronic database. The accuracy of the data entry would be verified by computerized data validity checks as the data are entered and by subsequent manual checking of the database.

These procedures would allow initial summaries of data to be prepared during and shortly after the field program, and would facilitate transfer of the data to statistical, graphical, and other programs for further processing and archiving.

Results from the vessel-based observations would provide:

1. The basis for real-time mitigation (airgun shutdown).
2. Information needed to estimate the number of marine mammals potentially taken by harassment, which must be reported to NMFS. During the proposed action, the number of takes would be monitored and used to stop seismic operations should requested number of takes be reached.
3. Data on the occurrence, distribution, and activities of marine mammals in the area where the seismic study is conducted.
4. Information to compare the distance and distribution of marine mammals relative to the source vessel at times with and without seismic activity.
5. Data on the behavior and movement patterns of marine mammals seen at times with and without seismic activity.

A report would be submitted to NMFS within 90 days after the end of the cruise. The report would describe the operations that were conducted and sightings of marine mammals near the operations. The report would provide full documentation of methods, results, and interpretation pertaining to all monitoring. The 90-day report would summarize the dates and locations of seismic operations, and all marine mammal sightings (dates, times, locations, activities, associated seismic survey activities). The report would also include estimates of the number and nature of exposures that could result in “takes” of marine mammals by harassment or in other ways.

14.0 RESEARCH COORDINATION

NOAA NMFS Requirement: Suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects.

ASC and NSF will coordinate the planned marine mammal monitoring program associated with the seismic survey with other parties that may have interest in this area. ASC and NSF will coordinate with applicable U.S. agencies (e.g., NMFS), and will comply with their requirements. NSF has already prepared a permit application to GSGSSI for the proposed research activities, including trawling and sampling of the seafloor.

The proposed action would complement fieldwork studying other Antarctic ice shelves, oceanographic studies, and ongoing development of ice sheet and other ocean models. It would facilitate learning at sea and ashore by students, help to fill important spatial and temporal gaps in a lightly sampled region of coastal Antarctica, provide additional data on marine mammals present in the Scotia Sea study areas, and communicate its findings via reports, publications and public outreach.

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