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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648-XA879

Takes of Marine Mammals Incidental to Specified Activities; Marine Geophysical Survey in the Northwest Pacific Ocean, March through April, 2012

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; proposed incidental harassment authorization; request for comments.

SUMMARY: NMFS has received an application from Lamont-Doherty Earth Observatory (L-DEO), a part of Columbia University, for an Incidental Harassment Authorization (IHA) to take marine mammals, by harassment, incidental to conducting a marine geophysical survey in the northwest Pacific Ocean, March through April, 2012.

DATES: Comments and information must be received no later than [insert date 30 days after date of publication in the FEDERAL REGISTER].

ADDRESSES: Comments on the application should be addressed to P. Michael Payne, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910-3225. The mailbox address for providing email comments is ITP.Cody@noaa.gov. NMFS is not responsible for e-mail comments sent to addresses other than the one provided here. Comments sent via email, including all attachments, must not exceed a 10-megabyte file size.

All comments received are a part of the public record and will generally be posted to http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications without change. All Personal Identifying Information (for example, name, address, etc.) voluntarily submitted by the commenter may be publicly accessible. Do not submit confidential business information or otherwise sensitive or protected information.

An electronic copy of the application containing a list of the references used in this document may be obtained by writing to the above address, telephoning the contact listed here (see FOR FURTHER INFORMATION CONTACT) or visiting the internet at: http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications.

The following associated documents are also available at the same internet address: the National Science Foundation's (NSF) draft Environmental Analysis (EA) pursuant to Executive Order 12114. The EA incorporates an ''Environmental Assessment of a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Northwest Pacific Ocean, March – April, 2012,'' prepared by LGL Limited, on behalf of NSF. Documents cited in this notice may be viewed, by appointment, during regular business hours, at the aforementioned address.

FOR FURTHER INFORMATION CONTACT: Jeannine Cody, Office of Protected Resources, NMFS, (301) 427-8401.

SUPPLEMENTARY INFORMATION:

Background

Section 101(a)(5)(D) of the Marine Mammal Protect Act of 1972, as amended (MMPA; 16 U.S.C. 1361 et seq.) directs the Secretary of Commerce to authorize, upon request, the incidental, but not intentional, taking of small numbers of marine mammals of a species or population stock, by United States citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review.

Authorization for the incidental taking of small numbers of marine mammals shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), and will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant). The authorization must set forth the permissible methods of taking, other means of effecting the least practicable adverse impact on the species or stock and its habitat, and requirements pertaining to the mitigation, monitoring and reporting of such takings. NMFS has defined "negligible impact" in 50 CFR 216.103 as "…an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival."

Section 101(a)(5)(D) of the MMPA established an expedited process by which citizens of the United States can apply for an authorization to incidentally take small numbers of marine mammals by harassment. Section 101(a)(5)(D) of the MMPA establishes a 45-day time limit for NMFS' review of an application followed by a 30-day public notice and comment period on any proposed authorizations for the incidental harassment of small numbers of marine mammals. Within 45 days of the close of the public comment period, NMFS must either issue or deny the authorization. NMFS must publish a notice in the Federal Register within 30 days of its determination to issue or deny the authorization.

Except with respect to certain activities not pertinent here, the MMPA defines "harassment" as:

> any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment].

Summary of Request

NMFS received an application on October 31, 2011, from L-DEO for the taking by harassment, of marine mammals, incidental to conducting a marine geophysical survey in the northwest Pacific Ocean in international waters. Upon receipt of additional information, NMFS determined the application complete and adequate on December 23, 2011.

L-DEO, with research funding from the U.S. National Science Foundation (NSF), plans to conduct the survey from March 24, 2012, through April 16, 2012. L-DEO received an IHA in 2010 to conduct the same specified activity in the same location. However, due to medical emergencies, L-DEO suspended its operations and was unable to complete the seismic survey. Thus, this 2011 survey will allow L-DEO to acquire data necessary to complete the abbreviated 2010 study.

L-DEO plans to use one source vessel, the R/V Marcus G. Langseth (Langseth), a seismic airgun array and a single hydrophone streamer to conduct a geophysical survey at the Shatsky Rise, a large igneous plateau in the northwest Pacific Ocean. The proposed survey will provide data necessary to decipher the crustal structure of the Shatsky Rise; may address major questions of earth history, geodynamics, and tectonics; could impact the understanding of terrestrial magmatism and mantle convection; and may obtain data that could be used to improve estimates of regional earthquake occurrence and distribution. In addition to the operations of the seismic airgun array and hydrophone streamer, L-DEO intends to operate a multibeam echosounder (MBES) and a sub-bottom profiler (SBP) continuously throughout the survey.

Acoustic stimuli (i.e., increased underwater sound) generated during the operation of the seismic airgun array, may have the potential to cause a short-term behavioral disturbance for marine mammals in the survey area. This is the principal means of marine mammal taking associated with these activities and L-DEO has requested an authorization to take 30 species of marine mammals by Level B harassment. Take is not expected to result from the use of the MBES or the SBP for reasons discussed in this notice. Also, NMFS does not expect take to result from collision with the Langseth because it is a single vessel moving at relatively slow speeds (4.6 knots (kts); 8.5 km per hr (km/h); 5.3 miles (mi) per hour (mph)) during seismic acquisition within the survey, for a relatively short period of time. It is likely that any marine mammal would be able to avoid the vessel.

Description of the Specified Activity

L-DEO's proposed seismic survey on the Shatsky Rise is scheduled to commence on March 24, 2012 and end on April 16, 2012. The Langseth would depart from Yokohama, Japan on March 24, 2012 and transit to the survey area in the northwest Pacific Ocean, approximately 1,200 kilometers (km) (745.6 miles (mi)) in international waters offshore of the east coast of Japan. At the conclusion of the survey activities, the Langseth proposes to arrive in Honolulu, Hawaii, on April 16, 2012. Some minor deviation from these dates is possible, depending on logistics, weather conditions, and the need to repeat some lines if data quality is substandard. Therefore, NMFS proposes to issue an authorization that is effective from March 24, 2012 to May 7, 2012.

Geophysical survey activities will involve 3-D seismic methodologies to decipher the crustal structure of the Shatsky Rise. To obtain high-resolution, 2-D structures of the area's magmatic systems and thermal structures, the Langseth will deploy a 36-airgun array as an energy source and a 6-km-long (3.7 mi-long) hydrophone streamer. As the airgun array is towed along the survey lines, the hydrophone streamer will receive the returning acoustic signals and transfer the data to the vessel's on-board processing system.

The proposed study (e.g., equipment testing, startup, line changes, repeat coverage of any areas, and equipment recovery) will require approximately 7 days (d) to complete approximately 1,216 km (755.6 mi) of transect lines. The Langseth will conduct additional seismic operations in the survey area associated with turns, airgun testing, and repeat coverage of any areas where the initial data quality is sub-standard. Data acquisition will include approximately 168 hours (hr) of airgun operations (7 d x 24 hr).

L-DEO, the Langseth's operator, will conduct all planned seismic data acquisition activities, with on-board assistance by the scientists who have proposed the study. The Principal Investigators for this survey are Drs. Jun Korenaga (Yale University, New Haven, CT) and William Sager (Texas A&M University, College Station, TX). The vessel will be self-contained, and the crew will live aboard the vessel for the entire cruise.

Description of the Specified Geographic Region

L-DEO will conduct the proposed survey in international waters in the northwest Pacific Ocean. The study area will encompass an area on the Shatsky Rise bounded by approximately 33.5 – 36 degrees (°) North by 156 -161° East (see Figure 1 in L-DEO's application). Water depths in the survey area range from approximately 3,000 to 5,000 meters (m) (1.9 to 3.1 mi).

Vessel Specifications

The Langseth, owned by NSF, is a seismic research vessel with a propulsion system designed to be as quiet as possible to avoid interference with the seismic signals emanating from the airgun array. The vessel, which has a length of 71.5 m (235 feet (ft)); a beam of 17.0 m (56 ft); a maximum draft of 5.9 m (19 ft); and a gross tonnage of 3,834 pounds, is powered by two 3,550 horsepower (hp) Bergen BRG-6 diesel engines which drive two propellers. Each propeller has four blades and the shaft typically rotates at 750 revolutions per minute. The vessel also has an 800-hp bowthruster, which is not used during seismic acquisition. The Langseth's operation speed during seismic acquisition will be approximately 4.6 kts (8.5 km/h; 5.3 mph) and the cruising speed of the vessel outside of seismic operations is 18.5 km/h (11.5 mph or 10 kts).

The Langseth will tow the 36-airgun array, as well as the hydrophone streamer, along predetermined lines. When the Langseth is towing the airgun array and the hydrophone streamer, the turning rate of the vessel is limited to five degrees per minute. Thus, the maneuverability of the vessel is limited during operations with the streamer.

The vessel also has an observation tower from which protected species visual observers (PSVO) will watch for marine mammals before and during the proposed airgun operations. When stationed on the observation platform, the PSVO's eye level will be approximately 21.5 m (71 ft) above sea level providing the PSVO an unobstructed view around the entire vessel.

Acoustic Source Specifications

Seismic Airguns

The Langseth will deploy a 36-airgun array, with a total volume of approximately 6,600 cubic inches (in^3) at a tow depth of 9 m (29.5 ft). The airguns are a mixture of Bolt 1500LL and Bolt 1900LLX airguns ranging in size from 40 to 360 in^3, with a firing pressure of 1,900 pounds per square inch. The dominant frequency components range from zero to 188 Hertz (Hz). The array configuration consists of four identical linear strings, with 10 airguns on each string; the first and last airguns will be spaced 16 m (52 ft) apart. Of the 10 airguns, nine will fire simultaneously while the tenth airgun will serve as a spare and will be turned on in case of failure of one of the other airguns. The Langseth will distribute the array across an area of approximately 24 x 16 m (78.7 x 52.5 ft) and will tow the array approximately 140 m (459.3 ft) behind the vessel. The tow depth of the array will be 9 m (29.5 ft).

During the multichannel seismic (MCS) survey, each airgun array will emit a pulse at approximately 20-second (s) intervals which corresponds to a shot interval of approximately 50 m (164 ft). During firing, the airguns will emit a brief (approximately 0.1 s) pulse of sound; during the intervening periods of operations, the airguns will be silent.

Metrics Used in This Document

This section includes a brief explanation of the sound measurements frequently used in the discussions of acoustic effects in this document. Sound pressure is the sound force per unit area, and is usually measured in micropascals (μPa), where 1 pascal (Pa) is the pressure resulting from a force of one newton exerted over an area of one square meter.

Sound pressure level (SPL) is expressed as the ratio of a measured sound pressure and a reference level. The commonly used reference pressure level in underwater acoustics is 1 μPa, and the units for SPLs are dB re: 1 μPa.

SPL (in decibels (dB)) = 20 log (pressure/reference pressure)

SPL is an instantaneous measurement and can be expressed as the peak, the peak-peak (p-p), or the root mean square (rms). Root mean square, which is the square root of the arithmetic average of the squared instantaneous pressure values, is typically used in discussions of the effects of sounds on vertebrates and all references to SPL in this document refer to the root mean square unless otherwise noted. SPL does not take the duration of a sound into account.

Characteristics of the Airgun Pulses

Airguns function by venting high-pressure air into the water which creates an air bubble. The pressure signature of an individual airgun consists of a sharp rise and then fall in pressure, followed by several positive and negative pressure excursions caused by the oscillation of the resulting air bubble. The oscillation of the air bubble transmits sounds downward through the seafloor and the amount of sound transmitted in the near horizontal directions is reduced. However, the airgun array also emits sounds that travel horizontally toward non-target areas.

The nominal source levels of the airgun array used by L-DEO on the Langseth is 236 to 265 dB re: 1 $\mu Pa_{(p-p)}$ and the rms value for a given airgun pulse is typically 16 dB re: 1 μPa lower than the peak-to-peak value (Greene, 1997; McCauley et al., 1998,2000a). However, the difference between rms and peak or peak-to-peak values for a given pulse depends on the frequency content and duration of the pulse, among other factors.

Accordingly, L-DEO has predicted the received sound levels in relation to distance and direction from the 36-airgun array and the single Bolt 1900LL 40-in^3 airgun, which will be used during power downs. A detailed description of L-DEO's modeling for marine seismic source arrays for species mitigation is provided in Appendix A of NSF's EA. These are the nominal source levels applicable to downward propagation. The effective source levels for horizontal propagation are lower than those for downward propagation because of the directional nature of the sound from the airgun array. Appendix B(3) of NSF's EA discusses the characteristics of the airgun pulses. NMFS refers the reviewers to the IHA application and EA documents for additional information.

Predicted Sound Levels for the Airguns

Tolstoy et al., (2009) reported results for propagation measurements of pulses from the Langseth's 36-airgun, 6,600 in^3 array in shallow-water (approximately 50 m (164 ft)) and deep-water depths (approximately 1,600 m (5,249 ft)) in the Gulf of Mexico in 2007 and 2008. Results of the Gulf of Mexico calibration study (Tolstoy et al., 2009) showed that radii around the airguns for various received levels varied with water depth and that sound propagation varied with array tow depth.

L-DEO used the results from the Gulf of Mexico study to determine the algorithm for its model that calculates the exclusion zones (EZ) for the 36-airgun array and the single airgun. L-DEO uses these values to designate mitigation zones and to estimate take (described in greater detail in Section VII of L-DEO's application and Section IV of NSF's EA) for marine mammals.

Comparison of the Tolstoy et al. calibration study with L-DEO's model for the Langseth's 36-airgun array indicated that the model represents the actual received levels, within the first few kilometers, where the predicted EZs are located. However, the model for deep water (greater than 1,000 m; 3,280 ft) overestimated the received sound levels at a given distance but is still valid for defining exclusion zones at various tow depths. Because the tow depth of the array in the calibration study is less shallow (6 m; 19.7 ft) than the tow depth array in the proposed survey (9 m; 29.5 ft), L-DEO used correction factors for estimating the received levels in deep water during the proposed survey. The correction factors used were the ratios of the 160-,180-, and 190-dB distances from the modeled results for the 6,600 in^3 airgun array towed at 6 m (19.7 ft) versus 9 m (29.5 ft) from LGL (2008); 1.285, 1.338, and 1.364 respectively. For a single airgun, the tow depth has minimal effect on the maximum near-field output and the shape of the frequency spectrum for the single airgun; thus, the predicted EZs are essentially the same at different tow depths. The L–DEO model does not allow for bottom interactions, and thus is most directly applicable to deep water.

Table 1 summarizes the predicted distances at which sound levels (160- and 180-dB) are expected to be received from the 36-airgun array and a single airgun operating in deep water. To avoid the potential for injury, NMFS (1995, 2000) concluded that cetaceans should not be exposed to pulsed underwater noise at received levels exceeding 180 dB re: 1 μPa. NMFS believes that to avoid the potential for permanent physiological damage (Level A harassment), cetaceans should not be exposed to pulsed underwater noise at received levels exceeding 180 dB re: 1 μPa. The 180-dB level is a shutdown criterion applicable to cetaceans, as specified by NMFS (2000); these levels were used to establish the EZs. NMFS also assumes that cetaceans exposed to levels exceeding 160 dB re: 1 μPa (rms) may experience Level B harassment.

Table 1. Measured (array) or predicted (single airgun) distances to which sound levels greater than or equal to 160 and 180 dB re: 1 μPa_{rms} that could be received in deep water using a 36-airgun array, as well as a single airgun towed at a depth of 9 m (29.5 ft) during the proposed survey in the northwest Pacific Ocean, during March - April, 2012. [Distances are based on model results provided by L–DEO.]

Source and Volume	Water Depth	Predicted RMS Distances (m)		
		160 dB	180 dB	190 dB
Single Bolt airgun (40 in^3)	Deep (> 1,000 m)	385	40	12
36-Airgun Array		3,850	940	400

Appendix A of NSF's EA discusses L-DEO's calculations for the model. NMFS refers the reviewers to L-DEO's application and the NSF's EA for additional information.

Multibeam Echosounder

The Langseth will operate a Kongsberg EM 122 MBES concurrently during airgun operations to map characteristics of the ocean floor. The hull-mounted MBES emits brief pulses of sound (also called a ping) (10.5 to 13 kilohertz (kHz)) in a fan-shaped beam that extends downward and to the sides of the ship. The transmitting beamwidth is one or two degrees (°) fore-aft and 150° athwartship and the maximum source level is 242 dB re: 1 µPa.

For deep-water operations, each ping consists of eight (in water greater than 1,000 m; 3,280 ft) or four (less than 1,000 m; 3,280 ft) successive, fan-shaped transmissions, from two to 15 milliseconds (ms) in duration and each ensonifying a sector that extends 1° fore-aft. Continuous wave pulses increase from two to 15 milliseconds (ms) long in water depths up to 2,600 m (8,530 ft). The MBES uses frequency-modulated chirp pulses up to 100-ms long in water greater than 2,600 m (8,530 ft). The eight successive transmissions span an overall cross-track angular extent of about 150°, with 2-ms gaps between the pulses for successive sectors.

Sub-bottom Profiler

The Langseth will also operate a Knudsen Chirp 3260 SBP concurrently during airgun and MBES operations to provide information about the sedimentary features and bottom topography. The SBP is capable of reaching depths of 10,000 m (6.2 mi). The dominant frequency component of the SBP is 3.5 kHz which is directed downward in a 27° cone by a hull-mounted transducer on the vessel. The nominal power output is 10 kilowatts (kW), but the actual maximum radiated power is three kW or 222 dB re: 1 μPa. The ping duration is up to 64 ms with a pulse interval of one second, but a common mode of operation is to broadcast five pulses at 1-s intervals followed by a 5-s pause.

NMFS expects that acoustic stimuli resulting from the proposed operation of the single airgun or the 36-airgun array has the potential to harass marine mammals, incidental to the conduct of the proposed seismic survey. NMFS expects these disturbances to be temporary and result in a temporary modification in behavior and/or low-level physiological effects (Level B harassment only) of small numbers of certain species of marine mammals. NMFS does not expect that the movement of the Langseth, during the conduct of the seismic survey, has the potential to harass marine mammals because of the relatively slow operation speed of the vessel (4.6 kts; 8.5 km/hr; 5.3 mph) during seismic acquisition.

Description of the Marine Mammals in the Area of the Specified Activity

Thirty-four marine mammal species may occur in the Shatsky Rise survey area, including 26 odontocetes (toothed cetaceans), seven mysticetes (baleen whales) and one species of pinniped during March through April. Six of these species are listed as endangered under the Endangered Species Act of 1973 (ESA; 16 U.S.C. 1531 et seq.), including the blue (Balaenoptera musculus), fin (Balaenoptera physalus), humpback (Megaptera novaeangliae), north Pacific right (Eubalaena japonica), sei (Balaenoptera borealis),and sperm (Physeter macrocephalus) whales.

Based on available data, the western north Pacific gray whale (Eschrichtius robustus) may have the potential to migrate off of the Pacific coast of Japan (Reilly et al., 2008a), though any occurrence in the survey area would be rare as gray whales are known to prefer nearshore coastal waters. Based on available data, L-DEO does not expect to encounter the western north Pacific gray whale within the proposed study area and does not present analysis for these species. Accordingly, NMFS did not consider this cetacean species in greater detail and the proposed IHA will only address requested take authorizations for the seven mysticetes, 26 odontocetes, and one species of pinniped. The species of marine mammals expected to be most common in the survey area (all delphinids) include the short-beaked common (Delphinus delphis), striped (Stenella coeruleoalba), and Fraser's (Lagenodelphis hosei) dolphins, and Dall's porpoise (Phocoenoides dalli).

Table 2 presents information on the abundance, distribution, and conservation status of the marine mammals that may occur in the proposed survey area March through April, 2012.

Table 2. Habitat, abundance, and conservation status of marine mammals that may occur in or near the proposed seismic survey area on the Shatsky Rise in the northwest Pacific Ocean. [See text and Tables 2 and 3 in L-DEO's application and the NSF's EA for further details.]

Species	Habitat	Abundance in the NW Pacific	ESA[1]	Density[2]
Mysticetes				
North Pacific right whale	Pelagic, coastal	few 100 [3]	EN	0.04
Humpback whale	Mainly nearshore, banks	938–1107 [4]	EN	0.47
Minke whale	Pelagic, coastal	25,000 [5]	NL	2.51
Bryde's whale	Pelagic, coastal	20,501 [6]	NL	0.52
Sei whale	Primarily offshore, pelagic	7260-12,620 [7]	EN	1.78
Fin whale	Continental slope, mostly pelagic	13,620–18,680 [8]	EN	0.74
Blue whale	Pelagic, coastal	3500 [9]	EN	0.39
Odontocetes				
Sperm whale	Usually pelagic, deep sea	29,674 [10]	EN	*1.04*
Pygmy sperm whale	Deep waters off the shelf	N.A.	NL	3.19
Dwarf sperm whale	Deep waters off the shelf	11,200 [11]	NL	7.82
Cuvier's beaked whale	Pelagic	20,000 [11]	NL	6.80
Baird's beaked whale	Deep water	N.A.	NL	0.88
Longman's beaked whale	Deep water	N.A.	NL	0.45
Hubb's beaked whale	Deep water	25,300 [12]	NL	1.28
Ginkgo-toothed beaked whale	Pelagic	25,300 [12]	NL	0.01
Blainville's beaked whale	Pelagic	25,300 [12]	NL	3.12
Stejneger's beaked whale	Deep water	25,300 [12]	NL	23.99
Rough-toothed dolphin	Deep water	145,900 [11]	NL	70.41
Common bottlenose dolphin	Coastal, oceanic, shelf break	168,000 [13]	NL	0.83
Pantropical spotted dolphin	Pelagic, coastal	438,000 [13]	NL	119.07
Spinner dolphin	Pelagic, coastal	801,000 [14]	NL	4.57
Striped dolphin	Off continental shelf	570,000 [13]	NL	309.35
Fraser's dolphin	Waters >1000 m	289,300 [11]	NL	36.40
Short-beaked common dolphin	Shelf, pelagic, seamounts	2,963,000 [15]	NL	0.41
Pacific white-sided dolphin	Continental slope, pelagic	988,000 [16]	NL	10.8
Northern right whale dolphin	Deep water	307,000 [16]	NL	1.32
Risso's dolphin	Deep water, seamounts	838,000 [13]	NL	0
Melon-headed whale	Oceanic	45,400 [11]	NL	2.05
Pygmy killer whale	Deep, pantropical waters	38,900 [11]	NL	0.16
False killer whale	Pelagic	16,000 [13]	NL	5.00
Killer whale	Widely distributed	8500 [11]	NL	21.94
Short-finned pilot whale	Mostly pelagic, high-relief	53,000 [13]	NL	*1.04*
Dall's porpoise	Deep water	1,337,224 [17]	NL	3.19
Pinnipeds				
Northern fur seal	Pelagic, coastal	1.1 million [18]	NL	1.79

N.A. – Not available or not assessed.
[1] Endangered Species Act: EN = Endangered, NL = Not listed
[2] Density estimate as listed in Table 3 of L-DEO's application. Refer to page 41 for specific references.
[3] North Pacific (Jefferson et al. 2008).
[4] Western North Pacific (Calambokidis et al. 2008).
[5] Northwest Pacific and Okhotsk Sea (Buckland et al. 1992; IWC 2010a).
[6] Western North Pacific (Kitakado et al. 2008; IWC 2010a).

[7] North Pacific (Tillman 1977).
[8] North Pacific (Ohsumi and Wada 1974).
[9] North Pacific (NMFS 1998).
[10] Western North Pacific (Whitehead 2002b).
[11] Eastern Tropical Pacific (ETP) (Wade and Gerrodette 1993).
[12] ETP; all *Mesoplodon* spp. (Wade and Gerrodette 1993).
[13] Western North Pacific (Miyashita 1993a).
[14] Whitebelly spinner dolphin in the ETP in 2000 (Gerrodette et al. 2005 *in* Hammond et al 2008a).
[15] ETP (Gerrodette and Forcada 2002 *in* Hammond et al 2008b).
[16] North Pacific (Miyashita 1993b).
[17] North Pacific (Buckland et al 1993).
[18] North Pacific, 2004–2005 (Gelatt and Lowry 2008).

NMFS refers the reader to Sections III and IV of L-DEO's application for detailed information regarding the abundance and distribution, population status, and life history and behavior of these species and their occurrence in the proposed project area. The application also presents how L-DEO calculated the estimated densities for the marine mammals in the proposed survey area. NMFS has reviewed these data and determined them to be the best available scientific information for the purposes of the proposed IHA.

Potential Effects on Marine Mammals

Acoustic stimuli generated by the operation of the airguns, which introduce sound into the marine environment, may have the potential to cause Level B harassment of marine mammals in the proposed survey area. The effects of sounds from airgun operations might include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, temporary or permanent impairment, or non-auditory physical or physiological effects (Richardson et al., 1995; Gordon et al., 2004; Nowacek et al., 2007; Southall et al., 2007).

Permanent hearing impairment, 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 proposed project would result in any cases of temporary or permanent hearing impairment, or any significant non-auditory physical or physiological effects. Based on the available data and studies described here, some behavioral disturbance is expected, but NMFS expects the disturbance to be localized and short-term.

Tolerance

Studies on marine mammals' tolerance to sound in the natural environment are relatively rare. Richardson et al. (1995) defines tolerance as the occurrence of marine mammals in areas where they are exposed to human activities or manmade noise. In many cases, tolerance develops by the animal habituating to the stimulus (i.e., the gradual waning of responses to a repeated or ongoing stimulus) (Richardson, et al., 1995; Thorpe, 1963), but because of ecological or physiological requirements, many marine animals may need to remain in areas where they are exposed to chronic stimuli (Richardson, et al., 1995).

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 (see Appendix B(5) in NSF's EA). 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 the marine mammal group. Although various baleen whales and toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to airgun pulses under some conditions, at other times marine mammals of all three types have shown no overt reactions (Stone 2003; Stone and Tasker 2006; Moulton et al. 2005, 2006a; Weir 2008a for sperm whales), (MacLean and Koski 2005; Bain and Williams 2006 for Dall's porpoises). The relative responsiveness of baleen and toothed whales are quite variable.

Masking of Natural Sounds

The term masking refers to the inability of a subject to recognize the occurrence of an acoustic stimulus as a result of the interference of another acoustic stimulus (Clark et al., 2009). Introduced underwater sound may, through masking, reduce the effective communication distance of a marine mammal species if the frequency of the source is close to that used as a signal by the marine mammal, and if the anthropogenic sound is present for a significant fraction of the time (Richardson et al., 1995).

NMFS expects the masking effects of pulsed sounds (even from large arrays of airguns) on marine mammal calls and other natural sounds to be limited, although there are very few specific data on this. Because of the intermittent nature and low duty cycle of seismic airgun pulses, animals can emit and receive sounds in the relatively quiet intervals between pulses. However, in some situations, reverberation occurs for much or the entire interval between pulses (e.g., Simard et al., 2005; Clark and Gagnon, 2006) which could mask calls. Some baleen and toothed whales are known to continue calling in the presence of seismic pulses, and their calls can usually be heard between the seismic pulses (e.g., Richardson et al., 1986; McDonald et al., 1995; Greene et al., 1999; Nieukirk et al., 2004; Smultea et al., 2004; Holst et al., 2005a,b, 2006; and Dunn and Hernandez, 2009). However, Clark and Gagnon (2006) reported that fin whales in the northeast Pacific Ocean went silent for an extended period starting soon after the onset of a seismic survey in the area. Similarly, there has been one report that sperm whales ceased calling when exposed to pulses from a very distant seismic ship (Bowles et al., 1994). However, more recent studies found that they continued calling in the presence of seismic pulses

(Madsen et al., 2002; Tyack et al., 2003; Smultea et al., 2004; Holst et al., 2006; and Jochens et al., 2008). Dolphins and porpoises commonly are heard calling while airguns are operating (e.g., Gordon et al., 2004; Smultea et al., 2004; Holst et al., 2005a, b; and Potter et al., 2007). 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, NMFS expects the masking effects of seismic pulses to be minor, given the normally intermittent nature of seismic pulses. Refer to Appendix B(4) of NSF's EA for a more detailed discussion of masking effects on marine mammals.

Behavioral Disturbance

Disturbance includes a variety of effects, including subtle to conspicuous changes in behavior, movement, and displacement. 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, 2007). 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, 2007). Given the many uncertainties in predicting the quantity and types of impacts of noise on marine mammals, it is common practice to estimate how many mammals would be present within a particular distance of industrial activities and/or exposed to a particular level of industrial sound. In most cases, this approach likely overestimates the numbers of marine mammals that would be affected in some 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. Scientists have conducted detailed studies on humpback, gray, bowhead (Balaena mysticetus), and sperm whales. Less detailed data are available for some other species of baleen whales, small toothed whales, and sea otters (Enhydra lutris), but for many species there are no data on responses to marine seismic surveys.

Baleen Whales—Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable (reviewed in Richardson et al., 1995). 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, as reviewed in Appendix B(5) of the NSF's EA, baleen whales exposed to strong noise pulses from airguns often react by deviating from their normal migration route and/or interrupting their feeding and moving away from the area. 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 (Richardson et al., 1995). They simply avoided the sound source by displacing their migration route to varying degrees, but within the natural boundaries of the migration corridors.

Studies of gray, bowhead, and humpback whales have shown that seismic pulses with received levels of 160 to 170 dB re: 1 μPa seem to cause obvious avoidance behavior in a substantial fraction of the animals exposed (Malme et al., 1986, 1988; Richardson et al., 1995). In many areas, seismic pulses from large arrays of airguns diminish to those levels at distances ranging from four to 15 km from the source. A substantial proportion of the baleen whales within those distances may show avoidance or other strong behavioral reactions to the airgun array. Subtle behavioral changes sometimes become evident at somewhat lower received levels, and studies summarized in Appendix B(5) of NSF's EA have shown that some species of baleen whales, notably bowhead and humpback whales, at times show strong avoidance at received levels lower than 160–170 dB re: 1 μPa.

Researchers have studied the responses of humpback whales to seismic surveys during migration, feeding during the summer months, breeding while offshore from Angola, and wintering offshore from Brazil. McCauley et al. (1998, 2000a) studied the responses of humpback whales off western Australia to a full-scale seismic survey with a 16-airgun array (2,678-in^3) and to a single, 20-in^3 airgun with source level of 227 dB re: 1 μPa (p-p). In the 1998 study, the researchers documented that avoidance reactions began at five to eight km (3.1 to 4.9 mi) from the array, and that those reactions kept most pods approximately three to four km (1.9 to 2.5 mi) from the operating seismic boat. In the 2000 study, McCauley et al. noted localized displacement during migration of four to five km (2.5 to 3.1 mi) by traveling pods and seven to 12 km (4.3 to 7.5 mi) by more sensitive resting pods of cow-calf pairs. Avoidance distances with respect to the single airgun were smaller but consistent with the results from the full array in terms of the received sound levels. The mean received level for initial avoidance of an approaching airgun was 140 dB re: 1 μPa for humpback pods containing females, and at the mean closest point of approach distance, the received level was 143 dB re: 1 μPa. The initial avoidance response generally occurred at distances of five to eight km (3.1 to 4.9 mi) from the airgun array and two km (1.2 mi) from the single airgun. However, some individual humpback whales, especially males, approached within distances of 100 to 400 m (328 to 1,312 ft), where the maximum received level was 179 dB re: 1 μPa.

Data collected by observers during several seismic surveys in the northwest Atlantic Ocean showed that sighting rates of humpback whales were significantly greater during non-seismic periods compared with periods when a full array was operating (Moulton and Holst, 2010). In addition, humpback whales were more likely to swim away and less likely to swim towards a vessel during seismic versus non-seismic periods (Moulton and Holst, 2010).

Humpback whales on their summer feeding grounds in Frederick Sound and Stephens Passage, Alaska did not exhibit persistent avoidance when exposed to seismic pulses from a 1.64-L (100-in^3) airgun (Malme et al., 1985). Some humpbacks seemed "startled" at received levels of 150 to 169 dB re: 1 μPa. Malme et al. (1985) concluded that there was no clear evidence of avoidance, despite the possibility of subtle effects, at received levels up to 172 re: 1 μPa.

Other studies have suggested that south Atlantic humpback whales wintering off Brazil may be displaced or even strand upon exposure to seismic surveys (Engel et al., 2004). Although, the evidence for this was circumstantial and subject to alternative explanations (IAGC, 2004). Also, the evidence was not consistent with subsequent results from the same area of Brazil (Parente et al., 2006), or with direct studies of humpbacks exposed to seismic surveys in other areas and seasons. After allowance for data from subsequent years, there was "no observable direct correlation" between strandings and seismic surveys (IWC, 2007: 236).

There are 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 versus 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 to 30 km (12.4 to 18.6 mi) from a medium-sized airgun source at received sound levels of approximately 120 to 130 dB re: 1 μPa (Miller et al., 1999; Richardson et al., 1999; see Appendix B(5) of NSF's EA). However, more recent research on bowhead whales (Miller et al., 2005; Harris et al., 2007) corroborates earlier evidence that, during the summer feeding season, bowheads are not as sensitive to seismic sources. Nonetheless, subtle but statistically significant changes in surfacing–respiration–dive cycles were evident upon statistical analysis (Richardson et al., 1986). In the summer, bowheads typically begin to show avoidance reactions at received levels of about 152 to 178 dB re: 1 μPa (Richardson et al., 1986, 1995; Ljungblad et al., 1988; Miller et al., 2005).

Reactions of migrating and feeding (but not wintering) gray whales to seismic surveys have been studied. Malme et al. (1986, 1988) studied the responses of feeding eastern Pacific gray whales to pulses from a single 100-in^3 airgun off St. Lawrence Island in the northern Bering Sea. They estimated, based on small sample sizes, that 50 percent 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 percent of feeding whales interrupted feeding at received levels of 163 dB re: 1 μPa. Those findings were generally consistent with the results of experiments conducted on larger numbers of gray whales that were migrating along the California coast (Malme et al., 1984; Malme and Miles, 1985), and western Pacific gray whales feeding off Sakhalin Island, Russia (Wursig et al., 1999; Gailey et al., 2007; Johnson et al., 2007; Yazvenko et al., 2007a,b), along with data on gray whales off British Columbia (Bain and Williams, 2006).

Various species of Balaenoptera (blue, sei, fin, and minke whales) have occasionally been seen in areas ensonified by airgun pulses (Stone, 2003; MacLean and Haley, 2004; Stone and Tasker, 2006), and calls from blue and fin whales have been localized in areas with airgun operations (e.g., McDonald et al., 1995; Dunn and Hernandez, 2009; Castellote et al., 2010). 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 shooting vs. silent (Stone, 2003; Stone and Tasker, 2006). However, these whales tended to exhibit localized avoidance, remaining significantly further (on average) from the airgun array during seismic operations compared with non-seismic periods (Stone and Tasker, 2006). Castellote et al. (2010) also observed localized avoidance by fin whales during seismic airgun events in the western Mediterranean Sea and adjacent Atlantic waters from 2006–2009. They reported that singing fin whales moved away from an operating airgun array for a time period that extended beyond the duration of the airgun activity.

Ship-based monitoring studies of baleen whales (including blue, fin, sei, minke, and whales) in the northwest Atlantic found that overall, this group had lower sighting rates during seismic versus non-seismic periods (Moulton and Holst, 2010). Baleen whales as a group were also seen significantly farther from the vessel during seismic compared with non-seismic periods, and they were more often seen to be swimming away from the operating seismic vessel (Moulton and Holst, 2010). Blue and minke whales were initially sighted significantly farther from the vessel during seismic operations compared to non-seismic periods; the same trend was observed for fin whales (Moulton and Holst, 2010). Minke whales were most often observed to be swimming away from the vessel when seismic operations were underway (Moulton and Holst, 2010).

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 (Appendix A in Malme et al., 1984; Richardson et al., 1995; Allen and Angliss, 2011). The western Pacific gray whale population did not seem affected by a seismic survey in its feeding ground during a previous year (Johnson et al., 2007). Similarly, bowhead whales have continued to travel to the eastern Beaufort Sea each summer, and their numbers have increased notably, despite seismic exploration in their summer and autumn range for many years (Richardson et al., 1987; Allen and Agliss, 2011).

Toothed Whales—Little systematic information is available about reactions of toothed whales to noise pulses. Few studies similar to the more extensive baleen whale/seismic pulse work summarized earlier and (in more detail) in Appendix B of NSF's EA have been reported for toothed whales. However, there are recent systematic studies on sperm whales (e.g., Gordon et al., 2006; Madsen et al., 2006; Winsor and Mate, 2006; Jochens et al., 2008; Miller et al., 2009). There is an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies (e.g., Stone, 2003; Smultea et al., 2004; Moulton and Miller, 2005; Bain and Williams, 2006; Holst et al., 2006; Stone and Tasker, 2006; Potter et al., 2007; Hauser et al., 2008; Holst and Smultea, 2008; Weir, 2008; Barkaszi et al., 2009; Richardson et al., 2009; Moulton and Holst, 2010).

Seismic operators and protected species observers (PSOs) 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 (e.g., Goold, 1996a,b,c; Calambokidis and Osmek, 1998; Stone, 2003; Moulton and Miller, 2005; Holst et al., 2006; Stone and Tasker, 2006; Weir, 2008; Richardson et al., 2009; Barkaszi et al., 2009; Moulton and Holst, 2010). Some dolphins seem to be attracted to the seismic vessel and floats, and some ride the bow wave of the seismic vessel even when large arrays of airguns are firing (e.g., Moulton and Miller, 2005). Nonetheless, small toothed whales more often tend to head away, or to maintain a somewhat greater distance from the vessel, when a large array of airguns is operating than when it is silent (e.g., Stone and Tasker, 2006; Weir, 2008, Barry et al., 2010; Moulton and Holst, 2010). 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 whale (Delphinapterus leucas) is a species that (at least at times) shows long-distance avoidance of seismic vessels. Summer aerial surveys conducted in the southeastern Beaufort Sea reported that sighting rates of beluga whales were significantly lower at distances of 10 to 20 km (6.2 to 12.4 mi) from an operating airgun array compared to distances of 20 to 30 km (12.4 to 18.6 mi). Further, PSOs on seismic boats in that area have rarely reported sighting beluga whales (Miller et al., 2005; Harris et al., 2007).

Captive bottlenose dolphins (Tursiops truncatus) and beluga whales exhibited changes in behavior when exposed to strong pulsed sounds similar in duration to those typically used in seismic surveys (Finneran et al., 2000, 2002, 2005). However, the animals tolerated high received levels of sound before exhibiting aversive behaviors.

Results for porpoises depend on species. The limited available data suggest that harbor porpoises (Phocoena phocoena) show stronger avoidance of seismic operations than do Dall's porpoises (Stone, 2003; MacLean and Koski, 2005; Bain and Williams, 2006; Stone and Tasker, 2006). Dall's porpoises seem relatively tolerant of airgun operations (MacLean and Koski, 2005; Bain and Williams, 2006), although they too have been observed to avoid large arrays of operating airguns (Calambokidis and Osmek, 1998; Bain and Williams, 2006). This apparent difference in responsiveness of these two porpoise species is consistent with their relative responsiveness to boat traffic and some other acoustic sources (Richardson et al., 1995; Southall et al., 2007).

Most studies of sperm whales exposed to airgun sounds indicate that the sperm whale shows considerable tolerance of airgun pulses (e.g., Stone, 2003; Moulton et al., 2005, 2006a; Stone and Tasker, 2006; Weir, 2008). In most cases the whales do not show strong avoidance, and they continue to call (see Appendix B of NSF's EA for review). However, controlled exposure experiments in the Gulf of Mexico indicate that foraging behavior was altered upon exposure to airgun sound (Jochens et al., 2008; Miller et al., 2009; Tyack, 2009).

There are almost no specific data on the behavioral reactions of beaked whales to seismic surveys. However, some northern bottlenose whales (Hyperoodon ampullatus) remained in the general area and continued to produce high-frequency clicks when exposed to sound pulses from distant seismic surveys (Gosselin and Lawson, 2004; Laurinolli and Cochrane, 2005; Simard et al., 2005). Most beaked whales tend to avoid approaching vessels of other types (e.g., Wursig et al., 1998). They may also dive for an extended period when approached by a vessel (e.g., Kasuya, 1986), although it is uncertain how much longer such dives may be as compared to dives by undisturbed beaked whales, which also are often quite long (Baird et al., 2006; Tyack et al., 2006). Based on a single observation, Aguilar-Soto et al. (2006) suggested that foraging efficiency of Cuvier's beaked whales (Ziphius cavirostris) may be reduced by close approach of vessels. In any event, it is likely that most beaked whales would also show strong avoidance of an approaching seismic vessel, although this has not been documented explicitly. In fact, Moulton and Holst (2010) reported 15 sightings of beaked whales during seismic studies in the Northwest Atlantic; seven of those sightings were made at times when at least one airgun was operating. There was little evidence to indicate that beaked whale behavior was affected by airgun operations; sighting rates and distances were similar during seismic and non-seismic periods (Moulton and Holst, 2010).

There are increasing indications that some beaked whales tend to strand when naval exercises involving mid-frequency sonar operation are ongoing nearby (e.g., Simmonds and Lopez-Jurado, 1991; Frantzis, 1998; NOAA and USN, 2001; Jepson et al., 2003;

Hildebrand, 2005; Barlow and Gisiner, 2006; see also the Stranding and Mortality section in this notice). These strandings are apparently a disturbance response, although auditory or other injuries or other physiological effects may also be involved. Whether beaked whales would ever react similarly to seismic surveys is unknown. Seismic survey sounds are quite different from those of the sonar in operation during the above-cited incidents.

Odontocete reactions to large arrays of airguns are variable and, at least for delphinids and Dall's porpoises, seem to be confined to a smaller radius than has been observed for the more responsive of the mysticetes, belugas, and harbor porpoises (See Appendix B of NSF's EA).

Pinnipeds—Pinnipeds are not likely to show a strong avoidance reaction to the airgun array. Visual monitoring from seismic vessels has shown only slight (if any) avoidance of airguns by pinnipeds, and only slight (if any) changes in behavior, see Appendix B(5) of NSF's EA. In the Beaufort Sea, some ringed seals avoided an area of 100 m (328 ft) to (at most) a few hundred meters around seismic vessels, but many seals remained within 100 to 200 m (328 to 656 ft) of the trackline as the operating airgun array passed by (e.g., Harris et al., 2001; Moulton and Lawson, 2002; Miller et al., 2005). Ringed seal sightings averaged somewhat farther away from the seismic vessel when the airguns were operating than when they were not, but the difference was small (Moulton and Lawson, 2002). Similarly, in Puget Sound, sighting distances for harbor seals and California sea lions tended to be larger when airguns were operating (Calambokidis and Osmek, 1998). Previous telemetry work suggests that avoidance and other behavioral reactions may be stronger than evident to date from visual studies (Thompson et al., 1998).

Hearing Impairment and Other Physical Effects

Exposure to high intensity sound for a sufficient duration may result in auditory effects such as a noise-induced threshold shift—an increase in the auditory threshold after exposure to noise (Finneran et al., 2005). Factors that influence the amount of threshold shift include the amplitude, duration, frequency content, temporal pattern, and energy distribution of noise exposure. The magnitude of hearing threshold shift normally decreases over time following cessation of the noise exposure. The amount of threshold shift just after exposure is called the initial threshold shift. If the threshold shift eventually returns to zero (i.e., the threshold returns to the pre-exposure value), it is called temporary threshold shift (TTS) (Southall et al., 2007).

Researchers have studied TTS in certain captive odontocetes and pinnipeds exposed to strong sounds (reviewed in Southall et al., 2007). However, there has been no specific documentation of TTS let alone permanent hearing damage, i.e., permanent threshold shift (PTS), in free-ranging marine mammals exposed to sequences of airgun pulses during realistic field conditions.

Temporary Threshold Shift–TTS is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter, 1985). While experiencing TTS, the hearing threshold rises and a sound must be stronger in order to be heard. At least in terrestrial mammals, TTS can last from minutes or hours to (in cases of strong TTS) days. For sound exposures at or somewhat above the TTS threshold, hearing sensitivity in both terrestrial and marine mammals recovers rapidly after exposure to the noise ends. Few data on sound levels and durations necessary to elicit mild TTS have been obtained for marine mammals, and none of the published data concern TTS elicited by exposure to multiple pulses of sound. Available data on TTS in marine mammals are summarized in Southall et al. (2007). Table 1 (introduced earlier in this document) presents the distances from the Langseth's airguns at which the received energy level (per pulse, flat-weighted) would be expected to be greater than or equal to 180 dB re: 1 μPa.

To avoid the potential for injury, NMFS (1995, 2000) concluded that cetaceans should not be exposed to pulsed underwater noise at received levels exceeding 180 dB re: 1 μPa. NMFS believes that to avoid the potential for permanent physiological damage (Level A harassment), cetaceans should not be exposed to pulsed underwater noise at received levels exceeding 180 dB re: 1 μPa. The 180-dB level is a shutdown criterion applicable to cetaceans, as specified by NMFS (2000); these levels were used to establish the EZs. NMFS also assumes that cetaceans exposed to SPLs exceeding 160 dB re: 1 μPa may experience Level B harassment.

Researchers have derived TTS information for odontocetes from studies on the bottlenose dolphin and beluga. For the one harbor porpoise tested, the received level of airgun sound that elicited onset of TTS was lower (Lucke et al., 2009). If these results from a single animal are representative, it is inappropriate to assume that onset of TTS occurs at similar received levels in all odontocetes (cf. Southall et al., 2007). Some cetaceans apparently can incur TTS at considerably lower sound exposures than are necessary to elicit TTS in the beluga or bottlenose dolphin.

For baleen whales, there are no data, direct or indirect, on levels or properties of sound that are required to induce TTS. The frequencies to which baleen whales are most sensitive are assumed to be lower than those to which odontocetes are most sensitive, and natural background noise levels at those low frequencies tend to be higher. As a result, auditory thresholds of baleen whales within their frequency band of best hearing are believed to be higher (less sensitive) than are those of odontocetes at their best frequencies (Clark and Ellison, 2004). From this, it is suspected that received levels causing TTS onset may also be higher in baleen whales (Southall et al., 2007). For this proposed study, L-DEO expects no cases of TTS given the low abundance of baleen whales in the planned study area at the time of the survey, and the strong likelihood that baleen whales would avoid the approaching airguns (or vessel) before being exposed to levels high enough for TTS to occur.

In pinnipeds, TTS thresholds associated with exposure to brief pulses (single or multiple) of underwater sound have not been measured. Initial evidence from more prolonged (nonpulse) exposures suggested that some pinnipeds (harbor seals in particular) incur TTS at somewhat lower received levels than do small odontocetes exposed for similar durations (Kastak et al., 1999, 2005; Ketten et al., 2001). The indirectly estimated TTS threshold for pulsed sounds would be approximately 181 to 186 dB re: 1 μPa (Southall et al., 2007), or a series of pulses for which the highest SEL values are a few dB lower. Corresponding values for California sea lions and northern elephant seals are likely to be higher (Kastak et al., 2005).

Permanent Threshold Shift–When PTS occurs, there is physical damage to the sound receptors in the ear. In severe cases, there can be total or partial deafness, whereas in other cases, the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter, 1985). There is no specific evidence that exposure to pulses of airgun sound can cause PTS in any marine mammal, even with large arrays of airguns. However, given the possibility that mammals close to an airgun array might incur at least mild TTS, there has been further speculation about the possibility that some individuals occurring very close to airguns might incur PTS (e.g., Richardson et al., 1995, p. 372ff; Gedamke et al., 2008). Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage, but repeated or (in some cases) single exposures to a level well above that causing TTS onset might elicit PTS.

Relationships between TTS and PTS thresholds have not been studied in marine mammals, but are assumed to be similar to those in humans and other terrestrial mammals. PTS might occur at a received sound level at least several dBs above that inducing mild TTS if the animal were exposed to strong sound pulses with rapid rise times–see Appendix B(6) of NSF's EA. Based on data from terrestrial mammals, a precautionary assumption is that the PTS threshold for impulse sounds (such as airgun pulses as received close to the source) is at least 6 dB higher than the TTS threshold on a peak-pressure basis, and probably greater than six dB (Southall et al., 2007).

Given the higher level of sound necessary to cause PTS as compared with TTS, it is considerably less likely that PTS would occur. Baleen whales generally avoid the immediate area around operating seismic vessels, as do some other marine mammals.

Stranding and Mortality

When a live or dead marine mammal swims or floats onto shore and becomes "beached" or incapable of returning to sea, the event is termed a "stranding" (Geraci et al., 1999; Perrin and Geraci, 2002; Geraci and Lounsbury, 2005; NMFS, 2007). The legal definition for a stranding under the MMPA is that "(A) a marine mammal is dead and is (i) on a beach or shore of the United States; or (ii) in waters under the jurisdiction of the United States (including any navigable waters); or (B) a marine mammal is alive and is (i) on a beach or shore of the United States and is unable to return to the water; (ii) on a beach or shore of the United States and, although able to return to the water, is in need of apparent medical attention; or (iii) in the waters under the jurisdiction of the United States (including any navigable waters), but is unable to return to its natural habitat under its own power or without assistance" (16 U.S.C. 1421h).

Marine mammals are known to strand for a variety of reasons, such as infectious agents, biotoxicosis, starvation, fishery interaction, ship strike, unusual oceanographic or weather events, sound exposure, or combinations of these stressors sustained concurrently or in series. However, the cause or causes of most strandings are unknown (Geraci et al., 1976; Eaton, 1979; Odell et al., 1980; Best, 1982). Numerous studies suggest that the physiology, behavior, habitat relationships, age, or condition of cetaceans may cause them to strand or might pre-dispose them to strand when exposed to another phenomenon. These suggestions are consistent with the conclusions of numerous other studies that have demonstrated that combinations of dissimilar stressors commonly combine to kill an animal or dramatically reduce its fitness, even though one exposure without the other does not produce the same result (Chroussos, 2000; Creel, 2005; DeVries et al., 2003; Fair and Becker, 2000; Foley et al., 2001; Moberg, 2000; Relyea, 2005a; 2005b, Romero, 2004; Sih et al., 2004).

Strandings Associated with Military Active Sonar–Several sources have published lists of mass stranding events of cetaceans in an attempt to identify relationships between those stranding events and military active sonar (Hildebrand, 2004; IWC, 2005; Taylor et al., 2004). For example, based on a review of stranding records between 1960 and 1995, the International Whaling Commission (2005) identified ten mass stranding events and concluded that, out of eight stranding events reported from the mid-1980s to the summer of 2003, seven had been coincident with the use of mid-frequency active sonar and most involved beaked whales.

Over the past 12 years, there have been five stranding events coincident with military MF active sonar use in which exposure to sonar is believed by NMFS and the Navy to have been a contributing factor to strandings: Greece (1996); the Bahamas (2000); Madeira (2000); Canary Islands (2002); and Spain (2006). NMFS refers the reader to Cox et al. (2006) for a summary of common features shared by the strandings events in Greece (1996), Bahamas (2000), Madeira (2000), and Canary Islands (2002); and Fernandez et al., (2005) for an additional summary of the Canary Islands 2002 stranding event.

Potential for Stranding from Seismic Surveys–The association of strandings of beaked whales with naval exercises involving mid-frequency active sonar and, in one case, an L-DEO seismic survey (Malakoff, 2002; Cox et al., 2006), has raised the possibility that beaked whales exposed to strong "pulsed" sounds may be especially susceptible to injury and/or behavioral reactions that can lead to stranding (e.g., Hildebrand, 2005; Southall et al., 2007). Appendix B (6) of NSF's EA provides additional details.

Specific sound-related processes that lead to strandings and mortality are not well documented, but may include:

(1) Swimming in avoidance of a sound into shallow water;

(2) A change in behavior (such as a change in diving behavior) that might contribute to tissue damage, gas bubble formation, hypoxia, cardiac arrhythmia, hypertensive

hemorrhage or other forms of trauma;

(3) A physiological change such as a vestibular response leading to a behavioral change or stress-induced hemorrhagic diathesis, leading in turn to tissue damage; and

(4) Tissue damage directly from sound exposure, such as through acoustically-mediated bubble formation and growth or acoustic resonance of tissues. Some of these mechanisms are unlikely to apply in the case of impulse sounds. However, there are increasing indications that gas-bubble disease (analogous to the bends), induced in supersaturated tissue by a behavioral response to acoustic exposure, could be a pathologic mechanism for the strandings and mortality of some deep-diving cetaceans exposed to sonar. However, the evidence for this remains circumstantial and associated with exposure to naval mid-frequency sonar, not seismic surveys (Cox et al., 2006; Southall et al., 2007).

Seismic pulses and mid-frequency sonar signals are quite different, and some mechanisms by which sonar sounds have been hypothesized to affect beaked whales are unlikely to apply to airgun pulses. Sounds produced by airgun arrays are broadband impulses with most of the energy below one kHz. Typical military mid-frequency sonar emits non-impulse sounds at frequencies of two to 10 kHz, generally with a relatively narrow bandwidth at any one time. A further difference between seismic surveys and naval exercises is that naval exercises can involve sound sources on more than one vessel. Thus, it is not appropriate to assume that there is a direct connection between the effects of military sonar and seismic surveys on marine mammals. However, evidence that sonar signals can, in special circumstances, lead (at least indirectly) to physical damage and mortality (e.g., Balcomb and Claridge, 2001; NOAA and USN, 2001; Jepson et al., 2003; Fernández et al., 2004, 2005; Hildebrand 2005; Cox et al., 2006) suggests that caution is warranted when dealing with exposure of marine mammals to any high-intensity "pulsed" sound.

There is no conclusive evidence of cetacean strandings or deaths at sea as a result of exposure to seismic surveys, but a few cases of strandings in the general area where a seismic survey was ongoing have led to speculation concerning a possible link between seismic surveys and strandings. Suggestions that there was a link between seismic surveys and strandings of humpback whales in Brazil (Engel et al., 2004) were not well founded (IAGC, 2004; IWC, 2007). In September 2002, there was a stranding of two Cuvier's beaked whales in the Gulf of California, Mexico, when the L-DEO vessel R/V Maurice Ewing was operating a 20-airgun (8,490 in^3) array in the general area. The link between the stranding and the seismic surveys was inconclusive and not based on any physical evidence (Hogarth, 2002; Yoder, 2002). Nonetheless, the Gulf of California incident plus the beaked whale strandings near naval exercises involving use of mid-frequency sonar suggests a need for caution in conducting seismic surveys in areas occupied by beaked whales until more is known about effects of seismic surveys on those species (Hildebrand, 2005). No injuries of beaked whales are anticipated during the proposed study because of:

(1) The likelihood that any beaked whales nearby would avoid the approaching vessel before being exposed to high sound levels; and

(2) Differences between the sound sources operated by L-DEO and those involved in the naval exercises associated with strandings.

Non-auditory Physiological Effects

Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to strong underwater sound include stress, neurological effects, bubble formation, resonance, and other types of organ or tissue damage (Cox et al., 2006; Southall et al., 2007). Studies examining such effects are limited. However, resonance effects (Gentry, 2002) and direct noise-induced bubble formations (Crum et al., 2005) are implausible in the case of exposure to an impulsive broadband source like an airgun array. If seismic surveys disrupt diving patterns of deep-diving species, this might perhaps result in bubble formation and a form of the bends, as speculated to occur in beaked whales exposed to sonar. However, there is no specific evidence of this upon exposure to airgun pulses.

In general, very little is known about the potential for seismic survey sounds (or other types of strong underwater sounds) to cause non-auditory physical effects in marine mammals. Such effects, if they occur at all, would presumably be limited to short distances and to activities that extend over a prolonged period. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall et al., 2007), or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. Marine mammals that show behavioral avoidance of seismic vessels, including most baleen whales and some odontocetes, are especially unlikely to incur non-auditory physical effects.

Potential Effects of Other Acoustic Devices

MBES

L-DEO will operate the Kongsberg EM 122 MBES from the source vessel during the planned study. Sounds from the MBES are very short pulses, occurring for two to 15 ms once every five to 20 s, depending on water depth. Most of the energy in the sound pulses emitted by this MBES is at frequencies near 12 kHz, and the maximum source level is 242 dB re: 1 μPa. The beam is narrow (1 to 2º) in fore-aft extent and wide (150º) in the cross-track extent. Each ping consists of eight (in water greater than 1,000 m deep) or four (less than 1,000 m deep) successive fan-shaped transmissions (segments) at different cross-track angles. Any given mammal at depth near the trackline would be in the main beam for only one or two of the segments. Also, marine mammals that encounter the Kongsberg EM 122 are unlikely to be subjected to repeated pulses because of the narrow fore–aft width of the beam and will receive only limited amounts of pulse energy because of the short pulses. Animals close to the vessel (where the beam is narrowest) are especially unlikely to be ensonified for more than one 2- to 15-ms pulse (or two pulses if in the overlap area). Similarly, Kremser et al. (2005) noted that the probability of a cetacean swimming through the area of exposure when an MBES emits a pulse is small. The animal would have to pass the transducer at close range and be swimming at speeds similar to the vessel in order to receive the multiple pulses that might result in sufficient exposure to cause TTS.

Navy sonars that have been linked to avoidance reactions and stranding of cetaceans: (1) Generally have longer pulse duration than the Kongsberg EM 122; and (2) are often directed close to horizontally versus more downward for the MBES. The area of possible influence of the MBES is much smaller–a narrow band below the source vessel. Also, the duration of exposure for a given marine mammal can be much longer for naval sonar. During L-DEO's operations, the individual pulses will be very short, and a given mammal would not receive many of the downward-directed pulses as the vessel passes by. Possible effects of an MBES on marine mammals are outlined in this section.

Masking—Marine mammal communications will not be masked appreciably by the MBES signals given the low duty cycle of the echosounder and the brief period when an individual mammal is likely to be within its beam. Furthermore, in the case of baleen whales, the MBES signals (12 kHz) do not overlap with the predominant frequencies in the calls, which would avoid any significant masking.

Behavioral Responses—Behavioral reactions of free-ranging marine mammals to sonars, echosounders, and other sound sources appear to vary by species and circumstance. Observed reactions have included silencing and dispersal by sperm whales (Watkins et al., 1985), increased vocalizations and no dispersal by pilot whales (Globicephala melas) (Rendell and Gordon, 1999), and the previously-mentioned beachings by beaked whales. During exposure to a 21 to 25 kHz "whale-finding" sonar with a source level of 215 dB re: 1 µPa, gray whales reacted by orienting slightly away from the source and being deflected from their course by approximately 200 m (Frankel, 2005). When a 38-kHz echosounder and a 150-kHz acoustic Doppler current profiler were transmitting during studies in the eastern Tropical Pacific Ocean, baleen whales showed no significant responses, while spotted and spinner dolphins were detected slightly more often and beaked whales less often during visual surveys (Gerrodette and Pettis, 2005).

Captive bottlenose dolphins and a beluga whale exhibited changes in behavior when exposed to 1-s tonal signals at frequencies similar to those that will be emitted by the MBES used by L-DEO, and to shorter broadband pulsed signals. Behavioral changes typically involved what appeared to be deliberate attempts to avoid the sound exposure (Schlundt et al., 2000; Finneran et al., 2002; Finneran and Schlundt, 2004). The relevance of those data to free-ranging odontocetes is uncertain, and in any case, the test sounds were quite different in duration as compared with those from an MBES.

Hearing Impairment and Other Physical Effects–Given recent stranding events that have been associated with the operation of naval sonar, there is concern that mid-frequency sonar sounds can cause serious impacts to marine mammals (see above). However, the MBES proposed for use by L-DEO is quite different than sonar used for navy operations. Pulse duration of the MBES is very short relative to the naval sonar. Also, at any given location, an individual marine mammal would be in the beam of the MBES for much less time given the generally downward orientation of the beam and its narrow fore-aft beamwidth; navy sonar often uses near-horizontally-directed sound. Those factors would all reduce the sound energy received from the MBES rather drastically relative to that from naval sonar.

Based upon the best available science, NMFS believes that the brief exposure of marine mammals to one pulse, or small numbers of signals, from the MBES is not likely to result in the harassment of marine mammals.

SBP

L-DEO will also operate an SBP from the source vessel during the proposed survey. Sounds from the SBP are very short pulses, occurring for one to four ms once every second. Most of the energy in the sound pulses emitted by the SBP is at 3.5 kHz, and the beam is directed downward. The sub-bottom profiler on the Langseth has a maximum source level of 222 dB re: 1 μPa.

Kremser et al. (2005) noted that the probability of a cetacean swimming through the area of exposure when a bottom profiler emits a pulse is small—even for an SBP more powerful than that on the Langseth—if the animal was in the area, it would have to pass the transducer at close range and in order to be subjected to sound levels that could cause TTS.

Masking—Marine mammal communications will not be masked appreciably by the SBP signals given the directionality of the signal and the brief period when an individual mammal is likely to be within its beam. Furthermore, in the case of most baleen whales, the SBP signals do not overlap with the predominant frequencies in the calls, which would avoid significant masking.

Behavioral Responses—Marine mammal behavioral reactions to other pulsed sound sources are discussed above, and responses to the SBP are likely to be similar to those for other pulsed sources if received at the same levels. However, the pulsed signals from the SBP are considerably weaker than those from the MBES. Therefore, behavioral responses are not expected unless marine mammals are very close to the source.

Hearing Impairment and Other Physical Effects—It is unlikely that the SBP produces pulse levels strong enough to cause hearing impairment or other physical injuries even in an animal that is (briefly) in a position near the source. The SBP is usually operated simultaneously with other higher-power acoustic sources. Many marine mammals will move away in response to the approaching higher-power sources or the vessel itself before the mammals would be close enough for there to be any possibility of effects from the less intense sounds from the SBP. Based upon the best available science, NMFS believes that the brief exposure of marine mammals to signals from the SBP is not likely to result in the harassment of marine mammals.

Potential Effects of Vessel Movement and Collisions

Vessel movement in the vicinity of marine mammals has the potential to result in either a behavioral response or a direct physical interaction. Both scenarios are discussed below this section.

Behavioral Responses to Vessel Movement

There are limited data concerning marine mammal behavioral responses to vessel traffic and vessel noise, and a lack of consensus among scientists with respect to what these responses mean or whether they result in short-term or long-term adverse effects. In those cases where there is a busy shipping lane or where there is a large amount of vessel traffic, marine mammals may experience acoustic masking (Hildebrand, 2005) if they are present in the area (e.g., killer whales in Puget Sound; Foote et al., 2004; Holt et al., 2008). In cases where vessels actively approach marine mammals (e.g., whale watching or dolphin watching boats), scientists have documented that animals exhibit altered behavior such as increased swimming speed, erratic movement, and active avoidance behavior (Bursk, 1983; Acevedo, 1991; Baker and MacGibbon, 1991; Trites and Bain, 2000; Williams et al., 2002; Constantine et al., 2003), reduced blow interval (Ritcher et al., 2003), disruption of normal social behaviors (Lusseau, 2003; 2006), and the shift of behavioral activities which may increase energetic costs (Constantine et al., 2003; 2004)). A detailed review of marine mammal reactions to ships and boats is available in Richardson et al. (1995). For each of the marine mammal taxonomy groups, Richardson et al. (1995) provides the following assessment regarding reactions to vessel traffic:

Toothed whales:. "In summary, toothed whales sometimes show no avoidance reaction to vessels, or even approach them. However, avoidance can occur, especially in response to vessels of types used to chase or hunt the animals. This may cause temporary displacement, but we know of no clear evidence that toothed whales have abandoned significant parts of their range because of vessel traffic."

Baleen whales:. "When baleen whales receive low-level sounds from distant or stationary vessels, the sounds often seem to be ignored. Some whales approach the sources of these sounds. When vessels approach whales slowly and non-aggressively, whales often exhibit slow and inconspicuous avoidance maneuvers. In response to strong or rapidly changing vessel noise, baleen whales often interrupt their normal behavior and swim rapidly away. Avoidance is especially strong when a boat heads directly toward the whale."

Behavioral responses to stimuli are complex and influenced to varying degrees by a number of factors, such as species, behavioral contexts, geographical regions, source characteristics (moving or stationary, speed, direction, etc.), prior experience of the animal and physical status of the animal. For example, studies have shown that beluga whales' reactions varied when exposed to vessel noise and traffic. In some cases, naive beluga whales exhibited rapid swimming from ice-breaking vessels up to 80 km (49.7 mi) away, and showed changes in surfacing, breathing, diving, and group composition in the Canadian high Arctic where vessel traffic is rare (Finley et al., 1990). In other cases, beluga whales were more tolerant of vessels, but responded differentially to certain vessels and operating characteristics by reducing their calling rates (especially older animals) in the St. Lawrence River where vessel traffic is common (Blane and Jaakson, 1994). In Bristol Bay, Alaska, beluga whales continued to feed when surrounded by fishing vessels and resisted dispersal even when purposefully harassed (Fish and Vania, 1971).

In reviewing more than 25 years of whale observation data, Watkins (1986) concluded that whale reactions to vessel traffic were "modified by their previous experience and current activity: habituation often occurred rapidly, attention to other stimuli or preoccupation with other activities sometimes overcame their interest or wariness of stimuli." Watkins noticed that over the years of exposure to ships in the Cape Cod area, minke whales changed from frequent positive interest (e.g., approaching vessels) to generally uninterested reactions; fin whales changed from mostly negative (e.g., avoidance) to uninterested reactions; right whales apparently continued the same variety of responses (negative, uninterested, and positive responses) with little change; and humpbacks dramatically changed from mixed responses that were often negative to reactions that were often strongly positive. Watkins (1986) summarized that "whales near shore, even in regions with low vessel traffic, generally have become less wary of boats and their noises, and they have appeared to be less easily disturbed than previously. In particular locations with intense shipping and repeated approaches by boats (such as the whale-watching areas of Stellwagen Bank), more and more whales had positive reactions to familiar vessels, and they also occasionally approached other boats and yachts in the same ways."

Although the radiated sound from the Langseth will be audible to marine mammals over a large distance, it is unlikely that animals will respond behaviorally (in a manner that NMFS would consider MMPA harassment) to low-level distant shipping noise as the animals in the area are likely to be habituated to such noises (Nowacek et al., 2004). In light of these facts, NMFS does not expect the Langseth's movements to result in Level B harassment.

Vessel Strike

Ship strikes of cetaceans can cause major wounds, which may lead to the death of the animal. An animal at the surface could be struck directly by a vessel, a surfacing animal could hit the bottom of a vessel, or an animal just below the surface could be cut by a vessel's propeller. The severity of injuries typically depends on the size and speed of the vessel (Knowlton and Kraus, 2001; Laist et al., 2001; Vanderlaan and Taggart, 2007).

The most vulnerable marine mammals are those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (e.g., the sperm whale). In addition, some baleen whales, such as the North Atlantic right whale, seem generally unresponsive to vessel sound, making them more susceptible to vessel collisions (Nowacek et al., 2004). These species are primarily large, slow moving whales. Smaller marine mammals (e.g., bottlenose dolphin) move quickly through the water column and are often seen riding the bow wave of large ships. Marine mammal responses to vessels may include avoidance and changes in dive pattern (NRC, 2003).

An examination of all known ship strikes from all shipping sources (civilian and military) indicates vessel speed is a principal factor in whether a vessel strike results in death (Knowlton and Kraus, 2001; Laist et al., 2001; Jensen and Silber, 2003; Vanderlaan and Taggart, 2007). In assessing records in which vessel speed was known, Laist et al. (2001) found a direct relationship between the occurrence of a whale strike and the speed of the vessel involved in the collision. The authors concluded that most deaths occurred when a vessel was traveling in excess of 14.9 mph (24.1 km/hr;13 kts).

L-DEO's proposed operation of one vessel for the proposed survey is relatively small in scale compared to the number of commercial ships transiting at higher speeds in the same areas on an annual basis. The probability of vessel and marine mammal interactions occurring during proposed survey is unlikely due to the Langseth's slow operational speed, which is typically 4.6 kts (8.5 km/h; 5.3 mph). Outside of operations, the Langseth's cruising speed would be approximately 11.5 mph (18.5 km/h; 10 kts) which is generally below the speed at which studies have noted reported increases of marine mammal injury or death (Laist et al., 2001).

As a final point, the Langseth has a number of other advantages for avoiding ship strikes as compared to most commercial merchant vessels, including the following: the Langseth's bridge offers good visibility to visually monitor for marine mammal presence; PSVOs posted during operations scan the ocean for marine mammals and must report visual alerts of marine mammal presence to crew; and the PSVOs receive extensive training that covers the fundamentals of visual observing for marine mammals and information about marine mammals and their identification at sea.

The potential effects to marine mammals described in this section of the document do not take into consideration the proposed monitoring and mitigation measures described later in this document (see the ''Proposed Mitigation'' and ''Proposed Monitoring and Reporting'' sections) which, as noted are designed to effect the least practicable adverse impact on affected marine mammal species and stocks.

Anticipated Effects on Marine Mammal Habitat

The proposed seismic survey is not anticipated to have any permanent impact on habitats used by the marine mammals in the proposed survey area, including the food sources they use (i.e., fish and invertebrates). Additionally, no physical damage to any habitat is anticipated as a result of conducting the proposed seismic survey. While it is anticipated that the specified activity may result in marine mammals avoiding certain areas due to temporary ensonification, this impact to habitat is temporary and reversible and was considered in further detail earlier in this document, as behavioral modification.

The main impact associated with the proposed activity will be temporarily elevated noise levels and the associated direct effects on marine mammals, previously discussed in this notice. The next section discusses the potential impacts of anthropogenic sound sources on common marine mammal prey in the proposed survey area (i.e., fish and invertebrates).

Anticipated Effects on Fish

One reason for the adoption of airguns as the standard energy source for marine seismic surveys is that, unlike explosives, they have not been associated with large-scale fish kills. However, existing information on the impacts of seismic surveys on marine fish populations is limited (see Appendix D of NSF's EA). There are three types of potential effects of exposure to seismic surveys: (1) Pathological, (2) physiological, and (3) behavioral. Pathological effects involve lethal and temporary or permanent sub-lethal injury. Physiological effects involve temporary and permanent primary and secondary stress responses, such as changes in levels of enzymes and proteins. Behavioral effects refer to temporary and (if they occur) permanent changes in exhibited behavior (e.g., startle and avoidance behavior). The three categories are interrelated in complex ways. For example, it is possible that certain physiological and behavioral changes could potentially lead to an ultimate pathological effect on individuals (i.e., mortality).

The specific received sound levels at which permanent adverse effects to fish potentially could occur are little studied and largely unknown. Furthermore, the available information on the impacts of seismic surveys on marine fish is from studies of individuals or portions of a population; there have been no studies at the population scale. The studies of individual fish have often been on caged fish that were exposed to airgun pulses in situations not representative of an actual seismic survey. Thus, available information provides limited insight on possible real-world effects at the ocean or population scale.

Hastings and Popper (2005), Popper (2009), and Popper and Hastings (2009a,b) provided recent critical reviews of the known effects of sound on fish. The following sections provide a general synopsis of the available information on the effects of exposure to seismic and other anthropogenic sound as relevant to fish. The information comprises results from scientific studies of varying degrees of rigor plus some anecdotal information. Some of the data sources may have serious shortcomings in methods, analysis, interpretation, and reproducibility that must be considered when interpreting their results (see Hastings and Popper, 2005). Potential adverse effects of the program's sound sources on marine fish are then noted.

Pathological Effects–The potential for pathological damage to hearing structures in fish depends on the energy level of the received sound and the physiology and hearing capability of the species in question (see Appendix D of NSF's EA). For a given sound to result in hearing loss, the sound must exceed, by some substantial amount, the hearing threshold of the fish for that sound (Popper, 2005). The consequences of temporary or permanent hearing loss in individual fish on a fish population are unknown; however, they likely depend on the number of individuals affected and whether critical behaviors involving sound (e.g., predator avoidance, prey capture, orientation and navigation, reproduction, etc.) are adversely affected.

Little is known about the mechanisms and characteristics of damage to fish that may be inflicted by exposure to seismic survey sounds. Few data have been presented in the peer-reviewed scientific literature. As far as we know, there are only two papers with proper experimental methods, controls, and careful pathological investigation implicating sounds produced by actual seismic survey airguns in causing adverse anatomical effects. One such study indicated anatomical damage, and the second indicated TTS in fish hearing. The anatomical case is McCauley et al. (2003), who found that exposure to airgun sound caused observable anatomical damage to the auditory maculae of pink snapper (Pagrus auratus). This damage in the ears had not been repaired in fish sacrificed and examined almost two months after exposure. On the other hand, Popper et al. (2005) documented only TTS (as determined by auditory brainstem response) in two of three fish species from the Mackenzie River Delta. This study found that broad whitefish (Coregonus nasus) exposed to five airgun shots were not significantly different from those of controls. During both studies, the repetitive exposure to sound was greater than would have occurred during a typical seismic survey. However, the substantial low-frequency energy produced by the airguns (less than 400 Hz in the study by McCauley et al. [2003] and less than approximately 200 Hz in Popper et al. [2005]) likely did not propagate to the fish because the water in the study areas was very shallow (approximately 9 m in the former case and less than two m in the latter). Water depth sets a lower limit on the lowest sound frequency that will propagate (the "cutoff frequency") at about one-quarter wavelength (Urick, 1983; Rogers and Cox, 1988).

Wardle et al. (2001) suggested that in water, acute injury and death of organisms exposed to seismic energy depends primarily on two features of the sound source: (1) The received peak pressure, and (2) the time required for the pressure to rise and decay. Generally, as received pressure increases, the period for the pressure to rise and decay decreases, and the chance of acute pathological effects increases. According to Buchanan et al. (2004), for the types of seismic airguns and arrays involved with the proposed program, the pathological (mortality) zone for fish would be expected to be within a few meters of the seismic source. Numerous other studies provide examples of no fish mortality upon exposure to seismic sources (Falk and Lawrence, 1973; Holliday et al., 1987; La Bella et al., 1996; Santulli et al., 1999; McCauley et al., 2000a,b, 2003; Bjarti, 2002; Thomsen, 2002; Hassel et al., 2003; Popper et al., 2005; Boeger et al., 2006).

Some studies have reported, some equivocally, that mortality of fish, fish eggs, or larvae can occur close to seismic sources (Kostyuchenko, 1973; Dalen and Knutsen, 1986; Booman et al., 1996; Dalen et al., 1996). Some of the reports claimed seismic effects from treatments quite different from actual seismic survey sounds or even reasonable surrogates. However, Payne et al. (2009) reported no statistical differences in mortality/morbidity between control and exposed groups of capelin eggs or monkfish larvae. Saetre and Ona (1996) applied a 'worst-case scenario' mathematical model to investigate the effects of seismic energy on fish eggs and larvae. They concluded that mortality rates caused by exposure to seismic surveys are so low, as compared to natural mortality rates, that the impact of seismic surveying on recruitment to a fish stock must be regarded as insignificant.

Physiological Effects—Physiological effects refer to cellular and/or biochemical responses of fish to acoustic stress. Such stress potentially could affect fish populations by increasing mortality or reducing reproductive success. Primary and secondary stress responses of fish after exposure to seismic survey sound appear to be temporary in all studies done to date (Sverdrup et al., 1994; Santulli et al., 1999; McCauley et al., 2000a,b). The periods necessary for the biochemical changes to return to normal are variable and depend on numerous aspects of the biology of the species and of the sound stimulus (see Appendix D of NSF's EA).

Behavioral Effects—Behavioral effects include changes in the distribution, migration, mating, and catchability of fish populations. Studies investigating the possible effects of sound (including seismic survey sound) on fish behavior have been conducted on both uncaged and caged individuals (e.g., Chapman and Hawkins, 1969; Pearson et al., 1992; Santulli et al., 1999; Wardle et al., 2001; Hassel et al., 2003). Typically, in these studies fish exhibited a sharp startle response at the onset of a sound followed by habituation and a return to normal behavior after the sound ceased.

In general, any adverse effects on fish behavior or fisheries attributable to seismic testing may depend on the species in question and the nature of the fishery (season, duration, fishing method). They may also depend on the age of the fish, its motivational state, its size, and numerous other factors that are difficult, if not impossible, to quantify at this point, given such limited data on effects of airguns on fish, particularly under realistic at-sea conditions.

Anticipated Effects on Fisheries

It is possible that the Langseth's streamer may become entangled with various types of fishing gear. L–DEO will employ avoidance tactics as necessary to prevent conflict. It is not expected that L–DEO's operations will have a significant impact on fisheries in the western Pacific Ocean. Nonetheless, L–DEO will minimize the potential to have a negative impact on the fisheries by avoiding areas where fishing is actively underway.

There is general concern about potential adverse effects of seismic operations on fisheries, namely a potential reduction in the ‘‘catchability’’ of fish involved in fisheries. Although reduced catch rates have been observed in some marine fisheries during seismic testing, in a number of cases the findings are confounded by other sources of disturbance (Dalen and Raknes, 1985; Dalen and Knutsen, 1986; Lokkeborg, 1991; Skalski et al., 1992; Engas et al., 1996). In other airgun experiments, there was no change in catch per unit effort of fish when airgun pulses were emitted, particularly in the immediate vicinity of the seismic survey (Pickett et al., 1994; La Bella et al., 1996). For some species, reductions in catch may have resulted from a change in behavior of the fish, e.g., a change in vertical or horizontal distribution, as reported in Slotte et al. (2004).

Anticipated Effects on Invertebrates

The existing body of information on the impacts of seismic survey sound on marine invertebrates is very limited. However, there is some unpublished and very limited evidence of the potential for adverse effects on invertebrates, thereby justifying further discussion and analysis of this issue. The three types of potential effects of exposure to seismic surveys on marine invertebrates are pathological, physiological, and behavioral. Based on the physical structure of their sensory organs, marine invertebrates appear to be specialized to respond to particle displacement components of an impinging sound field and not to the pressure component (Popper et al., 2001; see also Appendix E of NSF's EA).

The only information available on the impacts of seismic surveys on marine invertebrates involves studies of individuals; there have been no studies at the population scale. Thus, available information provides limited insight on possible real-world effects at the regional or ocean scale. The most important aspect of potential impacts concerns how exposure to seismic survey sound ultimately affects invertebrate populations and their viability, including availability to fisheries.

Literature reviews of the effects of seismic and other underwater sound on invertebrates were provided by Moriyasu et al. (2004) and Payne et al. (2008). The following sections provide a synopsis of available information on the effects of exposure to seismic survey sound on species of decapod crustaceans and cephalopods, the two taxonomic groups of invertebrates on which most such studies have been conducted. The available information is from studies with variable degrees of scientific soundness and from anecdotal information. A more detailed review of the literature on the effects of seismic survey sound on invertebrates is provided in Appendix E of L-DEO's EA.

Pathological Effects–In water, lethal and sub-lethal injury to organisms exposed to seismic survey sound appears to depend on at least two features of the sound source: (1) The received peak pressure; and (2) the time required for the pressure to rise and decay. Generally, as received pressure increases, the period for the pressure to rise and decay decreases, and the chance of acute pathological effects increases. For the type of airgun array planned for the proposed program, the pathological (mortality) zone for crustaceans and cephalopods is expected to be within a few meters of the seismic source, at most; however, very few specific data are available on levels of seismic signals that might damage these animals. This premise is based on the peak pressure and rise/decay time characteristics of seismic airgun arrays currently in use around the world.

Some studies have suggested that seismic survey sound has a limited pathological impact on early developmental stages of crustaceans (Pearson et al., 1994; Christian et al., 2003; DFO, 2004). However, the impacts appear to be either temporary or insignificant compared to what occurs under natural conditions. Controlled field experiments on adult crustaceans (Christian et al., 2003, 2004; DFO, 2004) and adult cephalopods (McCauley et al., 2000a,b) exposed to seismic survey sound have not resulted in any significant pathological impacts on the animals. It has been suggested that exposure to commercial seismic survey activities has injured giant squid (Guerra et al., 2004), but the article provides little evidence to support this claim.

Andre et al. (2011) exposed four cephalopod species (Loligo vulgaris, Sepia officinalis, Octopus vulgaris, and Ilex coindetii) to two hours of continuous sound from 50 to 400 Hz at 157 ± 5 dB re: 1 μPa. They reported lesions to the sensory hair cells of the statocysts of the exposed animals that increased in severity with time, suggesting that cephalopods are particularly sensitive to low-frequency sound.

The received SPL was reported as 157 +/- 5 dB re: 1 μPa, with peak levels at 175 dB re 1 μPa. As in the McCauley et al. (2003) paper on sensory hair cell damage in pink snapper as a result of exposure to seismic sound, the cephalopods were subjected to higher sound levels than they would be under natural conditions, and they were unable to swim away from the sound source.

Physiological Effects—Physiological effects refer mainly to biochemical responses by marine invertebrates to acoustic stress. Such stress potentially could affect invertebrate populations by increasing mortality or reducing reproductive success. Primary and secondary stress responses (i.e., changes in haemolymph levels of enzymes, proteins, etc.) of crustaceans have been noted several days or months after exposure to seismic survey sounds (Payne et al., 2007). The periods necessary for these biochemical changes to return to normal are variable and depend on numerous aspects of the biology of the species and of the sound stimulus.

Behavioral Effects–There is increasing interest in assessing the possible direct and indirect effects of seismic and other sounds on invertebrate behavior, particularly in relation to the consequences for fisheries. Changes in behavior could potentially affect such aspects as reproductive success, distribution, susceptibility to predation, and catchability by fisheries. Studies investigating the possible behavioral effects of exposure to seismic survey sound on crustaceans and cephalopods have been conducted on both uncaged and caged animals. In some cases, invertebrates exhibited startle responses (e.g., squid in McCauley et al., 2000a,b). In other cases, no behavioral impacts were noted (e.g., crustaceans in Christian et al., 2003, 2004; DFO, 2004). There have been anecdotal reports of reduced catch rates of shrimp shortly after exposure to seismic surveys; however, other studies have not observed any significant changes in shrimp catch rate (Andriguetto-Filho et al., 2005). Similarly, Parry and Gason (2006) did not find any evidence that lobster catch rates were affected by seismic surveys. Any adverse effects on crustacean and cephalopod behavior or fisheries attributable to seismic survey sound depend on the species in question and the nature of the fishery (season, duration, fishing method).

Proposed Mitigation

In order to issue an incidental take authorization (ITA) under section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable adverse impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and the availability of such species or stock for taking for certain subsistence uses.

L-DEO has based the mitigation measures described herein, to be implemented for the proposed seismic survey, on the following:

(1) Protocols used during previous L-DEO seismic research cruises as approved by NMFS;

(2) Previous IHA applications and IHAs approved and authorized by NMFS; and

(3) Recommended best practices in Richardson et al. (1995), Pierson et al. (1998), and Weir and Dolman, (2007).

To reduce the potential for disturbance from acoustic stimuli associated with the activities, L-DEO and/or its designees would implement the following mitigation measures for marine mammals:

(1) Proposed EZs;

(2) Power-down procedures;

(3) Shutdown procedures; and

(4) Ramp-up procedures.

Proposed Exclusion Zones - L-DEO uses safety radii to designate EZs and to estimate take for marine mammals. Table 1 (presented earlier in this document) shows the distances at which three sound levels (160-, 180-, and 190-dB) are expected to be received from the 36-airgun array and a single airgun. The 180-dB and 190-dB level shut-down criteria are applicable to cetaceans and pinnipeds, respectively, as specified by NMFS (2000); and L-DEO used these levels to establish the EZs.

If the protected species visual observer (PSVO) detects marine mammal(s) within or about to enter the appropriate EZ, the Langseth crew will immediately power down the airgun array, or perform a shut down if necessary (see Shut-down Procedures).

Power-down Procedures - A power-down involves decreasing the number of airguns in use such that the radius of the 180-dB (or 190-dB) zone is decreased to the extent that marine mammals are no longer in or about to enter the EZ. A power down of the airgun array can also occur when the vessel is moving from one seismic line to another. During a power-down for mitigation, L-DEO will operate one airgun (40 in^3). The continued operation of one airgun is intended to alert marine mammals to the presence of the seismic vessel in the area. In contrast, a shutdown occurs when the Langseth suspends all airgun activity.

If the PSVO detects a marine mammal outside the EZ, which is likely to enter the EZ, L-DEO will power-down the airguns before the animal enters the EZ. Likewise, if a mammal is already within the EZ, when first detected L-DEO will power-down the airguns immediately. During a power down of the airgun array, L-DEO will operate the

40-in^3 airgun. If a marine mammal is detected within or near the smaller EZ around that single airgun (Table 1), L-DEO will shut down the airgun (see next section).

Following a power-down, L-DEO will not resume airgun activity until the marine mammal has cleared the safety zone. L-DEO will consider the animal to have cleared the EZ if:

- A PSVO has visually observed the animal leave the EZ, or
- A PSVO has not sighted the animal within the EZ for 15 min for species with shorter dive durations (i.e., small odontocetes or pinnipeds), or 30 min for species with longer dive durations (i.e., mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, and beaked whales); or
- The vessel has moved outside the EZ (e.g., if a marine mammal is sighted close to the vessel and the ship speed is 8.5 km km/h (5.3 mph), it would take the vessel approximately eight minutes to leave the vicinity of the marine mammal).

During airgun operations following a power-down or shutdown whose duration has exceeded the time limits specified previously, L–DEO will ramp up the airgun array gradually (see Shutdown and Ramp-up Procedures).

Shut-down Procedures - L-DEO will shut down the operating airgun(s) if a marine mammal is seen within or approaching the EZ for the single airgun. L-DEO will implement a shut-down:

(1) If an animal enters the EZ of the single airgun after L-DEO has initiated a power down; or

(2) If an animal is initially seen within the EZ of the single airgun when more than one airgun (typically the full airgun array) is operating.

L-DEO will not resume airgun activity until the marine mammal has cleared the EZ, or until the PSVO is confident that the animal has left the vicinity of the vessel. Criteria for judging that the animal has cleared the EZ will be as described in the preceding section.

Considering the conservation status for north Pacific right whales, L-DEO will shut down the airgun(s) immediately in the unlikely event that this species is observed, regardless of the distance from the Langseth. L-DEO will only begin a ramp-up if the right whale has not been seen for 30 min.

Ramp-up Procedures - L-DEO will follow a ramp-up procedure when the airgun subarrays begin operating after a specified period without airgun operations or when a power down has exceeded that period. L-DEO proposes that, for the present cruise, this period will be approximately eight minutes. This period is based on the 180-dB radius (940 m; 3,083 ft) for the 36-airgun array towed at a depth of 9 m (29.5 ft) in relation to the minimum planned speed of the Langseth while shooting (8.5 km/h; 5.3 mph; 4.6 kts). L-DEO has used similar periods (8-10 min) during previous L-DEO surveys. L-DEO will not resume operations if a marine mammal has not cleared the EZ as described earlier.

Ramp-up will begin with the smallest airgun in the array (40-in^3). Airguns will be added in a sequence such that the source level of the array will increase in steps not exceeding six dB per five-minute period over a total duration of approximately 30 min. During ramp-up, the PSVOs will monitor the EZ, and if he/she sights a marine mammal, L-DEO will implement a power down or shut down as though the full airgun array were operational.

If the complete EZ is not visible to the PSVO for at least 30 min prior to the start of operations in either daylight or nighttime, L-DEO will not commence the ramp-up unless at least one airgun (40-in^3 or similar) has been operating during the interruption of seismic survey operations. Given these provisions, it is likely that L-DEO will not ramp up the airgun array from a complete shut-down at night or in thick fog, because the outer part of the EZ for that array will not be visible during those conditions. If one airgun has operated during a power-down period, ramp-up to full power will be permissible at night or in poor visibility, on the assumption that marine mammals will be alerted to the approaching seismic vessel by the sounds from the single airgun and could move away. L-DEO will not initiate a ramp-up of the airguns if a marine mammal is sighted within or near the applicable EZs during the day or close to the vessel at night.

NMFS has carefully evaluated the applicant's proposed mitigation measures and has considered a range of other measures in the context of ensuring that NMFS prescribed the means of effecting the least practicable adverse impact on the affected marine mammal species and stocks and their habitat. NMFS' evaluation of potential measures included consideration of the following factors in relation to one another:

(1) The manner in which, and the degree to which, the successful implementation of the measure is expected to minimize adverse impacts to marine mammals;

(2) The proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and

(3) The practicability of the measure for applicant implementation.

Based on NMFS' evaluation of the applicant's proposed measures, as well as other measures considered by NMFS or recommended by the public, NMFS has preliminarily determined that the mitigation measures provide the means of effecting the least practicable adverse impacts on marine mammals species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Proposed Monitoring and Reporting

In order to issue an ITA for an activity, section 101(a)(5)(D) of the MMPA states that NMFS must set forth "requirements pertaining to the monitoring and reporting of such taking." The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for IHAs must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the action area.

Proposed Monitoring

L-DEO proposes to sponsor marine mammal monitoring during the present project, in order to implement the mitigation measures that require real-time monitoring, and to satisfy the monitoring requirements of the IHA. L-DEO's proposed Monitoring Plan is described below this section. L-DEO understands that this monitoring plan will be 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. L-DEO 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

L-DEO will position PSVOs aboard the seismic source vessel to watch for marine mammals near the vessel during daytime airgun operations and during any start-ups at night. PSVOs will also watch for marine mammals near the seismic vessel for at least 30 min prior to the start of airgun operations after an extended shut down (i.e., greater than approximately eight minutes for this proposed cruise). When feasible, the PSVOs will conduct observations during daytime periods when the seismic system is not operating for comparison of sighting rates and behavior with and without airgun operations and between acquisition periods. Based on PSVO observations, the Langseth will power down or shut down the airguns when marine mammals are observed within or about to enter a designated EZ. The EZ is a region in which a possibility exists of adverse effects on animal hearing or other physical effects.

During seismic operations on the Shatsky Rise, at least four protected species observers (PSO) (i.e., either a PSVO and/or a protected species acoustic observer (PSAO)) will be based aboard the Langseth. L-DEO will appoint the PSOs with NMFS' concurrence. The PSOs will conduct observations during ongoing daytime operations and nighttime ramp-ups of the airgun array. During the majority of seismic operations, two PSVOs will be on duty from the observation tower to monitor marine mammals near the seismic vessel. Use of two simultaneous PSVOs will increase the effectiveness of detecting animals near the source vessel. However, during mealtimes and bathroom breaks, it is sometimes difficult to have two PSVOs on effort, but at least one PSVO will be on watch during bathroom breaks and mealtimes. PSVOs will be on duty in shifts of no longer than four hours in duration.

Two PSVOs will also be on visual watch during all nighttime ramp-ups of the seismic airguns. A third PSAO will monitor the PAM equipment 24 hours a day to detect vocalizing marine mammals present in the action area. In summary, a typical daytime cruise would have scheduled two PSVOs on duty from the observation tower, and a third PSAO on PAM. Other crew will also be instructed to assist in detecting marine mammals and implementing mitigation requirements (if practical). Before the start of the seismic survey, the crew will be given additional instruction on how to do so.

The Langseth is a suitable platform for marine mammal observations. When stationed on the observation platform, the eye level will be approximately 21.5 m (70.5 ft) above sea level, and the observer will have a good view around the entire vessel. During daytime, the PSVOs will scan the area around the vessel systematically with reticle binoculars (e.g., 7 x 50 Fujinon), Big-eye binoculars (25 x 150), and with the naked eye. During darkness, night vision devices (NVDs) will be available (ITT F500 Series Generation 3 binocular-image intensifier or equivalent), when required. Laser range-finding binoculars (Leica LRF 1200 laser rangefinder or equivalent) will be available to assist with distance estimation. Those are useful in training observers to estimate distances visually, but are generally not useful in measuring distances to animals directly; that is done primarily with the reticles in the binoculars.

When the PSVOs observe marine mammals within or about to enter the designated EZ, the Langseth will immediately power-down or shut-down the airguns if necessary. The PSVO(s) will continue to maintain watch to determine when the animal(s) are outside the EZ by visual confirmation. Airgun operations will not resume until the animal is confirmed to have left the EZ, or if not observed after 15 min for species with shorter dive durations (small odontocetes and pinnipeds) or 30 min for species with longer dive durations (mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, killer, and beaked whales).

Passive Acoustic Monitoring

Passive Acoustic Monitoring (PAM) will complement the visual monitoring program, when practicable. Visual monitoring typically is not effective during periods of poor visibility or at night, and even with good visibility, is unable to detect marine mammals when they are below the surface or beyond visual range. Acoustical monitoring can be used in conjunction with visual observations to improve detection, identification, and localization of cetaceans. The acoustic monitoring will serve to alert visual observers (if on duty) when vocalizing cetaceans are detected. It is only useful when marine mammals call, but it can be effective either by day or by night, and does not depend on good visibility. The PSAO will monitor the system in real time so that he/she can advise the PSVO when cetaceans are detected. When bearings (primary and mirror-image) to calling cetacean(s) are determined, the bearings will be relayed to the visual observer to help him/her sight the calling animal(s).

The PAM system consists of hardware (i.e., hydrophones) and software. The "wet end" of the system consists of a towed hydrophone array that is connected to the vessel by a tow cable. The tow cable is 250 m (820.2 ft) long, and the hydrophones are fitted in the last 10 m (32.8 ft) of cable. A depth gauge is attached to the free end of the cable, and the cable is typically towed at depths less than 20 m (65.6 ft). L-DEO will deploy the array from a winch located on the back deck. A deck cable will connect the tow cable to the electronics unit in the main computer lab where the acoustic station, signal conditioning, and processing system will be located. The acoustic signals received by the hydrophones are amplified, digitized, and then processed by the Pamguard software. The system can detect marine mammal vocalizations at frequencies up to 250 kHz.

One PSAO, an expert bioacoustician with primary responsibility for PAM will be aboard the Langseth in addition to the four PSVOs. The PSAO will monitor the towed hydrophones 24 h per day during airgun operations and during most periods when the Langseth is underway while the airguns are not operating. However, PAM may not be possible if damage occurs to both the primary and back-up hydrophone arrays during operations. The primary PAM streamer on the Langseth is a digital hydrophone streamer. Should the digital streamer fail, back-up systems should include an analog spare streamer and a hull-mounted hydrophone.

One PSAO will monitor the acoustic detection system by listening to the signals from two channels via headphones and/or speakers and watching the real-time spectrographic display for frequency ranges produced by cetaceans. The PSAO monitoring the acoustical data will be on shift for one to six hours at a time. The other PSVOs are expected to rotate through the PAM position, although the expert PSAO will be on PAM duty more frequently.

When a vocalization is detected while visual observations are in progress, the PSAO on duty will contact the visual PSVO immediately, to alert him/her to the presence of cetaceans (if they have not already been seen), and to allow a power down or shut down to be initiated, if required. The information regarding the call will be entered into a database. Data entry will include an acoustic encounter identification number, whether it was linked with a visual sighting, date, time when first and last heard and whenever any additional information was recorded, position and water depth when first detected, bearing if determinable, species or species group (e.g., unidentified dolphin, sperm whale), types and nature of sounds heard (e.g., clicks, continuous, sporadic, whistles, creaks, burst pulses, strength of signal, etc.), and any other notable information. The acoustic detection can also be recorded for further analysis.

PSVO Data and Documentation

PSVOs will 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 will be used to estimate numbers of animals potentially 'taken' by harassment (as defined in the MMPA). They will also provide information needed to order a power down or shut down of the airguns when a marine mammal is within or near the EZ.

When a sighting is made, the following information about the sighting will 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, sea state, visibility, and sun glare.

The data listed under (2) 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 power downs or shut downs will be recorded in a standardized format. Data will be entered into an electronic database. The accuracy of the data entry will be verified by computerized data validity checks as the data are entered and by subsequent manual checking of the database. These procedures will allow initial summaries of data to be prepared during and shortly after the field program, and will facilitate transfer of the data to statistical, graphical, and other programs for further processing and archiving.

Results from the vessel-based observations will provide:

1. The basis for real-time mitigation (airgun power down or shut down).

2. Information needed to estimate the number of marine mammals potentially taken by harassment, which must be reported to NMFS.

3. Data on the occurrence, distribution, and activities of marine mammals and turtles in the area where the seismic study is conducted.

4. Information to compare the distance and distribution of marine mammals and turtles 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.

Proposed Reporting

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

In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by the IHA (if issued), such as an injury (Level A harassment), serious injury or mortality (e.g., ship-strike, gear interaction, and/or entanglement), L-DEO shall immediately cease the specified activities and immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to Michael.Payne@noaa.gov and ITP.Cody@noaa.gov and the NMFS Pacific Islands Regional Stranding Coordinator at 808-944-2269 (David.Schofield@noaa.gov). The report must include the following information:

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

- Fate of the animal(s); and
- Photographs or video footage of the animal(s) (if equipment is available).

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

In the event that L-DEO discovers an injured or dead marine mammal, and the lead PSVO determines that the cause of the injury or death is unknown and the death is relatively recent (i.e., in less than a moderate state of decomposition as described in the next paragraph), L-DEO will immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to Michael.Payne@noaa.gov and ITP.Cody@noaa.gov and the NMFS Pacific Islands Regional Stranding Coordinator at 808-944-2269 (David.Schofield@noaa.gov). The report must include the same information identified in the paragraph above this section. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with L-DEO to determine whether modifications in the activities are appropriate.

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

Estimated Take by Incidental Harassment

Except with respect to certain activities not pertinent here, the MMPA defines "harassment" as:

any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment].

Only take by Level B harassment is proposed to be authorized as a result of the marine geophysical survey in the northwestern Pacific Ocean. Acoustic stimuli (i.e., increased underwater sound) generated during the operation of the seismic airgun array may have the potential to cause marine mammals in the survey area to be exposed to sounds at or greater than 160 dB or cause temporary, short-term changes in behavior. There is no evidence that the planned activities could result in injury, serious injury or mortality within the specified geographic area for which L-DEO seeks the IHA. The required mitigation and monitoring measures will minimize any potential risk for injury, serious injury, or mortality.

The following sections describe L–DEO’s methods to estimate take by incidental harassment and present the applicant’s estimates of the numbers of marine mammals that could be affected during the proposed seismic program. The estimates are based on a consideration of the number of marine mammals that could be disturbed appreciably by operations with the 36-airgun array to be used during approximately 1,216 km (755.6 mi) of survey lines on the Shatsky Rise in the northwestern Pacific Ocean.

L-DEO assumes that, during simultaneous operations of the airgun array and the other sources, any marine mammals close enough to be affected by the MBES and SBP 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 and SBP given their characteristics (e.g., narrow downward-directed beam) and other considerations described previously. Such reactions are not considered to constitute "taking" (NMFS, 2001). Therefore, L-DEO provides no additional allowance for animals that could be affected by sound sources other than airguns.

Density data on 18 marine mammal species in the Shatsky Rise area are available from two sources using conventional line transect methods: Japanese sighting surveys conducted since the early 1980s, and fisheries observers in the high-seas driftnet fisheries during 1987–1990 (see Table 3 in L-DEO's application).

For the 16 other marine mammal species that could be encountered in the proposed survey area, data from the western North Pacific right whale are not available (see Table 3 in L-DEO's application). L-DEO is not aware of any density estimates for three of those species—Hubb's (Mesoplodon carlhubbsi), Stejneger's (Mesoplodon stejnegeri), and gingko-toothed beaked whales (Mesoplodon ginkgodens). For the remaining 13 species out of the 16, (see Table 3 in L-DEO's application), density estimates are available from other areas of the Pacific: 11 species from the offshore stratum of the

2002 Hawaiian Islands survey (Barlow, 2006) and two species from surveys of the California Current ecosystem off the U.S. west coast between 1991 and 2005 (Barlow and Forney, 2007). Those estimates are based on standard line-transect protocols developed by NMFS' Southwest Fisheries Science Center (SWFSC).

Densities for 14 species are available from Japanese sighting surveys in the Shatsky Rise survey area. Miyashita (1993a) provided estimates for six dolphin species in this area that have been taken in the Japanese drive fisheries. The densities used here are Miyashita's (1993a) estimates for the 'Eastern offshore' survey area (30–42° N, 145°–180° E). Kato and Miyashita (1998) provided estimates for sperm whale densities from Japanese sightings data during 1982 to 1996 in the western North Pacific (20–50° N, 130°–180° E), and Hakamada et al. (2004) provided density estimates for sei whales during August through September in the JARPN II sub-areas 8 and 9 (35–50º N, 150–170º E excluding waters in the Exclusive Economic Zone of Russia) during 2002 and 2003. L-DEO used density estimates during 1994 through 2007 for minke whales at 35–40º N, 157–170º E from Hakamada et al. (2009), density estimates during 1998 through 2002 for Bryde's whales at 31–43º N, 145–165º E from Kitakado et al. (2008), and density estimates during 1994–2007 for blue, fin, humpback, and North Pacific right whales at 31–51ºN, 140–170ºE from Matsuoka et al. (2009).

For four species (northern fur seal, Dall's porpoise, Pacific white-sided dolphin (Lagenorhynchus obliquidens), northern right-whale dolphin (Lissodelphis borealis)), estimates of densities in the Shatsky Rise area are available from sightings data collected by observers in the high-seas driftnet fisheries during 1987 through 1990 (Buckland et al., 1993). Those data were analyzed for 5° x 5° blocks, and the densities used here are from blocks for which available data overlap the proposed survey area. In general, those data represent the average annual density in the northern half of the Shatsky Rise survey area (35–40° N).

The densities mentioned above had been corrected by the original authors for detectability bias and, with the exception of Kitakado et al. (2008) and Hakamada et al. (2009), for availability bias. Detectability bias is associated with diminishing sightability with increasing lateral distance from the track line [*f*(0)]. Availability bias refers to the fact that there is less than a 100 percent probability of sighting an animal that is present along the survey track line, and it is measured by *g*(0).

There is some uncertainty about the accuracy of the density data from the Japanese Whale Research Program under Special Permit (JARPN/JARPN II). For example, The available densities in Miyashita (1993a) and Buckland et al. (1993) are from the 1980s; although these densities represent the best available information for the Shatsky Rise area at present, they will be biased if abundance or distributions of those species have changed since the data were collected. Therefore, there is uncertainty with respect to the expected marine mammal densities during this time. However, the approach used here is based on the best available data.

The estimated numbers of individuals potentially exposed are based on the 160-dB re: 1 μPa criterion for all cetaceans (see Table 3 in this notice). It is assumed that marine mammals exposed to airgun sounds that strong might change their behavior sufficiently to be considered “taken by harassment.”

L-DEO’s estimates of exposures to various sound levels assume that the proposed surveys will be completed; in fact, the ensonified areas calculated using the planned number of line-kilometers have been increased by 25 percent to accommodate turns, lines that may need to be repeated equipment testing, etc. As is typical during ship surveys, inclement weather and equipment malfunctions are likely to cause delays and may limit the number of useful line-kilometers of seismic operations that can be undertaken. Furthermore, any marine mammal sightings within or near the designated exclusion zone will result in the shutdown of seismic operations as a mitigation measure. Thus, the following estimates of the numbers of marine mammals potentially exposed to 160-dB re 1 μPa sounds are precautionary, and probably overestimate the actual numbers of marine mammals that might be involved. These estimates assume that there will be no weather, equipment, or mitigation delays, which is highly unlikely.

L-DEO estimated the number of different individuals that may be exposed to airgun sounds with received levels greater than or equal to 160 dB re: 1 μPa on one or more occasions by considering the total marine area that would be within the 160-dB radius around the operating airgun array on at least one occasion and the expected density of marine mammals. The number of possible exposures (including repeated exposures of the same individuals) can be estimated by considering the total marine area that would be within the 160-dB radius around the operating airguns, including areas of overlap. In the proposed survey, the majority of seismic lines are widely spaced in the survey area, so few individual mammals would be exposed numerous times during the survey. The area including overlap is only 1.01 times the area excluding overlap, so a marine mammal that stayed in the survey area during the entire survey could be exposed only once. However, it is unlikely that a particular animal would stay in the area during the entire survey.

The number of different individuals potentially exposed to received levels greater than or equal to 160 re: 1 μPa was calculated by multiplying:

(1) The expected species density, times;

(2) The anticipated area to be ensonified to that level during airgun operations excluding overlap, which is approximately 10,971 square kilometers (km^2) (4,235.9 square miles (mi^2)).

The area expected to be ensonified was determined by entering the planned survey lines into a MapInfo GIS, using the GIS to identify the relevant areas by "drawing" the applicable 160-dB buffer (see Table 1 in this document) around each seismic line, and then calculating the total area within the buffers. Areas of overlap were included only once when estimating the number of individuals exposed. Applying this approach, approximately 9,229 km^2 (3,563 mi^2) (11,536 km^2; 4, 454 mi^2 including the 25 percent contingency) would be within the 160-dB isopleth on one or more occasions during the survey. Because this approach does not allow for turnover in the mammal populations in the study area during the course of the survey, the actual number of individuals exposed could be underestimated. However, the approach assumes that no cetaceans will move away from or toward the trackline as the Langseth approaches in response to increasing sound levels prior to the time the levels reach 160 dB, which will result in overestimates for those species known to avoid seismic vessels.

The total estimate of the number of individual cetaceans that could be exposed to seismic sounds with received levels greater than or equal to 160 dB re: 1 μPa during the survey is 7,354 (see Table 3). That total includes 74 baleen whales, 39 of which are endangered: 5 humpback whales or 0.53% of the regional population, 21 sei whales

(0.21%), 9 fin whales (0.05%), and 4 blue whales (0.13%). In addition, 12 sperm whales (also listed as endangered under the ESA) or 0.04% of the regional population could be exposed during the survey, and 108 beaked whales including Cuvier's, Longman's, Baird's, and Blainville's beaked whales. Most (96 percent) of the cetaceans potentially exposed are delphinids; short-beaked common, striped, pantropical spotted, and Pacific white-sided dolphins are estimated to be the most common species in the area, with estimates of 3,569 (0.12% of the regional population), 1,374 (0.24%), 812 (0.19%), and 420 (0.04%) exposed to greater than or equal to 160 dB re: 1 μPa, respectively.

Table 3. Estimates of the possible numbers of marine mammals exposed to different sound levels during L-DEO's seismic survey in the northwestern Pacific Ocean during March through April, 2012.

Species	**Estimated Number of Individuals Exposed to Sound Levels ≥ 160 dB re: 1 μPa**[1]	**Requested or Adjusted Take Authorization**	**Approximate Percent of Regional Population**[3]
North Pacific right whale	0	2[2]	0.23
Humpback whale	5	5	0.53
Minke whale	29	29	0.12
Bryde's whale	6	6	0.03
Sei whale	21	21	0.21
Fin whale	9	9	0.05
Blue whale	4	4	0.13
Sperm whale	12	12	0.04
Pygmy sperm whale	37	37	N.A.
Dwarf sperm whale	90	90	<0.01
Cuvier's beaked whale	78	78	0.39
Baird's beaked whale	10	10	N.A.
Longman's beaked whale	5	18[3]	N.A.
Blainville's beaked whale	15	15	0.06
Rough-toothed dolphin	36	36	0.02
Bottlenose dolphin	277	277	0.16
Pantropical spotted dolphin	812	812	0.19
Spinner dolphin	10	32[2]	<0.01
Striped dolphin	1374	1374	0.24
Fraser's dolphin	53	286[2]	0.02
Short-beaked common dolphin	3569	3569	0.12
Pacific white-sided dolphin	420	420	0.04
Northern right whale dolphin	5	5	<0.01
Risso's dolphin	125	125	0.01
Melon-headed whale	15	89[2]	0.03
False killer whale	24	24	0.15
Killer whale	2	73	0.02
Short-finned pilot whale	58	65[2]	0.11
Dall's porpoise	253	253	0.02
Northern fur seal	21	21	<0.01

[1] Estimates are based on densities in Table 3 and an ensonified area (including 25% contingency 11,536 km²).
[2] Requested Take Authorization increased to mean group size from density sources in Table 3 of L-DEO's application.
[3] Regional population size estimates are from Table 3 of L-DEO's application; NA means not available.

Encouraging and Coordinating Research

L-DEO and NSF will coordinate the planned marine mammal monitoring program associated with the seismic survey in the northwestern Pacific Ocean with other parties that may have interest in the area and/or be conducting marine mammal studies in the same region during the seismic survey.

Negligible Impact and Small Numbers Analysis and Determination

NMFS has defined ‘‘negligible impact’’ in 50 CFR 216.103 as “...an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.’’ In making a negligible impact determination, NMFS considers:

(1) The number of anticipated injuries, serious injuries, or mortalities;

(2) The number, nature, and intensity, and duration of Level B harassment (all relatively limited); and

(3) The context in which the takes occur (i.e., impacts to areas of significance, impacts to local populations, and cumulative impacts when taking into account successive/contemporaneous actions when added to baseline data);

(4) The status of stock or species of marine mammals (i.e., depleted, not depleted, decreasing, increasing, stable, impact relative to the size of the population);

(5) Impacts on habitat affecting rates of recruitment/survival; and

(6) The effectiveness of monitoring and mitigation measures.

For reasons stated previously in this document, the specified activities associated with the marine seismic survey are not likely to cause PTS, or other non-auditory injury, serious injury, or death because:

(1) The likelihood that, given sufficient notice through relatively slow ship speed, marine mammals are expected to move away from a noise source that is annoying prior to its becoming potentially injurious;

(2) The potential for temporary or permanent hearing impairment is relatively low and would likely be avoided through the incorporation of the required monitoring and mitigation measures (described previously in this document);

(3) The fact that cetaceans would have to be closer than 940 m (3,084 ft) in deep water when the 36-airgun array is in use at 9 m (29.5 ft) tow depth, and 40 m (131.2 ft) in deep water when the single airgun is in use at 9 m from the vessel to be exposed to levels of sound believed to have even a minimal chance of causing PTS; and

(4) The likelihood that marine mammal detection ability by trained PSVOs is high at close proximity to the vessel.

No injuries, serious injuries, or mortalities are anticipated to occur as a result of the L-DEO's planned marine seismic survey, and none are proposed to be authorized by NMFS. Only short-term behavioral disturbance is anticipated to occur due to the brief and sporadic duration of the survey activities. Table 3 of this document outlines the number of requested Level B harassment takes that are anticipated as a result of these activities. Due to the nature, degree, and context of Level B (behavioral) harassment anticipated and described (see "Potential Effects on Marine Mammals" section in this notice), the activity is not expected to impact rates of recruitment or survival for any affected species or stock. Additionally, the seismic survey will not adversely impact marine mammal habitat.

Many animals perform vital functions, such as feeding, resting, traveling, and socializing, on a diel cycle (i.e., 24 hr cycle). Behavioral reactions to noise exposure (such as disruption of critical life functions, displacement, or avoidance of important habitat) are more likely to be significant if they last more than one diel cycle or recur on subsequent days (Southall et al., 2007). While seismic operations are anticipated to occur on consecutive days, the entire duration of the survey is not expected to last more than approximately 23 days (i.e., 7 days of seismic operations, 16 days of transit) and the Langseth will be continuously moving along planned tracklines that are geographically spread-out. Therefore, the seismic survey will be increasing sound levels in the marine environment in a relatively small area surrounding the vessel, which is constantly travelling over far distances, for a relatively short time period (i.e., one week) in the study area.

Of the 34 marine mammal species under NMFS' jurisdiction that are known to occur or likely to occur in the study area, six of these species are listed as endangered under the ESA: the blue, fin, humpback, north Pacific right, sei, and sperm whales. These species are also categorized as depleted under the MMPA. L-DEO has requested authorized take for the six listed species. To protect these animals (and other marine mammals in the study area), L-DEO must cease or reduce airgun operations if animals enter designated zones. No injury, serious injury, or mortality is expected to occur and due to the nature, degree, and context of the Level B harassment anticipated. The activity is not expected to impact rates of recruitment or survival.

As mentioned previously, NMFS estimates that 30 species of marine mammals under its jurisdiction could be potentially affected by Level B harassment over the course of the IHA. For each species, these numbers are small (each, less than one percent) relative to the regional population size. NMFS provided the population estimates for the marine mammal species that may be taken by Level B harassment in Table 2 of this document.

NMFS' practice has been to apply the 160 dB re: 1 μPa received level threshold for underwater impulse sound levels to determine whether take by Level B harassment occurs. Southall et al. (2007) provides a severity scale for ranking observed behavioral responses of both free-ranging marine mammals and laboratory subjects to various types of anthropogenic sound (see Table 4 in Southall et al. [2007]).

NMFS has preliminarily determined, provided that the aforementioned mitigation and monitoring measures are implemented, that the impact of conducting a marine seismic survey on the Shatsky Rise in the northwestern Pacific Ocean, March to April, 2012, may result, at worst, in a temporary modification in behavior and/or low-level physiological effects (Level B harassment) of small numbers of certain species of marine mammals. See Table 3 for the requested authorized take numbers of cetaceans.

While behavioral modifications, including temporarily vacating the area during the operation of the airgun(s), may be made by these species to avoid the resultant acoustic disturbance, the availability of alternate areas within these areas and the short and sporadic duration of the research activities, have led NMFS to preliminary determine that this action will have a negligible impact on the species in the specified geographic region.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the mitigation and monitoring measures, NMFS preliminarily finds that L-DEO's planned research activities will result in the incidental take of small numbers of marine mammals, by Level B harassment only, and that the total taking from the marine seismic survey will have a negligible impact on the affected species or stocks of marine mammals; and that impacts to affected species or stocks of marine mammals have been mitigated to the lowest level practicable.

Impact on Availability of Affected Species or Stock for Taking for Subsistence Uses

Section 101(a)(5)(D) of the MMPA also requires NMFS to determine that the authorization will not have an unmitigable adverse effect on the availability of marine mammal species or stocks for subsistence use. There are no relevant subsistence uses of marine mammals in the study area (Shatsky Rise, northwestern Pacific Ocean) that implicate MMPA section 101(a)(5)(D).

Endangered Species Act

Of the species of marine mammals that may occur in the proposed survey area, several are listed as endangered under the ESA, including the blue, fin, humpback, north Pacific right, sei, and sperm whales. L-DEO did not request take of endangered western north Pacific gray whales because of the low likelihood of encountering these species during the cruise.

Under section 7 of the ESA, NSF has initiated formal consultation with the NMFS', Office of Protected Resources, Endangered Species Act Interagency Cooperation Division, on this proposed seismic survey. NMFS' Office of Protected Resources, Permits and Conservation Division, had initiated formal consultation under section 7 of the ESA with NMFS' Office of Protected Resources, Endangered Species Act Interagency Cooperation Division, to obtain a Biological Opinion (BiOp) evaluating the effects of issuing an IHA for threatened and endangered marine mammals and, if appropriate, authorizing incidental take. NMFS will conclude formal section 7 consultation prior to making a determination on whether or not to issue the IHA. If the IHA is issued, NSF and L-DEO, in addition to the mitigation and monitoring requirements included in the IHA, will be required to comply with the Terms and Conditions of the Incidental Take Statement corresponding to NMFS' BiOp issued to both NSF and NMFS' Office of Protected Resources.

National Environmental Policy Act (NEPA)

To meet NMFS' National Environmental Policy Act (NEPA; 42 U.S.C. 4321 et seq.) requirements for the issuance of an IHA to L-DEO, NMFS will prepare an Environmental Assessment (EA) titled "Issuance of an Incidental Harassment Authorization to the Lamont-Doherty Earth Observatory to Take Marine Mammals by Harassment Incidental to a Marine Geophysical Survey in the Northwest Pacific Ocean, March through April, 2012." This EA will incorporate the NSF's Environmental Analysis Pursuant To Executive Order 12114 (NSF, 2010) and an associated report (Report) prepared by LGL Limited Environmental Research Associates (LGL) for NSF, titled, "Environmental Assessment of a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Northwest Pacific Ocean, March – April, 2012," by reference pursuant to 40 CFR 1502.21 and NOAA Administrative Order (NAO) 216-6 § 5.09(d). Prior to making a final decision on the IHA application, NMFS will make a decision of whether or not to issue a Finding of No Significant Impact (FONSI).

Proposed Authorization

As a result of these preliminary determinations, NMFS proposes to authorize the take of marine mammals incidental to L-DEO's proposed marine seismic survey in the northwest Pacific Ocean, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated. The duration of the IHA would not exceed one year from the date of its issuance.

Information Solicited

NMFS requests interested persons to submit comments and information concerning this proposed project and NMFS's preliminary determination of issuing an IHA (see ADDRESSES). Concurrent with the publication of this notice in the Federal Register, NMFS is forwarding copies of this application to the Marine Mammal Commission and its Committee of Scientific Advisors.

Dated: January 25, 2012

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

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