DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XI15

Small Takes of Marine Mammals Incidental to Specified Activities; Marine Geophysical Survey in the Gulf of Alaska, September 2008

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

ACTION: Notice; proposed incidental take 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 incidental to conducting a marine seismic survey in the Gulf of Alaska during September 2008. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an IHA to L-DEO to incidentally take, by Level B harassment only, small numbers of several species of marine mammals during the aforementioned activity.

DATES: Comments and information must be received no later than September 4, 2008.

ADDRESSES: Comments on the application should be addressed to P. Michael Payne, Chief, Permits, Conservation and Education 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 *PR1.0648–XI15@noaa.gov*. Comments sent via e-mail, including all attachments, must not exceed a 10–megabyte file size.

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

Documents cited in this notice may be viewed, by appointment, during regular business hours, at the aforementioned address.

FOR FURTHER INFORMATION CONTACT: Howard Goldstein or Ken Hollingshead, Office of Protected Resources, NMFS, (301) 713–2289.

SUPPLEMENTARY INFORMATION:

Background

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review.

Authorization shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth. 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. 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].

Section 101(a)(5)(D) 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 marine mammals. Within 45 days of the close of the comment period, NMFS must either approve or deny the authorization.

Summary of Request

On April 10, 2008, NMFS received an application from L-DEO for the taking, by Level B harassment only, of small numbers of 21 species of marine mammals incidental to conducting, under a cooperative agreement with the National Science Foundation (NSF), a seismic survey in the northeast Gulf of Alaska (GOA). The proposed cruise will take place in the territorial waters and Exclusive Economic Zone (EEZ) of the U.S. and is scheduled to occur from 31 August to 23 September 2008.

The purpose of the proposed seismic survey is to examine crustal structure, fault patterns, and tectonic-climate geohistory of the area. The proposed program will investigate the interplay of climate and tectonics onshore and offshore in an area that includes the world's largest strike-slip earthquakes (Magnitude 8.0 Denali Event), largest earthquake caused uplift (14.4 m or 47 ft in 1962), largest area of seismic uplift (during the 1962 event), highest tsunami (over 200 m or 656 ft in Latoya Bay in 1958), largest temperate glaciers (the Malaspina and Bering Glaciers), and some of the highest sedimentation rates (over 1 m or 3.3 ft per year in some places). Nowhere else on the planet are tectonics and climate interacting to create this combination of mountain building, glacial erosion, strike-slip (California style), and subduction (Japan style) earthquakes.

While affecting a small local population in the past, natural seismic activity in the GOA could influence the whole of the North Pacific basin, which includes many large population centers. Alaska is being directly affected by modern climate change, and new evidence suggests that, as climate changes tectonics respond and vice versa. This interplay could be fundamental to the way the Earth works as a system, and by examining this interplay, the intention of the STEEP program is to examine the feedbacks that drive the system.

The STEEP program is 5 years in length and includes scientists from over 10 universities. The study represents the most comprehensive study of tectonic and climate interactions ever undertaken in a single project. The offshore seismic component is a keystone for the experiment. The data obtained from the seismic survey will be used to determine the history of tectonic-climate interplay, as well as the nature of the Yakutat plate that is causing all of the deformation in southern Alaska, built the Saint Elias Mountains, and started the aggressive glaciation that continues today.

Description of the Activity

The seismic survey will involve one source vessel, the R/V *Marcus G. Langseth* (*Langseth*), which will occur offshore from the Saint Elias Mountains. The *Langseth* will deploy an array of 36 airguns (6,600 in^3) as an energy source and, at times, a receiving system consisting of one 8–km (3.7–mi) towed hydrophone streamer. The streamer will be towed at a depth of 7 m (23 ft) and the airguns at 9 m (29.5 ft). The *Langseth* will also deploy Ocean Bottom Seismometers (OBSs) to receive the returning acoustic signals. The OBSs are housed in 43–cm diameter glass spheres that have a gross weight of approximately 45 kg (99 lbs). As the airgun array is towed along the survey lines, the hydrophone streamer and/or OBSs will receive the returning acoustic signals and transfer the data to the on-board processing system.

The *Langseth* is expected to depart Prince Rupert, British Columbia, Canada, on approximately 31 August, 2008 for the study area in the GOA (see Figure 1 of L-DEO's application). The airgun array is expected to operate for a total of ~200–250 hours. With OBS deployment and retrieval, the length of the survey will be ~18 days. The overall area within which the STEEP survey will take place is located at ~58–60.5° N, 138–146° W (see Figure 1 of L-DEO's application). The proposed survey will be conducted in water depths from <100 m to >3,000 m (<330 to>9,840 ft) entirely within the territorial waters and Exclusive Economic Zone (EEZ) of the United States. The exact dates of the activities depend upon logistics, as well as weather conditions and/or the need to repeat some lines if data quality is substandard.

The primary marine seismic survey will consist of two long transect lines that will cross each other (Figure 1 of L-DEO's application). For the longer line paralleling the shoreline, a seismic reflection-refraction profile will be shot using the hydrophone streamer as well as 25 OBSs deployed on the seafloor and 60 Texan seismometers deployed on land across the toe of the Bering Glacier. A reflection-refraction profile will also be obtained from the slightly shorter line that is perpendicular to the shoreline using the hydrophone streamer as well as 17 OBSs; this line will be shot twice if time allows. Both of these lines will have a shot spacing of 50 m (164 ft, 20 seconds); if the onshore-offshore line is shot twice, the shot interval used during the second run will be 150 m (492 ft, 60 s). During the reflection-refraction profiling, the airgun array will be towed at a depth of 9 m. In addition, two reflection-only 2–dimensional (2–D) seismic grids will be shot; the western grid is located approximately 150 km (93 mi) from shore whereas the eastern grid is located nearshore (see Figure 1 in L-DEO's application). The shot spacing for these grids will be 50 m (164 ft) and the airgun array will be towed at a depth of 9 m. No OBSs will be deployed during reflection-only profiling. There will be additional operations associated with equipment testing, startup, line changes, and repeat coverage of any areas where initial data quality is sub-standard. In L-DEO's calculations, 25% has been added to the line total for those additional operations.

The planned seismic survey (excluding the 25 percent contingency) will consist of 1909 km of survey lines including turns (see Figure 1 in L-DEO's application). Most of this effort (923 km or 574 mi) will take place in intermediate water depths of 100–1,000 m and in water depths >1,000 m deep (812 km or 504 mi), and a smaller portion (174 km or 108 mi) will take place in water <100 m deep.

All planned geophysical data acquisition activities will be conducted by L-DEO with on-board assistance by the scientists who have proposed the study. The scientific team is headed by Dr. Sean Gullick of the University of Texas at Austin Institute for Geophysics (UTIG) and also includes Drs. G. Christesen, P. Mann, and H. Van Avendonk of UTIG. The vessel will be self-contained, and the crew will live aboard the vessel for the entire cruise.

In addition to the operations of the airgun array, a multibeam echosounder (MBES) will be operated from the *Langseth* continuously throughout the STEEP cruise. Also, a sub-bottom profiler (SBP) will be operated by the *Langseth* during most of the survey.

Vessel Specifications

The *Langseth* has a length of 71.5 m (234.6 ft), a beam of 17 m (55.8 ft), and a maximum draft of 5.9 m (19.4 ft). The ship was designed as a seismic research vessel, with a propulsion system designed to be as quiet as possible to avoid interference with the seismic signals. The ship is powered by two Bergen BRG–6 diesel engines, each producing 3,550 hp, that drive the two propellers directly. Each propeller has four blades, and the shaft typically rotates at 750 rpm. The vessel also has an 800–hp bowthruster. The operation speed during seismic acquisition is typically 7.4–9.3 km/h (4–5 kt). When not towing seismic survey gear, the *Langseth* can cruise at 20–24 km/h (11–13 kt). The *Langseth* has a range of 25,000 km (15,534 mi). The *Langseth* will also serve as the platform from which vessel-based marine mammal (and sea turtle) observers (MMOs) will watch for animals before and during airgun operations.

Acoustic Source Specifications

Seismic Airguns

During the proposed survey, the airgun array to be used will consist of 36 airguns, with a total volume of approximately 6,600 in^3. The airguns will consist of a mixture of Bolt 1500LL and 1900LL airguns. The airguns array will be configured as four identical linear arrays or ''strings'' (see Figure 2 in L-DEO's application). Each string will have ten airguns; the first and last airguns in each string are spaced 16 m (52.5 ft) apart. Nine airguns in each string will be fired simultaneously, while the tenth is kept in reserve as a spare, to be turned on in case of failure of another airgun. The four airgun strings will be distributed across an approximate area of 24 x 16 m (78.7 x 52.5 ft) behind the *Langseth* and will be towed approximately 50–100 m (164–328 ft) behind the vessel at 9–m depth. The firing pressure of the array is 2,000 psi. The airgun array will fire in two modes: every 50 m (164 ft; 20 s) or every 150 m (492 ft; 60 s). During firing, a brief (approximately 0.1 s) pulse of sound is emitted. The airguns will be silent during the intervening periods.

Because the actual source is a distributed sound source (36 airguns) rather than a single point source, the highest sound levels measurable at any location in the water will be less than the nominal source level (265 dB re 1 µPa.m, peak to peak). In addition, the effective source level for sound propagating in near-horizontal directions will be substantially lower than the nominal source level applicable to downward propagation because of the directional nature of the sound from the airgun array.

Sound propagation has been predicted by L-DEO for the 36–airgun array operating in deep, intermediate, and shallow water and for a single 1900LL 40 in^3 airgun (which will be used during power downs), in relation to distance and direction from the airguns (See Table 1). A detailed description of L-DEO's modeling effort is provided in Appendix A of the application.

Multibeam Echosounder

The Simrad EM120 operates at 11.25–12.6 kHz and is hull-mounted on the *Langseth*. The beamwidth is 1° fore-aft and 150° athwartship. The maximum source level is 242 dB re 1 µPa (rms; Hammerstad, 2005). For deep-water operation, each ''ping'' consists of nine successive fan-shaped transmissions, each 15 ms in duration and each ensonifying a section that extends 1° fore-aft. The nine successive transmissions span an overall cross-track angular extent of about 150°, with 16 ms gaps between the pulses for successive sectors. A receiver in the overlap area between the two sectors would receive two 15–ms pulses separated by a 16–ms gap. In shallower water, the pulse duration is reduced to 5 or 2 ms, and the number of transmit beams is also reduced. The ping interval varies with water depth, from approximately 5 s at 1,000 m (3,280 ft) to 20 s at 4,000 m (13,123 ft; Kongsberg Maritime, 2005).

Sub-bottom Profiler

The SBP is normally operated to provide information about the sedimentary features and the bottom topography that is simultaneously being mapped by the MBES. The energy from the SBP is directed downward by a 3.5 kHz transducer in the hull of the *Langseth*. The output varies with water depth from 50 watts in shallow water to 800 watts in deep water. The pulse interval is 1 s, but a common mode of operation is to broadcast five pulses at 1–s intervals followed by a 5–s pause.

Source and Volume	Tow Depth (m)	Water Depth	Predicted RMS Distances (m)		
			190 dB	180 dB	160 dB
Single Bolt airgun		Deep	12	40	385
	9	Intermediate	18	60	578
40 in^3		Shallow	150	296	1050
4 strings		Deep	300	950	6000
36 airguns	9	Intermediate	450	1425	6667
6600 in^3		Shallow	2182	3694	8000

Table 1. Predicted distances to which sound levels ≥190, 180, and 160 dB re 1 μPa might be received in shallow (<100 m; 328 ft), intermediate (100-1,000 m; 328-3,280 ft), and deep (>1,000 m; 3,280 ft) water during the Central American SubFac and STEEP Gulf of Alaska survey.

Because the predictions in Table 1 are based in part on empirical correction factors derived from acoustic calibration of different airgun configurations than those to be used on the *Langseth* (cf. Tolstoy *et al.*, 2004a,b), L-DEO conducted an acoustic calibration study of the *Langseth*'s 36–airgun (approximately 6,600 in^3) array in late 2007/early 2008 in the Gulf of Mexico (LGL Ltd. 2006). Distances where sound levels (e.g., 190, 180, and 160 dB re 1 μPa rms) were received in deep, intermediate, and shallow water will be determined for various airgun configurations. Acoustic data analysis is ongoing. After, analysis, the empirical data from the 2007/2008 calibration study will be used to refine the exclusion zones proposed above for use during the STEEP cruise, if the data are appropriate and available for use at the time of the survey.

Description of Marine Mammals in the Activity Area

A total of 18 cetacean species, 3 species of pinnipeds, and the sea otter are known to or could occur in the GOA study area (see Table 2 of the application; Angliss and Outlaw, 2007). Several of the species are listed as Endangered under the U.S. Endangered Species Act (ESA), including the humpback, sei, fin, blue, North Pacific right, and sperm whale, sea otter, and the western stock of Steller sea lions. The eastern stock of Steller sea lions is listed as Threatened. The southeast Alaska Distinct Population Segment of northern sea otters are also listed as Threatened. There is little information on the distribution of marine mammals inhabiting the waters offshore of SE Alaska or the eastern GOA, although a few reports are available (e.g., Buckland *et al.*, 1993; Hobbs and Lerczak, 1993; Straley *et al.* 1995; Calambokidis *et al.*, 1997; MacLean and Koski, 2005; Angliss and Outlaw, 2007).

The marine mammals that occur in the proposed survey area belong to four taxonomic groups: odontocetes (toothed cetaceans such as dolphins), mysticetes (baleen whales), pinnipeds (seals and sea lions), and fissipeds (the sea otter). Cetaceans and pinnipeds are managed by NMFS and are the subject of this IHA application. Several of the 18 cetacean species are common in the area (see below). Of the three species of pinnipeds that potentially could occur in the study area, only the Steller sea lion and harbor seal are likely to be present. The northern fur seal inhabits the Bering Sea during the summer, and is generally found in SE Alaska in low numbers during the winter and during the northward migration in the spring. Sea otters are managed by the U.S. Fish and Wildlife Service (USFWS). Informal consultation with the USFWS is being sought for sea otters.

Information on the occurrence, distribution, population size, habitat, and conservation status for each of the 21 marine mammal species that are likely to occur in the proposed project area is presented in Table 5 of L-DEO's application and is reprinted in part here as Table 2.

Based on a compilation of data from 1979 to 2001, many cetaceans and pinnipeds occur within the EEZ in both oceanic and coastal waters. However, beaked, sperm, dwarf/pygmy sperm, and baleen whales (except for the humpback) occur predominantly in oceanic waters (May-Collado *et al.*, 2005). Bottlenose and pantropical spotted dolphins, as well as the humpback whale, tend to be coastal.

Table 2 below outlines the cetacean and pinniped species, their habitat and abundance in the proposed project area, and the requested take levels. Additional information regarding the distribution of these species expected to be found in the project area and how the estimated densities were calculated may be found in L-DEO's application.

Species	Habitat	Abundance (Alaska)	Regional Abundance	ESA [1]
Odontocetes				

Species	Habitat	Abundance (Alaska)	Regional Abundance	ESA [1]
Sperm whale (Physeter macrocephalus)	Pelagic	159 [4]	24,000 [5]	EN
Cuvier's beaked whale (Ziphius cavirostris)	Pelagic	N.A.	20,000 [6]	N.L.
Baird's beaked whale (Berardius bairdii)	Pelagic	N.A.	6,000 [7]	N.L.
Stejneger's beaked whale (Mesoplodon stejnegeri)	Likely Pelagic	N.A.	N.A.	N.L.
Beluga whale (Delphinapterus leucas)	Coastal & Ice Edges	366 [8]	N.A.	N.L.
Pacific white-sided dolphin (Lagenorhynchus obliquidens)	Pelagic, Shelf, Coastal	26,880 [9]	931,000 [10]	N.L.
Risso's dolphin (Grampus griseus)	Pelagic, Shelf, Coastal	N.A.	16,066 [11]	N.L.
Killer whale (Orcinus orca)	Pelagic, Shelf, Coastal	1,975 [12]	8,500 [13]	N.L.
Short-finned pilot whale (Globicephala macrorhynchus)	Pelagic, Shelf, Coastal	N.A.	160,200 [6]	N.L.
Harbor Porpoise (Phocoena phocoena)	Coastal	17,076 [14] 41,854 [15]	202,988 [16]	N.L.
Dall's Porpoise (Phocoenoides dalli)	Pelagic & Shelf	83,400 [17]	1,186,000 [18]	N.L.
Mysticetes				
Humpback whale (Megaptera novaeangliae)	Coastal & Banks	2,644 [21]	>6,000 [22]	EN
Minke whale (Balaenoptera acutorostrata)	Coastal & Shelf	1,232 [21]	9,000 [23]	N.L.
Gray whale (Eschrichtius robustus)	Coastal	N.A.	18,813 [20]	N.L.
Sei whale (Balaenoptera borealis)	Pelagic	N.A.	7,260-12,620 [22]	EN
Fin whale (Balaenoptera physalus)	Pelagic	1,652 [24]	13,620-18,680 [22]	EN
Blue whale (Balaenoptera musculus)	Pelagic, Shelf, Coastal	N.A.	1,744 [11]	EN
North Pacific right whale (Eubalaena japonica)	Coastal & Shelf	N.A.	100-200 [19]	EN
Pinnipeds				
Northern fur seal (Callorhinus ursinus)	Pelagic, Breeds Coastally	N.A.	721,935 [25]	N.L.
Steller sea lion (Eumetopias jubatus)	Coastal	47,885 [26] 44,780 [27]	N.A.	T EN
Harbor seal (Phoca vitulina richardsi)	Coastal	180,017 [28]	N.A.	N.L.

Table 2. The habitat, abundance, and conservation status of marine mammals inhabiting the proposed study area in the Gulf of Alaska. Regional abundance estimates are also given, usually for the Northeastern Pacific Ocean or the U.S. West Coast.

Note: N.A. = Not available or not applicable.

[1] U.S. Endangered Species Act. En = Endangered; T = Threatened; N.L. = Not Listed.

[2] IUCN Red List of Threatened Species (2007). Codes for IUCN classifications: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; LR = Lower Risk (-cd = Conservation Dependent; -nt = Near Threatened; -ic = Least Concern); DD = Data Deficient; NL = Not Listed.

[3] Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (UNEP-WCMC 2007). I and II are CITES Appendices; NL = Not Listed.

[4] Western GOA and eastern Aleutians (Zerbini et al., 2004).
[5] Eastern temperate North Pacific (Whitehead, 2002).
[6] Eastern Tropical Pacific (Wade and Gerrodette, 1993).
[7] Western North Pacific (Reeves and Leatherwood, 1994; Kasuya, 2002).
[8] Cook Inlet stock (Rugh et al., 2005a).
[9] GOA (Angliss and Outlaw, 2007).
[10] North Pacific Ocean (Buckland et al., 1993).
[11] California/Oregon/Washington (Carretta et al. 2007).
[12] Minimum abundance in Alaskan waters, includes 1,339 resident and 636 transient (Angliss and Outlaw, 2007).
[13] Eastern Tropical Pacific (Ford, 2002).
[14] SE Alaska stock (Angliss and Outlaw, 2007).
[15] GOA stock (Angliss and Outlaw 2007).
[16] Western North Pacific Ocean (totals from Carretta et al., 2007 and Angliss and Outlaw, 2007).
[17] Alaska stock (Angliss and Outlaw, 2007).
[18] North Pacific Ocean and Bering Sea (Houk and Jefferson, 1999).
[19] Eastern North Pacific (Wada, 1973).
[20] Mean of 2000-2001 and 2001-2002 abundance estimates for eastern North Pacific (Angliss and Outlaw, 2007).
[21] Western GOA and eastern Aleutians (Zerbini et al., 2006).
[22] North Pacific Ocean (Carretta et al., 2007).
[23] North Pacific Ocean (Wada, 1976).
[24] Central waters of western Alaska and eastern and central Aleutian Islands (Angliss and Outlaw, 2007).
[25] Abundance for Eastern Pacific Stock (Angliss and Outlaw, 2007).
[26] Eastern U.S. Stock (Angliss and Outlaw, 2007).
[27] Western U.S. Stock (Angliss and Outlaw, 2007).
[28] Alaska statewide (Angliss and Outlaw, 2007).
[29] Abundance estimate for SE Alaska stock (USFWS 2002 in Angliss and Outlaw, 2007).
[30] Abundance estimate Southcentral Alaska (USFWS 2002 in Angliss and Outlaw, 2007).
[31] SW Alaska stock (USFWS 2002 in Angliss and Outlaw, 2007).

Potential Effects on Marine Mammals

Potential Effects of Airguns

The effects of sounds from airguns might include one or more of the following: tolerance, masking of natural sounds, behavioral disturbances, and temporary or permanent hearing 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). With the possible exception of some cases of temporary threshold shift in harbor seals, it is unlikely that the project would result in any cases of temporary or especially permanent hearing impairment, or any significant non-auditory physical or physiological effects. Some behavioral disturbance is expected, but this would be localized and short-term.

The rms (root mean square) received levels that are used as impact criteria for marine mammals are not directly comparable to the peak or peak-to-peak values normally used to characterize source levels of airgun arrays. The measurement units used to describe airgun sources, peak or peak-to-peak decibels, are always higher than the rms decibels referred to in biological literature. A measured received level of 160 dB rms in the far field would typically correspond to a peak measurement of approximately 170 to 172 dB, and to a peak-to-peak measurement of approximately 176 to 178 dB, as measured for the same pulse received at the same location (Greene, 1997; McCauley *et al.*, 1998, 2000a). The precise difference between rms and peak or peak-to-peak values depends on the frequency content and duration of the pulse, among other factors. However, the rms level is always lower than the peak or peak-to-peak level for an airgun-type source.

Tolerance

Numerous studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers. For a summary of the characteristics of airgun pulses, see Appendices B) of L-DEO's application. Numerous studies have shown that marine mammals at distances more than a few kilometers from operating seismic vessels often show no apparent response see Appendix C (e) of the application. 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 mammal group. Although various baleen whales, toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to airgun pulses under some conditions, at other times, mammals of all three types have shown no overt reactions. In general, pinnipeds usually seem to be more tolerant of exposure to airgun pulses than are cetaceans, with relative responsiveness of baleen and toothed whales being variable.

Masking

Obscuring of sounds of interest by interfering sounds, generally at similar frequencies, is known as masking. Masking effects of pulsed sounds (even from large arrays of airguns) on marine mammal calls and other natural sounds are expected to be limited, although there are few specific data of relevance. Because of the intermittent nature and low duty cycle of seismic pulses, animals can emit and receive sounds in the relatively quiet intervals between pulses. Some baleen and toothed whales are known to continue calling in the presence of seismic pulses. The airgun sounds are pulsed, with quiet periods between the pulses, and whale calls often can be heard between the seismic pulses (Richardson *et al.*, 1986; McDonald *et al.*, 1995; Greene *et al.*, 1999; Nieukirk *et al.*, 2004; Smultea *et al.*, 2004). Although there has been one report that sperm whales cease calling when exposed to pulses from a very distant seismic ship (Bowles *et al.*, 1994), a more recent study reports that sperm whales off northern Norway continued calling in the presence of seismic pulses (Madsen *et al.*, 2002). That has also been shown during recent work in the Gulf of Mexico and Caribbean Sea (Smultea *et al.*, 2004; Tyack *et al.*, 2006). Masking effects of seismic pulses are expected to be negligible in the case of the small odontocetes given the intermittent nature of seismic pulses. Dolphins and porpoises commonly are heard calling while airguns are operating (Gordon *et al.*, 2004; Smultea *et al.*, 2004; Holst *et al.*, 2005a,b). Also, the sounds important to small odontocetes are predominantly at much higher frequencies than the airgun sounds, thus further limiting the potential for masking. Masking effects, in general, are discussed further in Appendix B (d) of L-DEO's application.

Disturbance Reactions

Disturbance includes a variety of effects, including subtle changes in behavior, more conspicuous changes in activities, 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. If a marine mammal responds to an underwater sound by changing its behavior or moving a small distance, the response may or may not rise to the level of ''harassment,'' let alone affect the stock or the species as a whole. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on animals or on the stock or species could potentially be significant. 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 are likely to be present within a particular distance of industrial activities, or exposed to a particular level of industrial sound. This practice potentially overestimates the numbers of marine mammals that are affected in some biologically-important manner.

The sound exposure thresholds that affect marine mammals behaviorally are based on behavioral observations during studies of several species. However, information is lacking for many species. Detailed studies have been done on humpback, gray, and bowhead whales and on ringed seals. Less detailed data are available for some other species of baleen whales, sperm whales, and small toothed whales.

Baleen Whales – Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable. Whales are often reported to show no overt reactions to pulses from large arrays of airguns at distances beyond a few kilometers, even though the airgun pulses remain well above ambient noise levels out to much longer distances. However, as reviewed in Appendix B (e) of L-DEO's application, baleen whales exposed to strong noise pulses from airguns often react by deviating from their normal migration route and/or interrupting their feeding activities and moving away from the sound source. In the case of the migrating gray and bowhead whales, the observed changes in behavior appeared to be of little or no biological consequence to the animals. They simply avoided the sound source by displacing their migration route to varying degrees, but within the natural boundaries of the migration corridors.

Studies of gray, bowhead, and humpback whales have determined that received levels of pulses in the 160–170 dB re 1 μPa rms range seem to cause obvious avoidance behavior in a substantial fraction of the animals exposed. In many areas, seismic pulses from large arrays of airguns diminish to those levels at distances ranging from 4.5–14.5 km (2.8–9 mi) from the source. A substantial proportion of the baleen whales within those distances may show avoidance or other strong disturbance reactions to the airgun array. Subtle behavioral changes sometimes become evident at somewhat lower received levels.

Responses of humpback whales to seismic surveys have been studied during migration and on the summer feeding grounds, and there has also been discussion of effects on the Brazilian wintering grounds. McCauley *et al.* (1998, 2000) studied the responses of humpback whales off Western Australia to a full-scale seismic survey with a 16–airgun, 2,678–in^3 array, and to a single 20–in^3 airgun with a source level of 227 dB re 1 μPa m peak-to-peak. McCauley *et al.* (1998) documented that initial avoidance reactions began at 5–8 km (3.1–5 mi) from the array, and that those reactions kept most pods approximately 3–4 km (1.9–2.5 mi) from the operating seismic boat. McCauley *et al.* (2000) noted localized displacement during migration of 4–5 km (2.5–3.1 mi) by traveling pods and 7–12 km (4.3–7.5 mi) by cow-calf pairs. Avoidance distances with respect to the single airgun were smaller (2 km (1.2 mi)) but consistent with the results from the full array in terms of received sound levels. Mean avoidance distance from the airgun corresponded to a received sound level of 140 dB re 1 μPa (rms); that was the level at which humpbacks started to show avoidance reactions to an approaching airgun. The standoff range, i.e., the closest point of approach of the whales to the airgun, corresponded to a received level of 143 dB re 1 μPa (rms). However, some individual humpback whales, especially males, approached within distances of 100–400 m (328–1,312 ft), where the maximum received level was 179 dB re 1 μPa (rms).

Humpback whales on their summer feeding grounds in southeast summering in southeast 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 150–169 dB re 1 μPa on an approximate rms basis. 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 on an approximate rms basis.

It has been suggested that South Atlantic humpback whales wintering off Brazil may be displaced or even strand upon exposure to seismic surveys (Engel *et al.*, 2004). The evidence for this was circumstantial, subject to alternative explanations (IAGC 2004), and not consistent with results from 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).

Results from bowhead whales show that responsiveness of baleen whales to seismic surveys can be quite variable depending on the activity (migrating vs. feeding) of the whales. Bowhead whales migrating west across the Alaskan Beaufort Sea in autumn, in particular, are unusually responsive, with substantial avoidance occurring out to distances of 20 30 km (12.4–18.6 mi) from a medium-sized airgun source, where received sound levels were on the order of 130 dB re 1 μPa (rms) (Miller *et al.*, 1999; Richardson *et al.*, 1999; see Appendix B (e) of L-DEO's application). However, more recent research on bowhead whales (Miller *et al.*, 2005a; Harris *et al.*, 2007) corroborates earlier evidence that, during the summer feeding season, bowheads are not as sensitive to seismic sources. In summer, bowheads typically begin to show avoidance reactions at a received level of about 160 170 dB re 1 μPa (rms) (Richardson *et al.*, 1986; Ljungblad *et al.*, 1988; Miller *et al.*, 2005a). Nonetheless, statistical analysis showed evidence of subtle changes in surfacing, respiration and diving cycles when feeding bowheads were exposed to lower-level pulses from distant seismic operations (Richardson *et al.*, 1986).

Reactions of migration 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. Malme *et al.* (1986, 1988) estimated, based on small sample sizes, that 50 percent of feeding gray whales ceased 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. 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 with observations of Western Pacific gray whales feeding off Sakhalin Island, Russia, when a seismic survey was underway just offshore of their feeding area (Gailey *et al.*, 2007; Johnson *et al.*, 2007; Yazvenko *et al.* 2007a,b).

Various species of *Balaenoptera* (blue, sei, fin, and minke whales) have occasionally been reported in areas ensonified by airgun pulses. Sightings by observers on seismic vessels off the United Kingdom from 1997 to 2000 suggest that, at times of good sightability, numbers of rorquals seen are similar when airguns are shooting and not shooting (Stone, 2003; Stone and Tasker, 2006). Although individual species did not show any significant displacement in relation to seismic activity, all baleen whales combined were found to remain significantly further from the airguns during shooting compared with periods without shooting (Stone, 2003; Stone and Tasker, 2006). In a study off Nova Scotia, Moulton and Miller (in press) found only a little or no difference in sighting rates and initial sighting distances of balaenopterid whales when airguns were operating vs. silent. However, there were indications that these whales were more likely to be moving away when seen during airgun operations.

Data on short-term reactions (or lack of reactions) of cetaceans to impulsive noises do not necessarily provide information about long-term effects. It is not known whether impulsive noises affect reproductive rate or distribution and habitat use in subsequent days or years. However, gray whales continued to migrate annually along the west coast of North America despite intermittent seismic exploration and much ship traffic in that area for decades (see Appendix A in Malme *et al.*, 1984). The western Pacific gray whale population did not seem affected by a seismic survey in its feeding ground during a prior year (Johnson *et al.*, 2007). Bowhead whales continued to travel to the eastern Beaufort Sea each summer despite seismic exploration in their summer and autumn range for many years (Richardson *et al.*, 1987). In any event, brief exposures to sound pulses from the proposed airgun source are highly unlikely to result in prolonged effects.

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 above have been reported for toothed whales. However, a systematic study on sperm whales has been done (Jochens and Biggs, 2003; Tyack *et al.*, 2003; Jochens *et al.*, 2006; Miller *et al.*, 2006), and 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).

Seismic operators and marine mammal observers sometimes see dolphins and other small toothed whales near operating airgun arrays, but in general there seems to be a tendency for most delphinids to show some limited avoidance of seismic vessels operating large airgun systems. However, 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 airgun arrays are firing. Nonetheless, there have been indications that small toothed whales sometimes 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., Goold, 1996a,b,c; Calambokidis and Osmek, 1998; Stone, 2003; Stone and Tasker, 2006). In most cases, the avoidance radii for delphinids appear to be small, on the order of 1 km (0.62 mi) or less. The beluga may be a species that (at least at times) shows long-distance avoidance of seismic vessels. Aerial surveys during seismic operations in the southeastern Beaufort Sea recorded much lower sighting rates of beluga whales within 10–20 km (6.2–12.4 mi) of an active seismic vessel. These results were consistent with the low number of beluga sightings reported by observers aboard the seismic vessel, suggesting that some belugas might be avoiding the seismic operations at distances of 10–20 km (6.2–12.4 mi) (Miller *et al.*, 2005a).

Captive bottlenose dolphins and beluga whales exhibited changes in behavior when exposed to strong pulsed sounds similar in duration to those typically used in seismic surveys (Finneran *et al.*, 2000, 2002, 2005; Finneran and Schlundt, 2004). The animals tolerated high received levels of sound (pk-pk level >200 dB re 1 μPa) before exhibiting aversive behaviors. For pooled data at 3, 10, and 20 kHz, sound exposure levels during sessions with 25, 50, and 75 percent altered behavior were 180, 190, and 199 dB re 1 μPa^2, respectively (Finneran and Schlundt, 2004).

Results for porpoises depend on species. Dall's porpoises seem relatively tolerant of airgun operations (MacLean and Koski, 2005) and, during a survey with a large airgun array, tolerated higher noise levels than did harbor porpoises and gray whales (Bain and Williams, 2006). However, Dall's porpoises do respond to the approach of large airgun arrays by moving away (Calambokidis and Osmek, 1998; Bain and Williams, 2006). The limited available data suggest that harbor porpoises show stronger avoidance (Stone, 2003; Bain and Williams, 2006; Stone and Tasker, 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 in general (Richardson *et al.*, 1995; Southall *et al.* 2007).

Most studies of sperm whales exposed to airgun sounds indicate that this species shows considerable tolerance of airgun pulses. In most cases, the whales do not show strong avoidance and continue to call (see Appendix B of L-DEO's application). However, controlled exposure experiments in the Gulf of Mexico indicate that foraging effort is somewhat reduced upon exposure to airgun pulses from a seismic vessel operating in the area, and there may be a delay in diving to foraging depth (Miller *et al.*, 2006; Tyack *et al.*, 2006).

There are no specific data on the behavioral reactions of beaked whales to seismic surveys. Most beaked whales tend to avoid approaching vessels of other types (Wursig *et al.*, 1998). They may also dive for an extended period when approached by a vessel (Kasuya, 1986). It is likely that these beaked whales would normally show strong avoidance of an approaching seismic vessel, but this has not been documented explicitly.

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 (Appendix B of L-DEO's application).

Pinnipeds – Pinnipeds are not likely to show a strong avoidance reaction to the airgun sources that will be used. Visual monitoring from seismic vessels, usually employing larger sources, has shown only slight (if any) avoidance of airguns by pinnipeds, and only slight (if any) changes in behavior (see Appendix B(e) of L-DEO's application). Ringed seals frequently do not avoid the area within a few hundred meters of operating airgun arrays (Harris *et al.*, 2001; Moulton and Lawson, 2002; Miller *et al.*, 2005a). However, initial telemetry work suggests that avoidance and other behavioral reactions by two other species of seals to small airgun sources may at times be stronger than evident to date from visual studies of pinniped reactions to airguns (Thompson *et al.*, 1998). Even if reactions of any pinnipeds that might be encountered in the present study area are as strong as those evident in the telemetry study, reactions are expected to be confined to relatively small distances and durations, with no long-term effects on pinniped individuals or populations.

Additional details on the behavioral reactions (or the lack thereof) by all types of marine mammals to seismic vessels can be found in Appendix B (e) of L-DEO's application.

Hearing Impairment and Other Physical Effects

Temporary or permanent hearing impairment is a possibility when marine mammals are exposed to very strong sounds, but there has been no specific documentation of this for marine mammals exposed to sequences of airgun pulses.

NMFS will be developing new noise exposure criteria for marine mammals that take account of the now-available scientific data on TTS, the expected offset between the TTS and permanent threshold shift (PTS) thresholds, differences in the acoustic frequencies to which different marine mammal groups are sensitive, and other relevant factors. Detailed recommendations for new science-based noise exposure criteria were published in early 2008 (Southall *et al.*, 2007).

Several aspects of the planned monitoring and mitigation measures for this project (see below) are designed to detect marine mammals occurring near the airguns to avoid exposing them to sound pulses that might, at least in theory, cause hearing impairment. In addition, many cetaceans are likely to show some avoidance of the area with high received levels of airgun sound (see above). In those cases, the avoidance responses of the animals themselves will reduce or (most likely) avoid any possibility of hearing impairment.

Non-auditory physical effects may also occur in marine mammals exposed to strong underwater pulsed sound. Possible types of non-auditory physiological effects or injuries that theoretically might occur in mammals close to a strong sound source include stress, neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage. It is possible that some marine mammal species (i.e., beaked whales) may be especially susceptible to injury and/or stranding when exposed to strong pulsed sounds. However, as discussed below, there is no definitive evidence that any of these effects occur even for marine mammals in close proximity to large arrays of airguns. It is especially unlikely that any effects of these types would occur during the present project given the brief duration of exposure of any given mammal and the proposed monitoring and mitigation measures (see below). The following subsections discuss in somewhat more detail the possibilities of Temporary Threshold Shift (TTS), Permanent Threshold Shift (PTS), and non-auditory physical effects.

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).

For toothed whales exposed to single short pulses, the TTS threshold appears to be, to a first approximation, a function of the energy content of the pulse (Finneran *et al.*, 2002, 2005). Given the available data, the received level of a single seismic pulse (with no frequency weighting) might need to be approximately 186 dB re 1 $\mu Pa^2 \cdot s$ (i.e., 186 dB SEL or approximately 221–226 dB pk-pk) in order to produce brief, mild TTS. Exposure to several strong seismic pulses that each have received levels near 175–180 dB SEL might result in slight TTS in a small odontocete, assuming the TTS threshold is (to a first approximation) a function of the total received pulse energy. The distance from the *Langseth*'s airguns at which the received energy level (per pulse) would be expected to be ≥175–180 dB SEL are the distances shown in the 190 dB re 1 μPa (rms) column in Table 3 of L-DEO's application and Table 1 above (given that the rms level is approximately 10–15 dB higher than the SEL value for the same pulse). Seismic pulses with received energy levels ≥175–180 dB SEL (190 dB re 1 μPa (rms)) are expected to be restricted to radii no more than 140–200 m (459–656 ft) around the airguns. The specific radius depends on the number of airguns, the depth of the water, and the tow depth of the airgun array. For an odontocete closer to the surface, the maximum radius with ≥175–180 dB SEL or ≥190 dB re 1 μPa (rms) would be smaller.

The above TTS information for odontocetes is derived from studies on the bottlenose dolphin and beluga. There is not published TTS information for other types of cetaceans. However, preliminary evidence from harbor porpoise exposed to airgun sound suggests that its TTS threshold may have been lower (Lucke *et al.* 2007).

For baleen whales, there are no data, direct or indirect, on levels or properties of sound required to induce TTS. The frequencies to which baleen whales are most sensitive are lower than those for odontocetes, 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. In any event, no cases of TTS are expected given three considerations: (1) the relatively low abundance of baleen whales expected in the planned study areas; (2) the strong likelihood that baleen whales would avoid the approaching airguns (or vessel) before being exposed to levels high enough for there to be any possibility of TTS; and (3) the mitigation measures that are planned.

In pinnipeds, TTS thresholds associated with exposure to brief pulses (single or multiple) of underwater sound have not been measured. Initial evidence from prolonged (non-pulse) exposures suggested that some pinnipeds may incur TTS at somewhat lower received levels than do small odontocetes exposed for similar durations (Kastak *et al.*, 1999, 2005; Ketten *et al.*, 2001; Au *et al.*, 2000). The TTS threshold for pulsed sounds has been indirectly estimated as being an SEL of approximately 171 dB re 1 $\mu Pa^2 \cdot s$ (Southall *et al.*, 2007), which would be equivalent to a single pulse with received level approximately 181–186 re 1 μPa (rms), or a series of pulses for which the highest rms 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).

A marine mammal within a radius of less than 100 m (328 ft) around a typical large array of operating airguns might be exposed to a few seismic pulses with levels of greater than or equal to 205 dB, and possibly more pulses if the mammal moved with the seismic vessel. (As noted above, most cetacean species tend to avoid operating airguns, although not all individuals do so.) In addition, ramping up airgun arrays, which is standard operational protocol for large airgun arrays, should allow cetaceans to move away form the seismic source and to avoid being exposed to the full acoustic output of the airgun array. Even with a large airgun array, it is unlikely that the cetaceans would be exposed to airgun pulses at a sufficiently high level for a sufficiently long period to cause more than mild TTS, given the relative movement of the vessel and the marine mammal. The potential for TTS is much lower in this project. With a large array of airguns, TTS would be most likely in any odontocetes that bow-ride or otherwise linger near the airguns. While bow-riding, odontocetes would be at or above the surface, and thus not exposed to strong pulses given the pressure-release effect at the surface. However, bow-riding animals generally dive below the surface intermittently. If they did so while bow-riding near airguns, they would be exposed to strong sound pulses, possibly repeatedly. If some cetaceans did incur TTS through exposure to airgun sounds, this would very likely be mild, temporary, and reversible.

To avoid the potential for injury, NMFS has determined that cetaceans and pinnipeds should not be exposed to pulsed underwater noise at received levels exceeding, respectively, 180 and 190 dB re 1 μPa (rms). As summarized above, data that are now available imply that TTS is unlikely to occur unless odontocetes (and probably mysticetes as well) are exposed to airgun pulses stronger than 180 dB re 1 μPa (rms).

Permanent Threshold Shift – When PTS occurs, there is physical damage to the sound receptors in the ear. In some cases, there can be total or partial deafness, while in other cases, the animal has an impaired ability to hear sounds in specific frequency ranges.

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 TTS, there has been further speculation about the possibility that some individuals occurring very close to airguns might incur PTS. Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage in terrestrial mammals. 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 decibels above that inducing mild TTS if the animal were exposed to strong sound pulses with rapid rise time (see Appendix B (f) of L-DEO's application). The specific difference between the PTS and TTS thresholds has not been measured for marine mammals exposed to any sound type. However, 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.

On an SEL basis, Southall *et al.* (2007) estimated that received levels would need to exceed the TTS threshold by at least 15 dB for there to be risk of PTS. Thus, for cetaceans they estimate that the PTS threshold might be a cumulative SEL (for the sequence of received pulses) of approximately 198 dB re 1 $\mu Pa^2 \cdot s$. Additional assumptions had to be made to derive a corresponding estimate for pinnipeds. Southall *et al.* (2007) estimate that the PTS threshold could be a cumulative SEL of approximately 186 dB 1 Pa2 s in the harbor seal; for the California sea lion and northern elephant seal the PTS threshold would probably be higher. Southall *et al.* (2007) also note that, regardless of the SEL, there is concern about the possibility of PTS if a cetacean or pinniped receives one or more pulses with peak pressure exceeding 230 or 218 dB re 1 μPa (3.2 bar· m, 0–pk), which would only be found within a few meters of the largest (360–in^3) airguns in the planned airgun array (Caldwell and Dragoset, 2000). A peak pressure of 218 dB re 1 μPa could be received somewhat farther away; to estimate that specific distance, one would need to apply a model that accurately calculates peak pressures in the near-field around an array of airguns.

Given the higher level of sound necessary to cause PTS as compared with TTS, it is considerably less likely that PTS could occur. In fact, even the levels immediately adjacent to the airguns may not be sufficient to induce PTS, especially because a mammal would not be exposed to more than one strong pulse unless it swam immediately alongside the airgun for a period longer than the inter-pulse interval. Baleen whales generally avoid the immediate area around operating seismic vessels, as do some other marine mammals. The planned monitoring and mitigation measures, including visual monitoring, passive acoustic monitoring (PAM), power downs, and shut downs of the airguns when mammals are seen within the EZ will minimize the already minimal probability of exposure of marine mammals to sounds strong enough to induce PTS.

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 effects, and other types of organ or tissue damage (Cox *et al.*, 2006.; Southall *et al.*, 2007). However, studies examining such effects are limited. If any such effects do occur, they would probably be limited to unusual situations when animals might be exposed at close range for unusually long periods, when sound is strongly channeled with less-than-normal propagation loss, or when dispersal of the animals is constrained by shorelines, shallows, etc. Airgun pulses, because of their brevity and intermittence, are less likely to trigger resonance or bubble formation than are more prolonged sounds. It is doubtful that any single marine mammal would be exposed to strong seismic sounds for time periods long enough to induce physiological stress.

Until recently, it was assumed that diving marine mammals are not subject to the bends or air embolism. This possibility was first explored at a workshop (Gentry [ed.], 2002) held to discuss whether a stranding of beaked whales in the Bahamas in 2000 (Balcomb and Claridge, 2001; NOAA and USN, 2001) might have been related to bubble formation in tissues caused by exposure to noise from naval sonar. However, this link could not be confirmed. Jepson *et al.* (2003) first suggested a possible link between mid-frequency sonar activity and acute chronic tissue damage that results from the formation *in vivo* of gas bubbles, based on a beaked whale stranding in the Canary Islands in 2002 during naval exercises. Fernandez *et al.* (2005a) showed those beaked whales did indeed have gas bubble-associated lesions, as well as fat embolisms. Fernandez *et al.* (2005b) also found evidence of fat embolism in three beaked whales that stranded 100 km (62 mi) north of the Canaries in 2004 during naval exercises. Examinations of several other stranded species have also revealed evidence of gas and fat embolisms (Arbelo *et al.*, 2005; Jepson *et al.*, 2005a; Mendez *et al.*, 2005). Most of the afflicted species were deep divers. There is speculation that gas and fat embolisms may occur if cetaceans ascend unusually quickly when exposed to aversive sounds, or if sound in the environment causes the destablization of existing bubble nuclei (Potter, 2004; Arbelo *et al.*, 2005; Fernandez *et al.* 2005a; Jepson *et al.*, 2005b; Cox *et al.*, 2006). Even if gas and fat embolisms can occur during exposure to mid-frequency sonar, there is no evidence that that type of effect occurs in response to airgun sounds.

In general, little is known about the potential for seismic survey sounds to cause auditory impairment or other physical effects in marine mammals. Available data suggest that such effects, if they occur at all, would be limited to within short distances of the sound source and probably to projects involving large arrays of airguns. The available data do not allow for 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, some odontocetes, and some pinnipeds, are especially unlikely to incur auditory impairment or non-auditory physical effects. It is not known whether aversive behavioral responses to airgun pulses by deep-diving species could lead to indirect physiological problems as apparently can occur upon exposure of some beaked whales to mid-frequency sonar (Cox *et al.*, 2006). Also, the planned mitigation measures, including shut downs of the airguns, will reduce any such effects that might otherwise occur.

Strandings and Mortality

Marine mammals close to underwater detonations of high explosives can be killed or severely injured, and their auditory organs are especially susceptible to injury (Ketten *et al.*, 1993; Ketten 1995). Airgun pulses are less energetic and have slower rise times, and there is no proof that they can cause injury, death, or stranding even in the case of large airgun arrays. However, the association of mass strandings of beaked whales with naval exercises and, in one case, an L-DEO seismic survey, 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. Appendix B(g) of LDEO's application provides addition details.

Seismic pulses and mid-frequency sonar pulses are quite different. Sounds produced by airgun arrays are broadband with most of the energy below 1 kHz. Typical military mid-frequency sonars operate at frequencies of 2–10 kHz, generally with a relatively narrow bandwidth at any one time. 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 pulses can, in special circumstances, lead to physical damage and mortality (Balcomb and Claridge, 2001; NOAA and USN, 2001; Jepson *et al.*, 2003; Fernandez *et al.*, 2004, 2005a; Cox *et al.*, 2006), even if only indirectly, 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 as a result of exposure to seismic surveys. Speculation concerning a possible link between seismic surveys and strandings of humpback whales in Brazil (Engel *et al.*, 2004) was not well founded based on available data (IAGC, 2004; IWC, 2006). In September 2002, there was a stranding of two Cuvier's beaked whales in the Gulf of California, Mexico, when the L-DEO vessel *Ewing* was operating a 20–gun, 8,490–in^3 array in the general area. The link between the stranding and the seismic survey was inconclusive and not based on any physical evidence (Hogarth, 2002; Yoder, 2002). Nonetheless, that plus the incidents involving beaked whale strandings near naval exercises involving use of mid-frequency sonar suggests a need for caution when conducting seismic surveys in areas occupied by beaked whales. No injuries of beaked whales are anticipated during the proposed study because of (1) the high likelihood that any beaked whales nearby would avoid the approaching vessel before being exposed to high sound levels, (2) the proposed monitoring and mitigation measures, and (3) differences between the sound sources operated by L-DEO and those involved in the naval exercises associated with strandings.

Potential Effects of Other Acoustic Devices

Multibeam Echosounder Signals

The Simrad EM 120 12–kHz MBES will be operated from the source vessel at some times during the planned study. Sounds from the MBES are very short pulses, occurring for 15 ms once every 5–20 s, depending on water depth. Most of the energy in the sound pulses emitted by the MBES is at frequencies centered at 12 kHz, and the maximum source level is 242 dB re 1 μPa (rms). The beam is narrow (1°) in fore-aft extent and wide (150°) in the cross-track extent. Each ping consists of nine 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 nine segments. Also, marine mammals that encounter the MBES 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 ship (where the beam is narrowest) are especially unlikely to be ensonified for more than one 2–15 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 in order to receive the multiple pulses that might result in sufficient exposure to cause TTS. Burkhardt *et al.* (2007) concluded that immediate direct auditory injury was possible only if a cetacean dived under the vessel into the immediate vicinity of the transducer.

Navy sonars that have been linked to avoidance reactions and stranding of cetaceans (1) generally have a longer pulse duration that the Simrad EM120, and (2) are often directed close to horizontally vs. more downward for the MBES.. The area of possible influence of the MBES is much smaller a narrow band below the source vessel. The duration of exposure for a given marine mammal can be much longer for a Navy sonar.

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

Behavioral reactions of free-ranging marine mammals to sonars 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 (Rendell and Gordon, 1999), and the previously-mentioned beachings by beaked whales. During exposure to a 21–25 kHz whale-finding sonar with a source level of 215 dB re 1 μPa, gray whales showed slight avoidance (approximately 200 m; 656 ft) behavior (Frankel, 2005). However, all of those observations are of limited relevance to the present situation. Pulse durations from those sonars were much longer than those of the MBES, and a given mammal would have received many pulses from the naval sonars. 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.

Captive bottlenose dolphins and a white whale exhibited changes in behavior when exposed to 1 s pulsed sounds 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 either duration or bandwidth as compared with those from an MBES.

L-DEO is not aware of any data on the reactions of pinnipeds to sonar or echosounder sounds at frequencies similar to the 12 kHz frequency of the *Langseth*'s MBES. Based on observed pinniped responses to other types of pulsed sounds, and the likely brevity of exposure to the MBES sounds, pinniped reactions are expected to be limited to startle or otherwise brief responses of no lasting consequence to the animals.

NMFS believes that the brief exposure of marine mammals to one pulse, or small numbers of signals, from the MBES are not likely to result in the harassment of marine mammals.

Sub-bottom Profiler Signals

A SBP will be operated from the source vessel during the planned study. Sounds from the SBP are very short pulses, occurring for 1–4 ms once every second. Most of the energy in the sound pulses emitted by the SBP is at mid frequencies, centered at 3.5 kHz. The beamwidth is approximately 30° and is directed downward. The SBP on the *Langseth* has a maximum source level of 204 dB re 1 μPam. 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, and if the animal was in the area, it would have to pass the transducer at close range in order to be subjected to sound levels that could cause TTS.

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

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. The pulsed signals from the SBP are somewhat weaker than those from the MBES. Therefore, behavioral responses are not expected unless marine mammals are very close to the source.

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. In the case of mammals that do not avoid the approaching vessel and its various sound sources, mitigation measures that would be applied to minimize effects of other sources would further reduce or eliminate any minor effects of the SBP.

NMFS believes that to avoid the potential for permanent physiological damage (Level A Harassment), cetaceans and pinnipeds should not be exposed to pulsed underwater noise at received levels exceeding, respectively, 180 and 190 dB re 1 μPa (rms). The precautionary nature of these criteria is discussed in Appendix B (f) of L-DEO's application, including the fact that the minimum sound level necessary to cause permanent hearing impairment is higher, by a variable and generally unknown amount, than the level that induces barely-detectable temporary threshold shift (TTS) and the level associated with the onset of TTS is often considered to be a level below which there is no danger of permanent damage. NMFS also assumes that cetaceans or pinnipeds exposed to levels exceeding 160 dB re 1 μPa (rms) may experience Level B Harassment.

Estimated Take by Incidental Harassment

All anticipated takes would be ''takes by harassment'', involving temporary changes in behavior. The proposed mitigation measures are expected to minimize the possibility of injurious takes. The sections below describe methods to estimate ''take by harassment'', and present estimates of the numbers of marine mammals that might be affected during the proposed Gulf of Alaska seismic survey. The estimates of ''take by harassment'' are based on consideration of the number of marine mammals that are exposed to certain received sound levels by approximately 2,386 km of seismic surveys in the Gulf of Alaska. The main sources of distributional and numerical data used in deriving the estimates are described below.

Empirical data concerning 190-, 180-, 170-, and 160 dB re 1 μPa isopleth distances in deep and shallow water were acquired for various airgun configurations during the acoustic calibration study of the R/V *Maurice Ewing*'s (*Ewing*) 20–airgun 8,600 in³ array in 2003 (Tolstoy *et al.*, 2004a,b). The results showed that radii around the airguns where the received level was 180 dB re 1 μPa rms, the threshold for estimating level B harassment applicable to cetaceans (NMFS 2000), varied with water depth. Similar depth-related variation is likely for the 190–dB re 1 μPa threshold for estimating Level B harassment applicable to cetaceans and the 190–dB re 1 μPa threshold applicable to pinnipeds, although these were not measured. The L-DEO model does not allow for bottom interactions, and thus is most directly applicable to deep water and to relatively short ranges.

The empirical data indicated that, for deep water (≤1,000 m; 3,280 ft), the L-DEO model (as applied to the *Ewing*'s airgun configurations) overestimated the measured received sound levels at a given distance (Tolstoy *et al.*, 2004a,b). However, to be conservative, the distances predicted by L-DEO's model for the survey will be applied to deep-water areas during the proposed study (see Figure 3 and 4 and Table 1 in the application). As very few, if any, mammals are expected to occur deeper than 2,000 m (6,562 ft), this depth was used as the maximum relevant depth.

Empirical measurements of sounds from the *Ewing*'s airgun arrays were not conducted for intermediate depths (100–1,000 m; 328–3,280 ft). On the expectation that results would be intermediate, the estimates provided by the model for deep-water situations are used to obtain estimates for intermediate-depth sites. Corresponding correction factors, applied to the modeled radii for the *Langseth*'s airgun configuration, will be used during the proposed study for intermediate depths (see Table 1 of the application).

Empirical measurements near the *Ewing* indicated that in shallow water (<100 m; 328 ft), the L-DEO model underestimates actual levels. In previous L-DEO projects, the exlusion zones were typically based on measured values and ranged from 1.3 to 15x higher than the modeled values depending on the size of the airgun array and the sound level measured (Tolstoy *et al.*, 2004b). During the proposed cruise, similar correction factors will be applied to derive appropriate shallow-water radii from the modeled deep-water radii for the *Langseth*'s airgun configuration (see Table 1 of the application).

Using the modeled distances and various correction factors, Table 1 (from the application) shows the distances at which four rms sound levels are expected to be received from the 36–airgun array and a single airgun in three different water depths.

The anticipated radii of influence of the MBES and the SBP are much smaller than those for the airgun array. It is assumed that, during simultaneous operations of the airgun array and echosounders, marine mammals close enough to be affected by the echosounders would already be affected by the airguns. However, whether or not the airguns are operating simultaneously with the echosounders, marine mammals are not expected to be exposed to sound pressure levels great enough or long enough for taking to occur given echosounders' characteristics (e.g., narrow downward-directed beam) and other considerations described above. Therefore, no additional allowance is included for animals that might be affected by sound sources other than airguns.

There are few systematic data on the numbers and distributions of marine mammals in SE Alaska and the GOA. Zerbini *et al.* (2003, 2006, 2007) conducted vessel-based surveys in the northern and western GOA from the Kenai Peninsula to the central Aleutian Islands during July-August 2001–2003. Killer whales were the principal target of the surveys, but the abundance and distribution of fin, humpback, and minke whales were also reported. Waite (2003) conducted vessel-based surveys in the northern and western GOA from PWS to approximately 160° W off Alaska Peninsula during 26 June- 15 July 2003; cetaceans recorded included small odontocetes, beaked whales, and mysticetes. The eastern part of Zerbini *et al.*'s surveys and Waite's survey were confined to water <1,000 m deep, and most effort was in depths <100 m. Dahlheim *et al.* (2000) conducted aerial surveys of the nearshore waters from Bristol Bay to Dixon Entrance for harbor porpoises; SE Alaska was surveyed during 1–26 June 1993. Dahlheim and Towell (1994) conducted vessel-based surveys of Pacific white-sided dolphins in the inland waterways of SE Alaska during April-May, June or July, and September- early October of 1991–1993. In a report on a seismic cruise in SE Alaska from Dixon Entrance to Kodiak Island during August-September 2004, MacLean and Koski (2005) included density estimates of cetaceans and pinnipeds for each of three depth ranges (<100 m, 100–1,000 m, and >1,000 m) during non-seismic periods.

Most surveys for pinnipeds in Alaskan waters have estimated the number of animals at haul-out sites, not in the water (e.g., Loughlin, 1994; Sease *et al.*, 2001; Withrow and Cesarone, 2002; Sease and York, 2003). To our knowledge, the estimates of MacLean and Koski (2005) are the only in-water estimates of pinnipeds in the proposed survey area.

Table 7 in L-DEO's application gives the average and maximum densities in each of three depth ranges for each cetacean and pinniped species reported to occur in SE Alaska. The densities from MacLean and Koski (2005) and those calculated from effort and sightings in Dahlheim and Towell (1994) and Waite (2003) have been corrected for both detectability and availability bias using correction factors from Dahlheim *et al.* (2000) and Koski *et al.* (1998). Detectability bias is associated with diminishing sightability with increasing lateral distance from the trackline. Availability bias refers to the fact that there is less-than–100 percent probability of sighting an animal that is present along the survey trackline. In determining the estimated numbers, L-DEO used the killer whale and mysticete densities from the easternmost blocks (1–6) surveyed by Zerbini *et al.* (2006, 2007), the harbor porpoise densities for the SE Alska portion of the areas surveyed by Dahlheim *et al.* (2000), and only the Pacific white-sided dolphin data from the June or July and September– early October surveys by Dahlheim and Towell (1994). Maps of effort and sightings in Waite (2003) an Zerbini *et al.* (2006, 2007) were used to roughly allocate effort and sighting between waters <100 m and 100–1,000 m deep as either all or none, most (80 percent), or similar (50 percent).

There is some uncertainty about the representatives of the data and the assumptions used in the calculations below for three main reasons: (1) all but the MacLean and Koski (2005) and Dahlheim and Towell (1994) September-early October surveys were carried out earlier (June-July) than the proposed September survey; (2) the Waite (2003) and Zerbini *et al.* (20006, 2007) surveys were in the northern and western GOA; and (3) only the MacLean and Koski (2005) surveys included depths >1,000 m, whereas approximately 43 percent of the proposed line-km are in water depths >1,000 m. However, these represent the best available information. Also, to provide some allowance for these uncertainties L-DEO calculated, ''maximum estimates'' as well as ''best estimates'' of the densities present and numbers potentially affected. Best estimates of density are effort-weighted mean densities from all previous surveys, whereas maximum estimates of density come from whichever of the individual surveys provided the highest density. Where only one estimate was available, the maximum density was assumed to be the observed (best) density multiplied by 1.5.

For three species, L-DEO's density estimates are much higher than densities expected during the proposed survey. The estimates for humpback and fin whales are based on surveys where large concentrations were sighted in nearshore waters and often inland waterways, *viz.* Sitka Sound, Icy Strait, and the bottom of Lynn Canal (MacLean and Koski, 2005), and near Kodiak Island (Waite, 2003; Zerbini *et al.*, 2006). No such concentrations are expected in the proposed survey area. L-DEO's estimates for Dall's porpoise are from vessel-based surveys without seismic survey activity; they are overestimates, possibly by a factor of 5x, given the tendency of this species to approach vessels (Turnock and Quinn, 1991). Noise from the airgun array during the proposed survey is expected to at least reduce and possibly eliminate the tendency to approach the vessel. Dall's porpoises are tolerant of small airgun sources (MacLean and Koski, 2005) and tolerated higher noise levels than other species during a large array survey (Bain and Williams, 2006), but they did respond to that and another large airgun array by moving away (Calambokidis and Osmek, 1998; Bain and Williams, 2006). Because of these considerable overestimates, the best and maximum estimates in Table 7 of L-DEO's application were halved by L-DEO to calculate numbers exposed. In fact, actual densities are undoubtedly much lower than that.

The estimated numbers of individuals potentially exposed are presented below based on a 160–dB re 1 μPa (rms) Level B harassment exposure threshold for cetaceans and pinnipeds. It is assumed that marine mammals exposed to airgun sounds at these levels might experience disruption of behavioral patterns.

It should be noted that the following estimates of takes by harassment assume that the surveys will be fully completed;

in fact, the planned number of line-km has been increased by 25 percent to accomodate lines that may need to be repeated, equipment testing, etc. As is typical during offshore ship surveys, inclement weather and equipment malfunctions are likely to cause delays and may limit the number of useful line-km to seismic operations that can be undertaken. Furthermore, any marine mammal sightings within or near the designated EZ (see will result in the shut down of seismic operations. Thus, the following estimates of the numbers of marine mammals exposed to 160–dB sounds 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.

The number of different individuals that may be exposed to airgun sounds with received levels ≥160 dB re 1 μPa (rms) on one or more occasions was estimated by considering the total marine area that would be within the 160–dB radius around the operating airgun array on at least one occasion. The proposed seismic lines do not run parallel to each other in close proximity, which minimizes the number of times an individual mammal may be exposed during the survey. Only one transect line is proposed to be surveyed twice, and it is unknown how much time will pass between the first and the second transit. Therefore, some of the same individuals may be approached by the operating airguns and come within the 160–dB distance on up to two occasions. However, this also means that some different marine mammals could occur in the area during the second pass. The line that could be surveyed twice was counted twice in L-DEO's calculations.

For each depth stratum, the number of different individuals potentially exposed to received levels ≥160 dB re 1 μPa (rms) was calculated by multiplying:

- The expected species density, either ''mean'' (i.e., best estimate) or ''maximum'', for a particular water depth, times
- The anticipated minimum area to be ensonified to that level during airgun operations in each water depth stratum.

The same approach was used to estimate exposures of pinnipeds, delphinids, and Dall's porpoise to received levels ≥170 dB.

The area expected to be ensonified was determined by entering the planned survey lines into a MapInfo Geographic Information System (GIS), using the GIS to identify the relevant areas by ''drawing'' the applicable 160–dB buffer around each seismic line (depending on water and tow depth) and then calculating the total area within the buffers. Areas where overlap occurred (because of intersecting lines) were limited and included only once to determine the area expected to be ensonified.

Applying the approach described above, approximately 28,900 km2 would be within the 160–dB isopleth on one or more occasions during the survey, including the 25 percent added as a contingency. However, this approach does not allow for turnover in the mammal populations in the study area during the course of the study. This might somewhat underestimate actual numbers of individuals exposed, although the conservative (i.e., probably overestimated) line-kilometer distances used to calculate the area may offset this. In addition, the approach assumes that no cetaceans will move away or toward the trackline (as the *Langseth* approaches) in response to increasing sound levels prior to the time the levels reach 160 dB re 1 μPa (rms). Another way of interpreting the estimates that follow is that they represent the number of individuals that are expected (in the absence of the seismic activity) to occur in the waters that will be exposed to ≥160 dB re 1 μPa (rms).

TABLE 3. ESTIMATES OF THE POSSIBLE NUMBERS OF MARINE MAMMALS EXPOSED TO SOUND LEVELS ≥160 DB DURING L DEO'S PROPOSED SEISMIC SURVEY IN SE ALASKA IN SEPTEMBER 2008. THE PROPOSED SOUND SOURCE CONSISTS OF A 36-GUN, 6600-IN^3, AIRGUN ARRAY. RECEIVED LEVELS OF AIRGUN SOUNDS ARE EXPRESSED IN DB RE 1 μPARMS (AVERAGED OVER PULSE DURATION), CONSISTENT WITH NMFS' PRACTICE. NOT ALL MARINE MAMMALS WILL CHANGE THEIR BEHAVIOR WHEN EXPOSED TO THESE SOUND LEVELS, BUT SOME MAY ALTER THEIR BEHAVIOR WHEN LEVELS ARE LOWER (SEE TEXT). THE COLUMN OF NUMBERS IN BOLDFACE SHOWS THE NUMBERS OF ″TAKES″ FOR WHICH AUTHORIZATION IS REQUESTED.

Species	Number of Individuals Exposed to Sound Levels >160 dB									Requested Take Authorization
	Best Estimate [1]					Maximum Estimate [1]				
	Number				% of Pop'n [2]					
	<100 m	100-1000 m	>1000 m	Total		<100 m	100-1000 m	>1000 m	Total	
Odontocetes										
Sperm whale	0	4	45	49	0.2	0	7	67	74	74
Cuvier's beaked whale	0	35	0	35	0.3	0	47	0	47	47
Baird's beaked whale	0	8	0	8	0.1	0	11	0	11	11
Stejneger's beaked whale	0	0	0	0	0	0	0	0	3	3
Beluga	0	0	0	0	0	0	0	0	5	5
Pacific white-sided dolphin	13	43	0	56	0.1	27	176	0	203	203
Risso's dolphin	0	0	0	0	0	0	0	0	5	5
Killer whale	65	51	0	116	1.4	173	112	0	285	285

TABLE 3. ESTIMATES OF THE POSSIBLE NUMBERS OF MARINE MAMMALS EXPOSED TO SOUND LEVELS ≥160 DB DURING L DEO'S PROPOSED SEISMIC SURVEY IN SE ALASKA IN SEPTEMBER 2008. THE PROPOSED SOUND SOURCE CONSISTS OF A 36-GUN, 6600-IN^3, AIRGUN ARRAY. RECEIVED LEVELS OF AIRGUN SOUNDS ARE EXPRESSED IN DB RE 1 µPARMS (AVERAGED OVER PULSE DURATION), CONSISTENT WITH NMFS' PRACTICE. NOT ALL MARINE MAMMALS WILL CHANGE THEIR BEHAVIOR WHEN EXPOSED TO THESE SOUND LEVELS, BUT SOME MAY ALTER THEIR BEHAVIOR WHEN LEVELS ARE LOWER (SEE TEXT). THE COLUMN OF NUMBERS IN BOLDFACE SHOWS THE NUMBERS OF "TAKES" FOR WHICH AUTHORIZATION IS REQUESTED.—Continued

Species	Number of Individuals Exposed to Sound Levels >160 dB									Requested Take Authorization
	Best Estimate [1]					Maximum Estimate [1]				
	Number				% of Pop'n [2]					
	<100 m	100-1000 m	>1000 m	Total		<100 m	100-1000 m	>1000 m	Total	
Short-finned pilot whale	0	0	0	0	0	0	0	0	20	20
Harbor porpoise	118	228	0	346	0.4	239	309	0	548	548
Dall's porpoise	372	4225	783	5379	0.5	561	5594	1174	7329	7329
Mysticetes										
North Pacific right whale	0	0	0	0	0	0	0	0	2	2
Gray whale	0	0	0	0	0	0	0	0	6	6
Humpback whale	83	76	87	246	4.1	138	156	130	424	424
Minke whale	6	3	0	9	0.1	25	16	0	41	41
Fin whale	19	71	0	89	0.6	49	129	0	178	178
Blue whale	0	0	0	0	0	0	0	0	2	2
Pinnipeds										
Northern fur seal	0	0	0	0	0	0	0	0	5	5
Harbor seal	10	259	0	269	<0.1	15	388	0	403	403
Steller sea lion	20	54	0	74	<0.1	30	80	0	110	110

[1] Best and maximum estimates of density are from Table 3 in L-DEO's application.
[2] Regional population size estimates are from Table 2 of L-DEO's application.

The ''best estimates'' of the numbers of individual marine mammals that could be exposed to seismic sounds with received levels ≥160 dB re 1 µPa (rms) during the proposed survey is shown in Table 8 of L-DEO's application and Table 3 (shown above). That total includes 49 sperm, 246 humpback, and 89 fin whales, which would represent 0.2 percent, 4.1 percent, and 0.6 percent, respectively, of the regional populations (Table 3). However the numbers of humpback and fin whales exposed are overestimated considerably because the estimated densities are overestimates (see previous section). Dall's porpoise is expected to be the most common species in the study area; the best estimate of the number of Dall's porpoise that could be exposed is 5,379 or 0.5 percent of the regional population (Table 3). This is also an overestimate because the estimated densities are overestimates (see previous section). Estimates for other species are lower (Table 3).

The ''maximum estimate'' column in Table 3 shows estimates totaling 9,701 marine mammals for the three depth ranges combined. For species that could occur in the study area but were not sighted in the surveys from which density estimates were calculated, the average group size has been used as the maximum estimate.

Based on the ''best'' densities, 74 threatened Steller sea lions and 269 harbor seals could be exposed to airgun sounds ≥160 dB re 1 µPa (rms), which would represent <0.1 percent for both of the respective regional populations. The ''maximum estimate'' column in Table 3 shows an estimated 110 Steller sea lions could be exposed to airgun sounds ≥160 dB re 1 µPa (rms). The corresponding numbers for harbor seals are 403. LDEO has also included a low maximum estimate for the northern fur seal, a species that could be present, but whose density was not calculated because it was not sighted during the survey of MacLean and Koski (2005). The numbers for which ''take authorization'' is requested, given in the far right column of Table 3, are based on the maximum 160–dB estimates.

Potential Effects on Habitat

The proposed L-DEO seismic survey in the GOA will not result in any permanent impact on habitats used by marine mammals or to the food sources they use. The main impact issue associated with the proposed activity will be temporarily elevated noise levels and the associated direct effects on marine mammals, as discussed above. The following sections briefly review effects of airguns on fish and invertebrates, and more details are included in Appendices C and D, respectively, in L-DEO's application.

Effects on Fish

One reason for the adoption of airguns as the standard energy source for marine seismic surveys was that, unlike explosives, they have not been associated with large-scale fish kills. However, existing information relating to the impacts of seismic surveys on marine fish populations and invertebrate species is very limited (see Appendix C of L-DEO's application). There are three types of potential effects of exposure to seismic surveys: (1) pathological, (2) physiological, and (3) behavioral. Pathological effects include 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 the ultimate pathological effect on individual animals (i.e., mortality).

The specific received sound levels at which permanent adverse effects to fish potentially 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. Thus, available information provides limited insight on possible real-world effects at the ocean or population scale. This makes drawing conclusions about impacts on fish problematic because ultimately, the most important aspect of potential impacts relates to how exposure to seismic survey sound affects marine fish populations and their viability, including their availability to fisheries.

The following sections provide a general synopsis of available information on the effects of exposure to seismic and other anthropogenic sound as relevant to fish and invertebrates. The information comprises results from scientific studies of varying degrees of soundness and 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 C of L-DEO's application). For a given sound to result in hearing loss, the sound must exceed, by some specific 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 is unknown; however, it likely depends 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 is known, there are two valid papers with proper experimental methods, controls, and careful pathological investigation implicating sounds produced by actual seismic survey airguns with 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 fishes from the Mackenzie River Delta. This study found that broad whitefish (*Coreogonus nasus*) that received a sound exposure level of 177 dB re 1 $\mu Pa^2 \cdot s$ showed no hearing loss. 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 airgun arrays [less than approximately 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, 29.5 ft, in the former case and <2 m, 6.6 ft, in the latter). Water depth sets a lower limit on the lowest sound frequency that will propagate (the ''cut-off frequency'') at about one-quarter wavelength (Urick, 1983; Rogers and Cox, 1988).

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 (Hubbs and Rechnitzer, 1951; Wardle *et al.*, 2001). Generally, the higher the received pressure and the less time it takes for the pressure to rise and decay, the greater the chance of acute pathological effects. Considering the peak pressure and rise/decay time characteristics of seismic airgun arrays used today, the pathological zone for fish and invertebrates would be expected to be within a few meters of the seismic source (Buchanan *et al.*, 2002). 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, 2000b; Bjarti, 2002; Hassel *et al.*, 2003; Popper *et al.*, 2005).

Except for these two studies, at least with airgun-generated sound treatments, most contributions rely on rather subjective assays such as fish ''alarm'' or ''startle response'' or changes in catch rates by fishers. These observations are important in that they attempt to use the levels of exposures that are likely to be encountered by most free-ranging fish in actual survey areas. However, the associated sound stimuli are often poorly described, and the biological assays are varied (Hastings and Popper, 2005).

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 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 fih would be expected to be with 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; Hassel *et al.*, 2003; Popper *et al.*, 2005).

Some studies have reported 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. Saetre and Ona (1996) applied a ''worst-case scenario'' mathematical model to investigate the effects of seismic energy on fish eggs and larvae and concluded that mortality rates caused by exposure to seismic 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.

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 there is no evidence to support such claims.

Physiological Effects – Physiological effects refer to cellular and/or biochemical responses of fish and invertebrates to acoustic stress. Such stress potentially could affect fish and 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 or fish after exposure to seismic survey sound appear to be temporary (hours to days) in all studies done to date (see Payne *et al.*, 2007 for invertebrates; see Sverdrup *et al.*, 1994; McCauley *et al.*, 2000a,b for fish). 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 (see Appendix C of L-DEO's application).

Summary of Physical (Pathological and Physiological) Effects – As indicated in the preceding general discussion, there is a relative lack of knowledge about the potential physical (pathological and physiological) effects of seismic energy on marine fish and invertebrates. Available data suggest that there may be physical impacts on egg, larval, juvenile, and adult stages at very close range. Considering typical source levels associated with commercial seismic arrays, close proximity to the source would result in exposure to very high energy levels. Whereas egg and larval stages are not able to escape such exposures, juveniles and adults most likely would avoid it. In the case of eggs and larvae, it is likely that the numbers adversely affected by such exposure would not be that different from those succumbing to natural mortality. Limited data regarding physiological impacts on fish and invertebrates indicate that these impacts are short term and are most apparent after exposure at close range.

The proposed seismic program for 2008 is predicted to have negligible to low physical effects on the various life stages of fish and invertebrates for its short duration (approximately 24 days) and approximately 1,909–km of unique survey lines extent. Therefore, physical effects of the proposed program on fish and invertebrates would not be significant.

Behavioral Effects – Because of the apparent lack of serious pathological and physiological effects of seismic energy on marine fish and invertebrates, the highest level of concern now centers on the possible effects of exposure to seismic surveys on the distribution, migration patterns, mating, and catchability of fish. There is a need for more information on exactly what effects such sound sources might have on the detailed behavior patterns of fish and invertebrates at different ranges.

Behavioral effects include changes in the distribution, migration, mating, and catchability of fish populations. Studies investigating the possible effects of sound (including seismic sound) on fish and invertebrate behavior have been conducted on both uncaged and caged animals (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.

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 (CPUE) 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).

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.

For marine invertebrates, behavioral changes could potentially affect such aspects as reproductive success, distribution, susceptibility to predation, and catchability by fisheries. Studies of squid indicated startle responses (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). Parry and Gason (2006) reported no changes in rock lobster CPUE during or after seismic surveys off western Victoria, Australia, from 1978–2004. 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). Additional information regarding the behavioral effects of seismic on invertebrates is contained in Appendix D (c) of L-DEO's application.

Summary of Behavioral Effects – As is the case with pathological and physiological effects of seismic on fish and invertebrates, available information is relatively scant and often contradictory. There have been well-documented observations of fish and invertebrates exhibiting behaviors that appeared to be responses to exposure to seismic energy (i.e., startle response, change in swimming direction and speed, and change in vertical distribution), but the ultimate importance of those behaviors is unclear. Some studies indicate that such behavioral changes are very temporary, whereas others imply that fish might not resume pre-seismic behaviors or distributions for a number of days. There appears to be a great deal of inter- and intra-specific variability. In the case of finfish, three general types of behavioral responses have been identified: startle, alarm, and avoidance. The type of behavioral reaction appears to depend on many factors, including the type of behavior being exhibited before exposure, and proximity and energy level of sound source.

During the proposed study, only a small fraction of the available habitat would be ensonified at any given time, and fish species would return to their pre-disturbance behavior once the seismic activity ceased. The proposed seismic program is predicted to have negligible to low behavioral effects on the various life stages of the fish and invertebrates during its relatively short duration and extent.

Because of the reasons noted above and the nature of the proposed activities, the proposed operations are not expected to have any habitat-related effects that could cause significant or long-term consequences for individual marine mammals or their populations or stocks. Similarly, any effects to food sources are expected to be negligible.

Subsistence Activities

Subsistence hunting and fishing continue to feature prominently in the household economies and social welfare of some Alaskan residents, particularly among those living in small, rural villages (Wolfe and Walker, 1987). Subsistence remains the basis for Alaska Native culture and community. In rural Alaska, subsistence activities are often central to many aspects o human existence from patterns of family life to artistic expression and community religious and celebratory activities.

Marine mammals are hunted legally in Alaskan waters by coastal Alaska Natives. In SE Alaska, the only marine mammals that are hunted are Steller sea lions, harbor seals, and sea otters. Wolfe *et al.* (2004 in Angliss and Outlaw, 2007) estimated that means of 959 and 678 harbor seals from the SE Alaska and the Gulf of Alaska stock, respectively, harvested per year by Alaska Natives between 2000 and 2004, with 743 and 747 seals, respectively, harvested in 2004. Means of 3 and 191 Steller sea lions from the Eastern and Western Alaska stocks, respectively, were harvested per year by Alaska Natives between 2000 and 2004, with 5 and 137 sea lions, respectively, harvested in 2004.

Sea otters are harvested by Alaska Native hunters from SE Alaska to the Aleutian Islands. The USFWS monitors the harvest of sea otters in Alaska. The mean annual subsistence takes from 1996 to 2000 were 97, 297, and 301 animals from the Southwest, Southcentral, and Southeast Alaska sea otter stocks, respectively (USFWS 2002 in Angliss and Outlaw, 2007).

The subsistence harvest of sea otters occurs year-round in coastal communities throughout SE Alaska and the northern GOA. However, there is a general reduction in harvest during the summer months. Hunters are required to obtain tags for sea otter pelts from designated USFWS taggers located in all harvesting villages. The geographical distribution of the harvest is difficult to determine because reports are generated by marking location; harvest location is generally not recorded. Harvests can take place from a large geographic area surrounding each sea otter harvesting village.

Since 1992, the seasonal distribution of harbor seal takes by Alaska Natives has shown two distinct peaks, one during spring, and the other during fall and early winter (Wolfe *et al.*, 2003). The peak harbor seal harvest season for villages in SE Alaska and the northern GOA varies, but in general the months of highest harvest are September through December, with a smaller peak in March. Harvests are traditionally low from May through August, when harbor seals are raising pups and molting in SE Alaska. The Steller sea lion harvest in SE Alaska and the northern GOA is low throughout the year. In 2002, the only harvests in SE Alaska occurred during March and November, and in the northern GOA and Prince William Sound, harvests occurred in July, November, and December (Wolfe *et al.*, 2003).

Beluga whales do not occur regularly within the project area. Any occassional subsistence hunting of belugas that might occur in that area would be opportunistic hunting of extralimital animals.

Gray whales are not hunted within the project area. Some of the gray whales that migrate through SE Alaska in spring and late autumn are hunted in Russian waters during summer, and a very limited subsistence has occurred in recent years off Washington. Any small-scale disturbance effects that might occur in SE Alaska as a result of L-DEO's project would have no effect on the hunts for gray whales in those distant locations.

The proposed survey could potentially impact the availability of marine mammals for harvest in a very small area immediately around the *Langseth*, and for a very short time period during seismic activities. Considering the limited time and locations for the planned seismic surveys, most of which are well offshore (Figure 1 of L-DEO's application), the proposed survey is not expected to have any significant impacts to the availability of Steller sea lions, harbor seals, or sea otters for subsistence harvest. Nonetheless, L-DEO will coordinate its activities with local communities, so that seismic operations will be conducted outside of subsistence hunting times and areas if possible.

TABLE 4. THE ESTIMATED 2002 HARVEST OF HARBOR SEALS AND STELLER SEA LIONS BY ALASKA NATIVE COMMUNITIES NEAR THE PROPOSED STUDY AREA IN THE GULF OF ALASKA.

Village	Estimated Total Harvest of Harbor Seal [1]	Estimated Total Harvest of Steller Sea Lion [1]	Peak of Harbor Seal Harvest [2]
Southeast Alaska Pelican	1.8	0.0	October
Yakutat	137.5	0.0	March
Northern GOA and PWS Chenega Bay	10.5	0.0	August
Cordova	108.5	3.5	February
Tatilek	14.9	0.0	February and March [3]
Valdez	50.0	0.0	December

[1] Includes estimates of both harvested and struck-and-lost animals. Totals are estimated from incomplete household surveys and were multiplied by a correction factor for missed households, which result in fractional estimates rather than whole number counts.
[2] Maximum number harvested in 2002 reported by Wolfe et al. (2003).
[3] Peak harvest in 2000 (Wolfe, 2001).

Subsistence fisheries, on average, provide about 230 pounds (104.5 kg) of food per person per year in rural Alaska (Wolfe, 2000). Of the estimated 43.7 million pounds of wild food harvested in rural Alaska communities annually, subsistence fisheries contributed approximately 60 percent from finfish and 2 percent from shellfish. In the rural communities along the GOA, salmon species are the most targeted subsistence fish.

In 2006, there were 609 residents in the Yakutat Region eligible to participate in the Alaska subsistence fishery. The Yakutat Region subsistence fishers rely mostly upon Pacific halibut, with 5,079–16,561 kg taken in annual catch from 2003 to 2006 (Fall *et al.*, 2007). Halibut typically are taken with a setline or hand-operated fishing gear, with the majority of the catch coming from the setline gear. The halibut fishery is open for subsistence harvest from 1 February to 31 December unless limited for expanded by emergency order. Salmon are also significant importance to subsistence fisheres in the Yakutat Region, with 6,918 harvested there in 2003 (ADFG, 2005). Set gillnets are thee preferred subsistence harvest method for salmon, and there are not restrictions on specific streams, nor are there daily or annual limits to the number of fish taken; there are restrictions to keep subsistence and commercial fisheries separate (ADFG, 2005). Bottomfish, Pacific herring, smelt, and crustaceans are also caught by substance fishers in the Yakutat Region.

Seismic surveys can, at times, cause changes in the catchability of fish. L-DEO will minimize the potential to negatively impact the subsistence fish harvest by avoiding areas where subsistence fishers are fishing. Additionally, L-DEO will consult with each village near the planned project area to identify and avoid areas of potential conflict. These consultations will include all marine subsistence activities (marine mammals and fisheries).

Proposed Mitigation and Monitoring

Mitigation and monitoring measures proposed to be implemented for the proposed seismic survey have been developed and refined during previous L-DEO seismic studies and associated environmental assessments (EAs), IHA applications, and IHAs. The mitigation and monitoring measures described herein represent a combination of the procedures required by past IHAs for other similar projects and on recommended best practices in Richardson *et al.* (1995), Pierson *et al.* (1998), and Weir and Dolman (2007). The measures are described in detail below.

Mitigation measures that will be adopted during the proposed STEEP survey include: (1) speed or course alteration, provided that doing so will not compromise operational safety requirements; (2) power-down procedures; (3) shutdown procedures; (4) ramp-up procedures; and (5) special procedures for situations or species of particular concern, e.g., avoidance of critical habitat around Steller sea lion rookeries and haul-outs (see ''shut-down procedures'' and ''special procedures for situations and species of particular concern,'' below). The thresholds used for estimating take are also used in connection with proposed mitigation.

Vessel-based Visual Monitoring

Marine Mammal Visual Observers (MMVOs) will be based aboard the seismic source vessel and will watch for marine mammals near the vessel during daytime airgun operations and during start-ups of airguns at night. MMVOs will also watch for marine mammals near the seismic vessel for at least 30 minutes prior to the start of airgun operations after an extended shutdown of the airguns. When feasible, MMVOs will also make observations during daytime periods when the seismic system is not operating for comparison of sighting rates and animal behavior with vs. without airgun operations. Based on MMVO observations, the airguns will be powered down, or if necessary, shut down completely (see below), when marine mammals are detected within or about to enter a designated EZ. The MMVOs will continue to maintain watch to determine when the animal(s) are outside the safety radius, and airgun operations will not resume until the animal has left that zone. The predicted distances for the safety radius' are listed according to the sound source, water depth, and received isopleth in Table 1.

During seismic operations in the GOA, at least three MMVOs will be based aboard the *Langseth*. MMVOs will be appointed by L-DEO with NMFS concurrence. At least one MMVO, and when practical two, will monitor the EZ for marine mammals during ongoing daytime operations and nighttime startups of the airguns. Use of two simultaneous MMVOs will increase the proportion of the animals present near the source vessel that are detected. MMVO(s) will be on duty in shifts of duration no longer than 4 hours. The vessel 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 regarding 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 17.8 m (58.4 ft) above sea level, and the observer will have a good view around the entire vessel. During daytime, the MMVO(s) will scan the area around the vessel systematically with reticle binoculars (e.g., 7x50 Fujinon), Big-eye binoculars (25x150), 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 rangefinding binoculars (Leica LRF 1200 laser rangefinder or equivalent) will be available to assist with distance estimation. Those are useful in training MMVOs to estimate distances visually, but are generally not useful in measuring distances to animals directly.

Speed or Course Alteration – If a marine mammal is detected outside the safety radius and, based on its position and the relative motion, is likely to enter the exclusion zone, the vessel's speed and/or direct course may be changed. This would be done if practicable while minimizing the effect on th planned science objectives. The activities and movements of the marine mammal(s) (relative to the seismic vessel) will then be closely monitored to determine whether the animals is approaching the applicable EZ. If the animal appears likely to enter the EZ, further mitigative actions will be taken, i.e., either further course alterations or a power down or shut down of the airguns. Typically, during seismic operations, major course and speed adjustments are often impractical when towing long seismic streamers and large source arrays, thus alternative mitigation measures (see below) will need to be implemented.

Power-down Procedures – A power-down involves reducing the number of operating airguns in use to minimize the EZ, so that marine mammals are no longer in or about to enter this zone. A power-down of the airgun array to a reduced number of operating airguns may also occur when the vessel is moving from one seismic line to another. During a power down for mitigation, one airgun will be operated. The continued operation of at least one airgun is intended to alert marine mammals to the presence of the seismic vessel in the area. In contrast, a shut down occurs when all airgun activity is suspended.

If a marine mammal is detected outside the EZ but is likely to enter it, and if the vessel's speed and/or course cannot be changed to avoid the animal(s) entering the EZ, the airguns will be powered down to a single airgun before the animal is within the EZ. Likewise, if a mammal is already within the EZ when first detected, the airguns will be powered down immediately. During a power down of the airgun array, the 40–in^3 airgun will be operated. If a marine mammal is detected within or near the smaller EZ around that single airgun (see Table 1 of L-DEO's application and Table 1 above), all airguns will be shutdown (see next subsection).

Following a power down, airgun activity will not resume until the marine mammal is outside the EZ for the full array. The animal will be considered to have cleared the EZ if it:

(1) Is visually observed to have left the EZ; or

(2) Has not been seen within the EZ for 15 minutes in the case of small odontocetes and pinnipeds; or

(3) Has not been seen within the EZ for 30 minutes in the case of mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, and beaked whales; or

During airgun operations following a power-down (or shut down) and subsequent animal departure as above, the airgun array will resume operations following ramp-up procedures described below.

Shutdown Procedures – The operating airgun(s) will be shutdown if a marine mammal is detected within or approaching the EZ for the then-operating single 40 in^3 airgun source while the airgun array is at full volume or during a power down. Airgun activity will not resume until the marine mammal has cleared the EZ or until the MMVO 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 describing in the preceding subsection.

Ramp-up Procedures – A ramp-up procedure will be followed when the airgun array begins operating after a specified-duration period without airgun operations or when a power down has exceeded that period. It is proposed that, for the present cruise, this period would be approximately 7 minutes. This period is based on the modeled 180–dB radius for the 36–airgun array (see Table 1 of L-DEO's application and Table 1 here) in relation to the planned speed of the *Langseth* while shooting. Similar periods (approximately 8–10 minutes) were used during previous L-DEO surveys.

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 6 dB per 5–minute period over a total duration of approximately 20–25 minutes. During ramp-up, the MMVOs will monitor the EZ, and if marine mammals are sighted, a course/speed change, power down, or shutdown will be implemented as though the full array were operational.

If the complete EZ has not been visible for at least 30 min prior to the start of operations in either daylight or nighttime, ramp up will not commence 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 the airgun array will not be ramped up from a complete shut down at night or in thick fog, because the other 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 if they choose. Ramp up of the airguns will not be initiated if a marine mammal is isghted within or near the applicable EZ during the day or close to the vessel at night.

Special Procedures for Situations and Species of Particular Concern

Several species of particular concern could occur in the study area. Special mitigation procedures will be used for those species, as follows:

(1) Critical habitat around Steller sea lion rookeries and haul-outs will be avoided;

(2) The airguns will be shut down if a North Pacific right whale is sighted at any distance from the vessel;

(3) Concentrations of humpack whales, fin whales, and sea otters will be avoided;

(4) The seismic vessel will avoid areas where subsistence fishers are fishing; and

(5) Because the sensitivity of beaked whales, approach to slopes and submarine canyons will be minimized, if possible. There are no submarine canyons in or near the study area, and only a limited amount of airgun operations is planned over slope during the proposed survey (Figure 1 of L-DEO's application).

Passive Acoustic Monitoring

Passive Acoustic Monitoring (PAM) will take place to complement the visual monitoring program. Visual monitoring typically is not effective during periods of bad weather 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 addition to visual observations to improve detection, identification, localization, and tracking 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. It will be monitored in real time so visual observers can be advised 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 low-noise, towed hydrophone array that is connected to the vessel by a ''hairy'' faired cable. The array will be deployed from a winch located on the back deck. A deck cable will connect from th winch to the main computer lab where the acoustic station and signal condition and processing system will be located. Th lead-in from the hydrophone array is approximately 400 m (1,312 ft) long, and the active part of the hydrophone is approximately 56 m (184 ft) long. The hydrophone array is typically towed at depths <20 m (65.6 ft).

The towed hydrophone array will be monitored 24 hours per day while at the survey area during airgun operations, and also during most periods when the *Langseth* is underway while the airguns are not operating. One Marine Mammal Observer (MMO) will monitor the acoustic detection system at any one time, 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. MMOs monitoring the acoustical data will be on shift for 1–6 hours. Besides the ''visual'' MMOs, an additional MMO with primary responsibility for PAM will also be aboard. However, all MMOs are expected to rotate through the PAM position, although the most experienced with acoustics will be on PAM duty more frequently.

When a vocalization is detected, the acoustic MMO will, if visual observations are in progress, contact the MMVO immediately to alert him/her to the presence of the cetacean(s) (if they have not already been seen), and to allow a power down or shutdown to be initiated, if required. The information regarding the call will be entered into a database. The data to be entered 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.

MMVO Data and Documentation

MMVOs will record data to estimate the numbers of marine mammals exposed to various received sound levels and to document any apparent disturbance reactions or lack thereof. Data will be used to estimate the numbers of mammals potentially ''taken'' by harassment. They will also provide information needed to order a power down or shutdown of airguns when marine mammals are 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 (shooting or not), sea state, visibility, cloud cover, 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, as well as information regarding airgun power down and shutdown, will be recorded in a standardized format. Data will be entered into a custom 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. Preliminary reports will be prepared during the field program and summaries forwarded to the operating institution's shore facility and to NSF weekly or more frequently. MMVO observations will provide the following information:

(1) The basis for decisions about powering down or shutting down airgun arrays.

(2) Information needed to estimate the number of marine mammals potentially 'taken by harassment.' These data will be reported to NMFS per terms of MMPA authorizations or regulations.

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

(4) Data on the behavior and movement patterns of marine mammals seen at times with and without seismic activity.

Proposed Reporting

A report will be submitted to NMFS within 90 days after the end of the cruise. The report will describe the operations that were conducted and sightings of marine mammals near the operations. The report will be submitted to NMFS, providing full documentation of methods, results, and interpretation pertaining to all monitoring. The 90–day report will summarize the dates and locations of seismic operations, all marine mammal sightings (dates, times, locations, activities, associated seismic survey activities). The report will also include estimates of the amount and nature of potential ''take'' of marine mammals by harassment or in other ways.

Endangered Species Act (ESA)

Under section 7 of the ESA, NSF has begun consultation with the NMFS, Office of Protected Resources, Endangered Species Division on this proposed seismic survey. NMFS will also consult on the issuance of an IHA under section 101(a)(5)(D) of the MMPA for this activity. Consultation will be concluded prior to a determination on the issuance of the IHA.

National Environmental Policy Act (NEPA)

NSF prepared an Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G.Langseth* in the Gulf of Alaska, September 2008. NMFS will either adopt NSF's EA or conduct a separate NEPA analysis, as necessary, prior to making a determination of the issuance of the IHA.

Preliminary Determinations

NMFS has preliminarily determined that the impact of conducting the seismic survey in the Gulf of Alaska may result, at worst, in a temporary modification in behavior (Level B Harassment) of small numbers of 20 species of marine mammals. Further, this activity is expected to result in a negligible impact on the affected species or stocks. The provision requiring that the activity not have an unmitigable adverse impact on the availability of the affected species or stock for subsistence uses is not implicated for this proposed action.

For reasons stated previously in this document, this determination is supported by: (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 fact that pinnipeds would have to be closer than 300 m (0.19 mi) in deep water, 450 m (0.28 mi) at intermediate depths, or 2,182 m (1.36 mi) in shallow water when a single airgun is in use from the vessel to be exposed to levels of sound (190 dB) and to have even a minimal chance of causing TTS; (3) the fact that cetaceans would have to be closer than 950 m (0.6 mi) in deep water, 1,425 m (0.9 mi) at intermediate depths, and 3,694 m (2.3 mi) in shallow water when the full array is in use at a 9 m (29.5 ft) tow depth from the vessel to be exposed to levels of sound (180 dB) believed to have even a minimal chance of causing TTS; (4) the fact that marine mammals would have to be closer than 6,000 m (3.7 mi) in deep water, 6,667 m (4.1 mi) at intermediate depths, and 8,000 m (4.9 mi) in shallow water when the full array is in use at a 9 m (29.5 ft) tow depth from the vessel to be exposed to levels of sound (160 dB) believed to have even a minimal chance of causing TTS; and (5) the likelihood that marine mammal detection ability by trained observers is high at that short distance from the vessel. As a result, no take by injury or death is anticipated, and the potential for temporary or permanent hearing impairment is very low and will be avoided through the incorporation of the proposed mitigation measures.

While the number of potential incidental harassment takes will depend on the distribution and abundance of marine mammals in the vicinity of the survey activity, the number of potential harassment takings is estimated to be small, less than a few percent of any of the estimated population sizes, and has been mitigated to the lowest level practicable through incorporation of the measures mentioned previously in this document.

Proposed Authorization

As a result of these preliminary determinations, NMFS proposes to issue an IHA to L-DEO for conducting a marine geophysical survey in the Gulf of

Alaska from August-September, 2008, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated.

Dated: July 30, 2008.

James H. Lecky,

Director, Office of Protected Resources, National Marine Fisheries Service.

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DEPARTMENT OF DEFENSE

GENERAL SERVICES ADMINISTRATION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

[OMB Control No. 9000–0142]

Federal Acquisition Regulation; Information Collection; Past Performance Information

AGENCIES: Department of Defense (DOD), General Services Administration (GSA), and National Aeronautics and Space Administration (NASA).

ACTION: Notice of request for public comments regarding an extension to an existing OMB clearance (9000–0142).

SUMMARY: Under the provisions of the Paperwork Reduction Act of 1995 (44 U.S.C. Chapter 35), the Federal Acquisition Regulation (FAR) Secretariat will be submitting to the Office of Management and Budget (OMB) a request to review and approve an extension of a currently approved information collection requirement concerning past performance information. The clearance currently expires on November 30, 2008.

Public comments are particularly invited on: Whether this collection of information is necessary for the proper performance of functions of the FAR, and whether it will have practical utility; whether our estimate of the public burden of this collection of information is accurate, and based on valid assumptions and methodology; ways to enhance the quality, utility, and clarity of the information to be collected; and ways in which we can minimize the burden of the collection of information on those who are to respond, through the use of appropriate technological collection techniques or other forms of information technology.

DATES: Submit comments on or before October 6, 2008.

ADDRESSES: Submit comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to the General Services Administration, FAR Secretariat (VPR), 1800 F Street, NW, Room 4041, Washington, DC 20405.

FOR FURTHER INFORMATION CONTACT: Ms. Jeritta Parnell, Contract Policy Division, at GSA (202) 501–4082.

SUPPLEMENTARY INFORMATION:

A. Purpose

Past performance information is relevant information, for future source selection purposes, regarding a contractor's actions under previously awarded contracts. When past performance is to be evaluated, the rule states that the solicitation shall afford offerors the opportunity to identify Federal, state and local government, and private contracts performed by offerors that were similar in nature to the contract being evaluated.

B. Annual Reporting Burden

Respondents: 150,000.
Responses Per Respondent: 4.
Annual Responses: 600,000.
Hours Per Response: 2.
Total Burden Hours: 1,200,000.

OBTAINING COPIES OF PROPOSALS: Requesters may obtain a copy of the information collection documents from the General Services Administration, FAR Secretariat (VPR), 1800 F Street, N.W., Room 4041, Washington, DC 20405, telephone (202) 501–4755. Please cite OMB Control No. 9000–0142, Past Performance Information, in all correspondence.

Dated: July 29, 2008.

Al Matera,

Director, Office of Acquisition Policy.

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BILLING CODE 6820–EP–S

DEPARTMENT OF EDUCATION

Submission for OMB Review; Comment Request

AGENCY: Department of Education.

SUMMARY: The IC Clearance Official, Regulatory Information Management Services, Office of Management invites comments on the submission for OMB review as required by the Paperwork Reduction Act of 1995.

DATES: Interested persons are invited to submit comments on or before September 4, 2008.

ADDRESSES: Written comments should be addressed to the Office of Information and Regulatory Affairs, Attention: Education Desk Officer, Office of Management and Budget, 725 17th Street, NW., Room 10222, Washington, DC 20503. Commenters are encouraged to submit responses electronically by e-mail to *oira_submission@omb.eop.gov* or via fax to (202) 395–6974. Commenters should include the following subject line in their response ''Comment: [insert OMB number], [insert abbreviated collection name, e.g., ''Upward Bound Evaluation'']." Persons submitting comments electronically should not submit paper copies.

SUPPLEMENTARY INFORMATION: Section 3506 of the Paperwork Reduction Act of 1995 (44 U.S.C. Chapter 35) requires that the Office of Management and Budget (OMB) provide interested Federal agencies and the public an early opportunity to comment on information collection requests. OMB may amend or waive the requirement for public consultation to the extent that public participation in the approval process would defeat the purpose of the information collection, violate State or Federal law, or substantially interfere with any agency's ability to perform its statutory obligations. The IC Clearance Official, Regulatory Information Management Services, Office of Management, publishes that notice containing proposed information collection requests prior to submission of these requests to OMB. Each proposed information collection, grouped by office, contains the following: (1) Type of review requested, e.g., new, revision, extension, existing or reinstatement; (2) Title; (3) Summary of the collection; (4) Description of the need for, and proposed use of, the information; (5) Respondents and frequency of collection; and (6) Reporting and/or Recordkeeping burden. OMB invites public comment.

Dated: July 30, 2008

Angela C. Arrington,

IC Clearance Official, Regulatory Information Management Services, Office of Management.

Office of Elementary and Secondary Education

Type of Review: New.
Title: Migrant Student Information Exchange User Application Form.
Frequency: On Occasion.
Affected Public: Individuals or household; State, Local, or Tribal Gov't, SEAs or LEAs.
Reporting and Recordkeeping Hour Burden:
Responses: 9,800.
Burden Hours: 4,900.

Abstract: The collection is the user application form that is completed by State migrant education program staff who need to obtain access to the Migrant Student Information Exchange (MSIX) system. MSIX User