program; and alternatives for effort limitation.

In accordance with NOAA's Administrative Order 216–6, Section 5.02(c), the Council has identified this preliminary range of alternatives as a means to initiate discussion for scoping purposes only. These preliminary issues may not represent the full range of issues that eventually will be evaluated in the Environmental Impact Statement.

The Council has scheduled the following scoping meetings to provide the opportunity for additional public input:

1. Tuesday, December 9, 2008 Hilton Garden Inn, 1101 US Highway 231, Panama City, FL 32405, phone: 850–392–1093;

2. Wednesday, December 10, 2008 City of Madeira Beach, 300 Municipal Drive, Madeira Beach, FL 33708, phone: 727–391–9951.

Copies of the scoping document are available from the Council or can be downloaded from the Council Web site (see **ADDRESSES**).

All scoping meetings will begin at 7 p.m. The meetings will be physically accessible to people with disabilities. Requests for sign language interpretation or other auxiliary aids should be directed to the Council (see **ADDRESSES**).

Once the DEIS associated with the regulatory action is completed, it will be filed with the Environmental Protection Agency (EPA). The EPA will publish a notice of availability of the DEIS for public comment in the **Federal Register**. The DEIS will have a 45-day comment period. This procedure is pursuant to regulations issued by the Council on Environmental Quality (CEQ) for implementing the procedural provisions of the National Environmental Policy Act (NEPA; 40 CFR parts 1500–1508) and to NOAA's Administrative Order 216–6 regarding NOAA's compliance with NEPA and the CEQ regulations.

NMFS will consider public comments received on the DEIS in developing the final environmental impact statement (FEIS) and before adopting final management measures for the action. NMFS will submit both the final measures and the supporting FEIS to the Secretary of Commerce (Secretary) for review as per the Magnuson-Stevens Fishery Conservation and Management Act.

Authority: 16 U.S.C. 1801 *et seq.*

Dated: November 20, 2008.

Emily H. Menashes,

Acting Director, Office of Sustainable Fisheries, National Marine Fisheries Service.

[FR Doc. E8–28017 Filed 11–24–08; 8:45 am]

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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XK83

Incidental Takes of Marine Mammals During Specified Activities; Marine Seismic Surveys in the Southwest Pacific Ocean, January–February, 2009

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 the Lamont-Doherty Earth Observatory (L-DEO) for an Incidental Harassment Authorization (IHA) to take small numbers of marine mammals, by harassment, incidental to conducting a seismic survey in the southwest Pacific Ocean. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS requests comments on its proposal to authorize L-DEO to take, by Level B harassment only, small numbers of marine mammals incidental to conducting a marine seismic survey during January through February, 2009.

DATES: Comments and information must be received no later than December 26, 2008.

ADDRESSES: Comments on the application should be addressed to 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–XK83@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*.

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

FOR FURTHER INFORMATION CONTACT: Jeannine Cody 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 United States 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 for incidental taking 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, 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 small numbers of marine mammals. Within 45 days of the close of the comment period, NMFS must either issue or deny issuance of the authorization.

Summary of Request

On August 18, 2008, NMFS received an application from L-DEO for the taking by Level B harassment only, of small numbers of 29 species of marine mammals incidental to conducting, with research funding from the National Science Foundation (NSF), a marine seismic survey within the Exclusive Economic Zone (EEZ) of Tonga in the southwest Pacific Ocean during January through February 2009.

L-DEO proposes to tomographically image the crust and uppermost mantle of the Eastern Lau Spreading Center (ELSC). The survey area is approximately 42 kilometers (km) offshore from Tonga in water depths ranging from 1000 - 2600 meters (m). L-DEO chose to survey the ELSC because it provides the best site to study the complete range of spreading center processes, magma storage and thermal systems. This study is part of NSF's RIDGE 2000 program, which was developed to facilitate the study of mid-ocean ridges and back-arc spreading centers. These areas mark the boundaries where oceanic plates separate from one another. Around the mid-ocean ridges, heat from the mantle drives vast hydrothermal systems that influence ocean water chemistry and nourish enormous ecosystems. These data are integral to understanding how mid-ocean ridges influence global climatic conditions and to understanding plate tectonic processes and their effects on earthquake occurrence and distribution.

Description of the Specified Activity

The planned survey will involve one source vessel, the R/V *Marcus G. Langseth* (*Langseth*), a seismic vessel owned by the NSF. The proposed project is scheduled to commence on January 14, 2009, and end on February 21, 2009. The vessel will depart Nuku'alofa, Tonga on January 14, 2009 for a one-day transit to the study area in the Lau Basin in the southwest Pacific Ocean (between 19–21° S. and 175–176° W.).

To obtain high-resolution three-dimensional (3D) structures of the Lau Basin's magmatic systems and thermal structures, the *Langseth* will deploy a towed array of 36 airguns with a total discharge volume of approximately 6,600 cubic inches (in^3). The *Langseth* will also deploy 55 to 64 Ocean Bottom Seismometers (OBS) for the survey. As the airgun array is towed along the survey lines, the OBS will receive the returning acoustic signals and record them internally for later analysis. In addition to the OBS, L-DEO may use a relatively short (up to 6–km) hydrophone streamer to receive the returning acoustic signals and transfer the data to the on-board processing system.

The seismic survey effort (e.g., equipment testing, startup, line changes, repeat coverage of any areas, and equipment recovery) will require approximately 19 days to complete 42 transects of variable lengths, totaling 3650 km and will include approximately 456 hours of airgun operation. Please see L-DEO's application for more detailed information. The proposed seismic transects will provide a tomographical image in three dimensions of the physical properties of the crust and uppermost mantle of this area. The exact dates of the activities will depend on logistics, weather conditions, and the need to repeat some lines if data quality is substandard.

Vessel Specifications

The *Langseth*, operated by L-DEO, 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 vessel, which has a length of 71.5 m (235 feet (ft); a beam of 17.0 m (56 ft); a maximum draft of 5.9 m (19 ft); and a gross tonnage of 2925, can accommodate up to 55 people. The ship is powered by two Bergen BRG–6 diesel engines, each producing 3550 horsepower (hp), which drive the two propellers directly. Each propeller has four blades, and the shaft typically rotates at 750 revolutions per minute. The vessel also has an 800 hp bowthruster, which is not used during seismic acquisition. The operation speed during seismic acquisition is typically 7.4B9.3 km/h (4–5 knots). When not towing seismic survey gear, the *Langseth* can cruise at 20B24 km/h (11–13 knots). The *Langseth* has a range of 25,000 km (13,499 nautical miles). The *Langseth* will also serve as the platform from which vessel-based marine mammal (and sea turtle) observers will watch for animals before and during airgun operations.

Acoustic Source Specifications

Seismic Airguns

The full airgun array for the survey consists of 36 airguns (a mixture of Bolt 1500LL and Bolt 1900LLX airguns ranging in size from 40 to 360 in^3), with a total volume of approximately 6,600 in^3 and a firing pressure of 1900 pounds per square inch (psi). The airgun array will fire every 400 m or 180 seconds. The dominant frequency component is 2–188 Hertz (Hz).

The array configuration consists of four identical linear arrays or strings, with 10 airguns on each string; the first and last airguns will be spaced 16 m (52 ft) apart. For each operating string, nine airguns will be fired simultaneously, whereas 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 24H16 m (79 x 52 ft) behind the *Langseth* and will be towed approximately 50–100 m (164–328 ft) behind the vessel at a tow-depth of 9–12 m (29.5–39.4 ft). The airgun array will fire for a brief (0.1 second (s)) pulse every 180 s. The array will remain silent at all other times.

Multibeam Echosounder

The *Langseth* will operate a Simrad EM120 multibeam echosounder (MBES) simultaneously during airgun operations to map characteristics of the ocean floor. The hull-mounted MBES emits brief pulses of mid- or high-frequency (11.25–12.6 kHz) sound in a fanshaped beam that extends downward and to the sides of the ship. The beamwidth is 1° fore-aft and 150° athwartship. The maximum source level is 242 dB re 1 μPa•m (root mean square (rms)). For deep-water operation, each ''ping'' consists of nine successive fan-shaped transmissions, each 15 millisecond (ms) in duration and each ensonifying a sector that extends 1° foreBaft. 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 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 1000 m (3,281 ft) to 20 s at 4000 m (13,124 ft).

Sub-bottom Profiler

The *Langseth* will operate a sub-bottom profiler (SBP) continuously throughout the cruise with the MBES. An SBP operates at mid- to high frequencies and is generally used simultaneously with an MBES to provide information about the sedimentary features and bottom topography. SBP pulses are directed downward at typical frequencies of approximately 3 18 kHz. However, the dominant frequency component of the SBP is 3.5 kHz which is directed downward in a narrow beam by a hull-mounted transducer on the vessel. The SBP output varies with water depth from 50 watts in shallow water to 800 watts in deep water and has a normal source output (downward) of 200 dB re 1 μPa m and a maximum source level output (downward) of 204 dB re 1 μPa • m.

The SBP used aboard the *Langseth* uses seven beams simultaneously, with a beam spacing of up to 15 degrees (°) and a fan width up to 30°. Pulse duration is 0.4 100 ms at intervals of 1 s; a common mode of operation is to broadcast five pulses at 1–s intervals followed by a 5–s pause.

Characteristics of Airgun Pulses

Discussion of the characteristics of airgun pulses has been provided in Appendix B of L-DEO=s application and in previous **Federal Register** notices (see 69 FR 31792, June 7, 2004; 71 FR 58790, October 5, 2006; 72 FR 71625, December 18, 2007; or 73 FR 52950, September 12, 2008). Reviewers are referred to those documents for additional information.

Safety Radii

To aid in estimating the number of marine mammals that are likely to be taken, pursuant to the MMPA, and in developing effective mitigation measures, NMFS applies certain acoustic thresholds that indicate the received level at which Level A or Level B harassment would occur in marine mammals were exposed, see Table 1.

Source and Volume	Tow Depth (m)	Predicted RMS Distances (m)		
		190 dB	180 dB	160 dB
Single Bolt airgun 40 in^3	9-12	12	40	385
4 strings 36 airguns 6600 in^3	9	300	950	6000
	12	340	1120	6850

Table 1. Predicted distances to which sound levels ≥ 190, 180, and 160 dB re 1 μ Pa might be received in deep (>1000 m; 3280 ft) water from the 36 airgun array during the seismic survey, January - February, 2009.

The distance from the sound source at which an animal would be exposed to these different received sound levels may be estimated and is typically referred to as safety radii. These safety radii are specifically used to help NMFS estimate the number of marine mammals likely to be harassed by the proposed activity and in deciding how close a marine mammal may approach an operating sound source before the applicant will be required to power-down or shut down the sound source.

During this study, all survey efforts will take place in deep (greater than 1000 m, 3820 ft) water. The L-DEO model does not allow for bottom interactions, and thus is most directly applicable to deep water and to relatively short ranges. L-DEO has summarized the modeled distances for the planned airgun configuration in Table 1 which shows the distances at which four rms sound levels (190 decibel (dB), 180 dB, and 160 dB) are expected to be received from the 36–airgun array and a single airgun operating in water greater than 1000 m (3,820 ft) in depth.

The calculated distances are expected to overestimate the actual distances to the corresponding Sound Pressure Levels (SPL), given the deep-water results of Tolstoy *et al.* (2004a,b). Additional information regarding how the safety radii were calculated and how the empirical measurements were used to correct the modeled numbers may be found in Section I and Appendix A of L-DEO's application.

The conclusion that the model predictions in Table 1 are precautionary, relative to actual 180 and 190 dB (rms) radii, is based on empirical data from the acoustic calibration of different airgun configurations than those used on the *Langseth* (cf. Tolstoy *et al.*, 2004a,b); that sound source verification study was done in the northern Gulf of Mexico. L-DEO has recently (late 2007/early 2008) conducted a more extensive acoustic calibration study of the *Langseth*'s 36–airgun array, also in the northern Gulf of Mexico (LGL Ltd. 2006; Holst and Beland, 2008). Distances where various sound levels (e.g., 190, 180, and 160 dB re 1 μPa (rms) were received are being determined for various airgun configurations and water depths. Those results are not yet available. However, the empirical data from the 2007/2008 calibration study will be used to refine the exclusion zones proposed above for use during survey, if the data are appropriate and available at the time of the survey.

Description of Marine Mammals in the Activity Area

Twenty-nine marine mammal species may occur off the coast of Tonga, including 21 odontocetes (toothed cetaceans, such as dolphins), and 8 mysticetes (baleen whales). Pinnipeds are unlikely to be encountered in or near the Lau Basin survey area where seismic operations will occur, and are, therefore, not addressed further in this document. Five of these species are listed as endangered under the U.S. Endangered Species Act (ESA), including the humpback (*Megaptera novaeangelae*), sei (Balaenoptera borealis), fin (*Balenoptera physalus*), blue (*Balenoptera musculus*), and sperm (*Physeter macrocephalus*) whales. This IHA will only address requested take authorizations for cetaceans as L-DEO does not expect to encounter pinnipeds that far offshore in the study area. Thus L-DEO is not requesting any takes for pinnipeds in this IHA.

Table 2 below outlines the species, their habitat and abundance in the proposed survey area, and the requested number of takes by both instances and individuals.

Species	Habitat	Abundance in the SW Pacific	Occurrence in the Survey Area	Maximum Estimate of Individuals	Best Esti-mate of Individuals	Best Esti-mate of Exposures	Approx. % of Regional Population
				Request		Instances	
Mysticetes							
Humpback whale*	Nearshore waters	6,200	Rare	3	1	3	0.01
Sei whale*	Offshore, pelagic	12,000	Common	3	1	3	0.01

Species	Habitat	Abundance in the SW Pacific	Occurrence in the Survey Area	Maximum Estimate of Individuals	Best Estimate of Individuals	Best Estimate of Exposures	Approx. % of Regional Population
				Request		Instances	
Fin whale*	Pelagic, continental slope	3,031	Uncommon	3	1	3	0.03
Blue whale*	Pelagic, coastal	756	Uncommon	3	1	3	0.12
Pygmy right whale	Coastal, oceanic	0	Common	3	1	3	N.A.
Minke whale	Pelagic, coastal	155,000	Rare in Jan.	3	1	3	0.001
Dwarf minke whale	Coastal	N.A.	N.A.	3	1	3	N.A.
Bryde's whale	Pelagic, coastal	16,500	Common	14	4	15	0.02
Odontocetes							
Sperm whale*	Pelagic, deep seas	22,700	Common	22	6	22	0.03
Pygmy sperm whale	Deep waters off the shelf	N.A.	Common	353	96	358	N.A.
Dwarf Sperm whale	Deep waters off the shelf	11,200	Uncommon	353	96	358	0.85
Cuvier's beaked whale	Pelagic	20,000	Common	40	17	64	0.09
Southern bottlenose whale	Pelagic	N.A.	Rare	0	0	0	N.A.
Longman's beaked whale	Pelagic	N.A.	Uncommon	16	7	26	N.A.
Blainville's beaked whale	Pelagic	25,300	Common	40	17	64	0.07
Ginkgo-toothed beaked whale	Pelagic	25,300	Rare	16	7	26	0.03
Rough-toothed dolphin	Deep water	145,900	Uncommon	1,649	857	3,214	0.59
Bottlenose dolphin	Coastal, oceanic	243,500	Common	330	171	643	0.07
Pantropical spotted dolphin	Coastal, pelagic	1,298,400	Uncommon	1,649	857	3,214	0.07
Spinner dolphin	Coastal, pelagic	1,019,300	Rare	3,298	1,714	6,428	0.17
Striped dolphin	Continental shelf	1,918,000	Rare	330	171	643	0.01
Fraser's dolphin	Waters > 1000 m	289,300	Rare	989	514	1,929	0.18
Short-beaked common dolphin	Shelf, pelagic	2,210,900	Common	330	171	643	0.01
Risso's dolphin	Waters > 1000 m	175,800	Common	330	171	643	0.10
Melon-headed whale	Oceanic	45,400	Uncommon	152	43	163	0.10
Pygmy killer whale	Deep, pantropical	38,900	Uncommon	30	9	33	0.02
False killer whale	Pelagic	39,800	Uncommon	91	26	98	0.07
Killer whale	Widely distributed	8,500	Common	61	17	65	0.20
Short-finned pilot whale	Pelagic	160,200	Common	61	17	65	0.01

Species	Habitat	Abundance in the SW Pacific	Occurrence in the Survey Area	Maximum Estimate of Individuals	Best Estimate of Individuals	Best Estimate of Exposures	Approx. % of Regional Population
				Request		Instances	
Total				10,173	4,997	18,735	

Table 2. Abundance, preferred habitat, and commonness of the marine mammal species that may be encountered during the proposed survey within the Lau Basin survey area. The far right columns indicate the estimated number of each species that will be exposed to 160 dB based on best and maximum density estimates. NMFS believes that, when mitigation measures are taken into consideration, the activity is likely to result in take of numbers of animals less than those indicated by the column titled Maximum Estimate of Exposures - Request.
* Federally listed endangered species.

Detailed information regarding the status and distribution of these marine mammals may be found in sections III and IV of L-DEO's application.

Potential Effects of the Proposed Activity on Marine Mammals

Summary of Potential Effects of Airgun Sounds on Marine Mammals

The effects of sounds from airguns might include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, 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). Although the possibility cannot be entirely excluded, it is unlikely that the project would result in any cases of temporary or permanent hearing impairment, or any significant non-auditory physical or physiological effects. Some behavioral disturbance is expected, but is expected to be localized and short-term. These effects are discussed below, but also in further detail in Appendix B of L-DEO=s application.

Tolerance

Numerous studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers. A summary of the characteristics of airgun pulses, is provided in Appendix B of L-DEO's application. Several studies have also shown that marine mammals at distances more than a few kilometers from operating seismic vessels often show no apparent response (tolerance) (see Appendix B of L-DEO's 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 that 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 cetaceans, with the relative responsiveness of baleen and toothed whales being variable.

Masking

Introduced underwater sound may, through masking, reduce the effective communication distance of a marine mammal species if the frequency of the source is close to that used as a signal by the marine mammal, and if the anthropogenic sound is present for a significant fraction of the time (Richardson *et al.*, 1995).

Masking effects of pulsed sounds (even from large arrays of airguns) on marine mammal calls and other natural sounds are expected to be limited, although there are very few specific data on this. Because of the intermittent nature (one pulse every 180 seconds) and low duty cycle of seismic pulses, animals can emit and receive sounds in the relatively quiet intervals between pulses. However, in exceptional situations, reverberation occurs for much or the entire interval between pulses (e.g., Simard *et al.*, 2005; Clark and Gagnon, 2006) which could mask calls. Some baleen and toothed whales are known to continue calling in the presence of seismic pulses, and their calls can usually be heard between the seismic pulses (e.g., Richardson *et al.*, 1986; McDonald *et al.*, 1995; Greene *et al.*, 1999; Nieukirk *et al.*,, 2004; Smultea *et al.*, 2004; Holst *et al.*, 2005a,b, 2006). In the northeastern Pacific Ocean, blue whale calls have been recorded during a seismic survey off Oregon (McDonald *et al.*, 1995). Among odontocetes, there has been one report that sperm whales ceased calling when exposed to pulses from a very distant seismic ship (Bowles *et al.*, 1994), but more recent studies found that they continued calling in the presence of seismic pulses (Madsen *et al.*, 2002c; Tyack *et al.*, 2003; Smultea *et al.*, 2004; Holst *et al.*, 2006; Jochens *et al.*, 2006). Dolphins and porpoises commonly are heard calling while airguns are operating (e.g., Gordon *et al.*, 2004; Smultea *et al.*, 2004; Holst *et al.*, 2005a,b; Potter *et al.*, 2007). The sounds important to small odontocetes are predominantly at much higher frequencies than are the dominant components of airgun sounds, thus limiting the potential for masking. In general, masking effects of seismic pulses are expected to be minor, given the normally intermittent nature of seismic pulses and the *Langseth* being the only seismic vessel operating in the area for a limited time. Masking effects on marine mammals are discussed further in Appendix B of L-DEO's application.

Disturbance Reactions

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

Reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, and many other factors (Richardson *et al.*, 1995; Wartzok *et al.*, 2004; Southall *et al.*, 2007). If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, l*et al.*ne the stock or population. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and populations could be significant. Given the many uncertainties in predicting the quantity and types of impacts of noise on marine mammals, it is common practice to estimate how many mammals would be present within a particular distance of industrial activities and exposed to a particular level of industrial sound. In most cases, this approach likely overestimates the numbers of marine mammals that would be affected in some biologically-important manner.

The sound criteria used to estimate how many marine mammals might be disturbed to some biologically-important degree by a seismic program are based primarily on behavioral observations of a few species. Detailed studies have been done on humpback and sperm whales. Less detailed data are available for some other species of baleen whales, and small toothed whales, but for many species there are no data on responses to marine seismic surveys.

Baleen Whales

Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable. 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 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 and moving away. In the cases of migrating gray and bowhead whales, the observed changes in behavior appeared to be of little or no biological consequence to the animals. They simply avoided the sound source by displacing their migration route to varying degrees, but within the natural boundaries of the migration corridors.

Studies of gray (*Eshrichtius robustus*), bowhead (Balena mysticetes), and humpback whales have shown that seismic pulses with received levels of 160 170 dB re 1 µPa (rms) seem to cause obvious avoidance behavior in a substantial fraction of the animals exposed (Richardson *et al.*, 1995). In many areas, seismic pulses from large arrays of airguns diminish to those levels at distances ranging from 4 15 km (2.5–9.3 mi) from the source. A substantial proportion of the baleen whales within those distances may show avoidance or other strong behavioral reactions to the airgun array. Subtle behavioral changes sometimes become evident at somewhat lower received levels, and studies summarized in Appendix B of L-DEO's application have shown that some species of baleen whales, notably bowhead and humpback whales, at times show strong avoidance at received levels lower than 160 170 dB re 1 µPa (rms).

Responses of humpback whales to seismic surveys have been studied during migration, on summer feeding grounds, and on Angolan winter breeding grounds; there has also been discussion of effects on the Brazilian wintering grounds. McCauley *et al.* (1998, 2000a) studied the responses of humpback whales off Western Australia to a full-scale seismic survey with a 16–airgun, 2678–in^3 array, and to a single 20–in^3 airgun with source level 227 dB re 1 µPa m (peak to peak). McCauley *et al.* (1998) documented that avoidance reactions began at 5–8 km (3–5 mi) from the array, and that those reactions kept most pods approximately 3–4 km (1.8–2.5 mi) from the operating seismic boat. McCauley *et al.* (2000a) 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 more sensitive resting pods of cow-calf pairs. Avoidance distances with respect to the single airgun were smaller but consistent with the results from the full array in terms of the received sound levels. The mean received level for initial avoidance of an approaching airgun was 140 dB re 1 µPa (rms) for humpback pods containing females, and at the mean closest point of approach distance the received level was 143 dB re 1 µPa (rms). The initial avoidance response generally occurred at distances of 5–8 km (3.1–4.9 mi) from the airgun array and 2 km (1.2 mi) from the single airgun. However, some individual humpback whales, especially males, approached within distances of 100–400 m (328–1312 ft), where the maximum received level was 179 dB re 1 µPa (rms).

Humpback whales on their summer feeding grounds 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). Malme *et al.* reported that some of the humpbacks seemed startled at received levels of 150 169 dB re 1 FPa and 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 and subject to alternative explanations (IAGC, 2004). Also, the evidence was not consistent with subsequent results from the same area of Brazil (Parente *et al.*, 2006), or with direct studies of humpbacks exposed to seismic surveys in other areas and seasons. After allowance for data from subsequent years, there was ''no observable direct correlation'' between strandings and seismic surveys (IWC, 2007:236).

Various species of Balaenoptera (blue, sei, fin, and minke whales) have occasionally been reported in areas ensonified by airgun pulses (Stone, 2003; MacLean and Haley, 2004; Stone and Tasker, 2006). Sightings by observers on seismic vessels off the United Kingdom from 1997 to 2000 suggest that, during times of good sightability, sighting rates for mysticetes (mainly fin and sei whales) were similar when large arrays of airguns were shooting vs. silent (Stone, 2003; Stone and Tasker, 2006). However, these whales tended to exhibit localized avoidance, remaining significantly further (on average) from the airgun array during seismic operations compared with non-seismic periods (Stone and Tasker, 2006). In a study off Nova Scotia, Moulton and Miller (2005) found little difference in sighting rates (after accounting for water depth) and initial sighting distances of balaenopterid whales when airguns were operating versus silent. However, there were indications that these whales were more likely to be moving away when seen during airgun operations. Similarly, ship-based monitoring studies of blue, fin, sei and minke whales offshore of Newfoundland (Orphan Basin and Laurentian Sub-basin) found no more than small differences in sighting rates and swim directions during seismic vs. non-seismic periods Moulton *et al.*, 2005, 2006a,b).

Data on short-term reactions by cetaceans to impulsive noises are not necessarily indicative of long-term or biologically significant effects. It is not known whether impulsive sounds affect reproductive rate or distribution and habitat use in subsequent days or years. However, gray whales have continued to migrate annually along the west coast of North America with substantial increases in the population over recent years, despite intermittent seismic exploration (and much ship traffic) in that area for decades (Appendix A in Malme *et al.*, 1984; Richardson *et al.*, 1995; Angliss and Outlaw, 2008). The western Pacific gray whale population did not seem affected by a seismic survey in its feeding ground during a previous year (Johnson *et al.*, 2007). Similarly, bowhead whales have continued to travel to the eastern Beaufort Sea each summer, and their numbers have increased notably, despite seismic exploration in their summer and autumn range for many years (Richardson *et al.*, 1987; Angliss and Outlaw, 2008).

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 and (in more detail) in Appendix B of L-DEO's application have been reported for toothed whales. However, there are recent systematic studies on sperm whales (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; Potter *et al.*, 2007; Weir, 2008).

Seismic operators and marine mammal observers on seismic vessels regularly see dolphins and other small toothed whales near operating airgun arrays, but in general there is a tendency for most delphinids to show some avoidance of operating seismic vessels (e.g., Goold, 1996a,b,c; Calambokidis and Osmek, 1998; Stone, 2003; Moulton and Miller, 2005; Holst *et al.*, 2006; Stone and Tasker, 2006; Weir, 2008). Some dolphins seem to be attracted to the seismic vessel and floats, and some ride the bow wave of the seismic vessel even when large arrays of airguns are firing (e.g., Moulton and Miller, 2005). Nonetheless, small toothed whales more often tend to head away, or to maintain a somewhat greater distance from the vessel, when a large array of airguns is operating than when it is silent (e.g., Stone and Tasker, 2006; Weir, 2008). In most cases the avoidance radii for delphinids appear to be small, on the order of 1 km less, and some individuals show no apparent avoidance. The beluga (Delphinapterus leucas) is a species that (at times) shows long-distance avoidance of seismic vessels. Aerial surveys conducted in the southeastern Beaufort Sea during summer found that sighting rates of beluga whales were significantly lower at distances 10 20 km (6.2–12.4 mi) compared with 20 30 km (12.4–18.6 mi) from an operating airgun array, and observers on seismic boats in that area rarely see belugas (Miller *et al.*, 2005; Harris *et al.*, 2007).

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

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

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

There are almost no specific data on the behavioral reactions of beaked whales to seismic surveys. However, northern bottlenose whales (*Hyperoodon ampullatus*) continued to produce high-frequency clicks when exposed to sound pulses from distant seismic surveys (Laurinolli and Cochrane, 2005; Simard *et al.*, 2005). Most beaked whales tend to avoid approaching vessels of other types (e.g., Wursig *et al.*, 1998). They may also dive for an extended period when approached by a vessel (e.g., Kasuya, 1986). Thus, it is likely that beaked whales would also show strong avoidance of an approaching seismic vessel, although this has not been documented explicitly.

There are increasing indications that some beaked whales tend to strand when naval exercises involving mid-frequency sonar operation are ongoing nearby (e.g., Simmonds and Lopez-Jurado, 1991; Frantzis, 1998; NOAA and USN, 2001; Jepson *et al.*, 2003; Hildebrand, 2005; Barlow and Gisiner, 2006; see also the ''Strandings and Mortality'' subsection, later). These strandings are apparently at least in part a disturbance response, although auditory or other injuries or other physiological effects may also be involved. Whether beaked whales would ever react similarly to seismic surveys is unknown (see ''Strandings and Mortality'', below). Seismic survey sounds are quite different from those of the sonar in operation during the above-cited incidents.

Odontocete reactions to large arrays of airguns are variable and, at least for delphinids and Dall's porpoises, seem to be confined to a smaller radius than has been observed for the more responsive of the mysticetes, belugas, and harbor porpoises (refer to Appendix B in 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, and temporary threshold shift (TTS) has been demonstrated and studied in certain captive odontocetes and pinnipeds exposed to strong sounds (reviewed in Southall *et al.*, 2007). However, there has been no specific documentation of TTS l*et al.*ne permanent hearing damage, i.e., permanent threshold shift (PTS), in free-ranging marine mammals exposed to sequences of airgun pulses during realistic field conditions. 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).

Several aspects of the planned monitoring and mitigation measures for this project are designed to detect marine mammals occurring near the airgun array, and to avoid exposing them to sound pulses that might, at least in theory, cause hearing impairment. In addition, many cetaceans and (to a limited degree) pinnipeds and sea turtles are likely to show some avoidance or the area with high received levels of airgun sound. 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 might also occur in marine mammals exposed to strong underwater pulsed sound. Possible types of non-auditory physiological effects or injuries that might (in theory) occur in mammals close to a strong sound source include stress, neurological effects, bubble formation, and other types of organ or tissue damage. It is possible that some marine mammal species (i.e., beaked whales) 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 unlikely that any effects of these types would occur during the proposed project given the brief duration of exposure of any given mammal, the deep water in the survey area, and the planned monitoring and mitigation measures (see below). The following subsections discuss in somewhat more detail the possibilities of TTS, PTS, and non-auditory physical effects.

Temporary Threshold Shift (TTS)

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). Sound exposure level (SEL), which takes into account the duration of the sound, is the metric used to measure energy and uses the units dB re 1 μPa²•s, as opposed to SPL, which is the pressure metric used in the rest of this document (units - dB re 1 μPa). Given the available data, the received energy level of a single seismic pulse (with no frequency weighting) might need to be approximately 186 dB re 1 μPa²•s (i.e., 186 dB SEL or approximately 196 201 dB re 1 μPa (rms)) in order to produce brief, mild TTS. Exposure to several strong seismic pulses that each have received levels near 190 dB re 1 μPa (rms) might result in cumulative exposure of approximately 186 dB SEL and thus slight TTS in a small odontocete, assuming the TTS threshold is (to a first approximation) a function of the total received pulse energy. The distances from the *Langseth*'s airguns at which the received energy level (per pulse, flat-weighted) would be expected to be 190 dB re 1 μPa (rms) or above, are shown in Table 1. Levels 190 dB re 1 μPa (rms) or above are expected to be restricted to radii no more than 340 m (1115.5 ft) (Table 1) from the 36–airgun array. For an odontocete closer to the surface, the maximum radius with 190 dB re 1 μPa (rms) or above, would be smaller.

The above TTS information for odontocetes is derived from studies on the bottlenose dolphin and beluga. There is no published TTS information for other types of cetaceans. However, preliminary evidence from a 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 that are required to induce TTS. The frequencies to which baleen whales are most sensitive are assumed to be lower than those to which odontocetes are most sensitive, and natural background noise levels at those low frequencies tend to be higher. As a result, auditory thresholds of baleen whales within their frequency band of best hearing are believed to be higher (less sensitive) than are those of odontocetes at their best frequencies (Clark and Ellison, 2004). From this, it is suspected that received levels causing TTS onset may also be higher in baleen whales (Southall *et al.*, 2007). In any event, no cases of TTS are expected given three considerations: (1) the low abundance of baleen whales in most parts of the planned study area; (2) the strong likelihood that baleen whales would avoid the approaching airguns (or vessel) before being exposed to levels high enough for TTS to occur; 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 more prolonged (non-pulse) exposures suggested that some pinnipeds (harbor seals in particular) incur TTS at somewhat lower received levels than do small odontocetes exposed for similar durations (Kastak *et al.*, 1999, 2005; Ketten *et al.*, 2001). The TTS threshold for pulsed sounds has been indirectly estimated as being an SEL of approximately 171 dB re 1 μPa²•s (Southall *et al.*, 2007), which would be equivalent to a single pulse with received level of approximately 181 186 dB re 1 FPa (rms), or a series of pulses for which the highest rms values are a few dB lower. However, pinnipeds are not expected to occur in or near the planned study area.

Permanent Threshold Shift (PTS)

When PTS occurs, there is physical damage to the sound receptors in the ear. In severe 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 (Kryter, 1985). There is no specific evidence that exposure to pulses of airgun sound can cause PTS in any marine mammal, even with large arrays of airguns. However, given the possibility that mammals close to an airgun array might incur at least mild TTS, there has been further speculation about the possibility that some individuals occurring very close to airguns might incur PTS (Richardson *et al.*, 1995, p. 372*ff*). Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage. 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 of L-DEO's application. Based on data from terrestrial mammals, a precautionary assumption is that the PTS threshold for impulse sounds (such as airgun pulses as received close to the source) is at least 6 dB higher than the TTS threshold on a peak-pressure basis, and probably greater than 6 dB (Southall *et al.*, 2007). On an SEL basis, Southall *et al.* (2007:441–4) 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 mammal-weighted (M-weighted) SEL (for the sequence of received pulses) of approximately 198 dB re 1 μPa²•s (15 dB higher than the TTS threshold for an impulse), where the SEL value is accumulated over the sequence of pulses. Additional assumptions had to be made to derive a corresponding estimate for pinnipeds, as the only available data on TTS-thresholds in pinnipeds pertain to non-impulse sound. Southall *et al.* (2007) estimate that the PTS threshold could be a cumulative M_{pw}-weighted SEL of approximately 186 dB re 1 μPa2•s in the harbor seal exposed to impulse sound. The PTS threshold for the California sea lion and northern elephant seal the PTS threshold would probably be higher, given the higher TTS thresholds in those species.

Southall *et al.* (2007) also note that, regardless of the SEL, there is concern about the possibility of PTS if a cetacean or pinniped received one or more pulses with peak pressure exceeding 230 or 218 dB re 1 FPa (peak), respectively. A peak pressure of 230 dB re 1 µPa (3.2 bar•m, 0–peak) would only be found within a few meters of the largest (360 in^3) airgun 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 nearfield 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 would occur. Baleen whales generally avoid the immediate area around operating seismic vessels, as do some other marine mammals and sea turtles. The planned monitoring and mitigation measures, including visual monitoring, PAM, power downs, and shut downs of the airguns when mammals are seen within or approaching the exclusion zones, will further reduce the 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, and other types of organ or tissue damage (Cox *et al.*, 2006; Southall *et al.*, 2007). Studies examining such effects are limited. However, resonance (Gentry, 2002) and direct noise-induced bubble formation (Crum *et al.*, 2005) are not expected in the case of an impulsive source like an airgun array. If seismic surveys disrupt diving patterns of deep-diving species, this might perhaps result in bubble formation and a form of the bends, as speculated to occur in beaked whales exposed to sonar. However, there is no specific evidence of this upon exposure to airgun pulses.

In general, very little is known about the potential for seismic survey sounds (or other types of strong underwater sounds) to cause non-auditory physical effects in marine mammals. Such effects, if they occur at all, would presumably be limited to short distances and to activities that extend over a prolonged period. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall *et al.*, 2007), or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. Marine mammals that show behavioral avoidance of seismic vessels, including most baleen whales, some odontocetes, and some pinnipeds, are especially unlikely to incur non-auditory physical effects. 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 the auditory organs are especially susceptible to injury (Ketten *et al.*, 1993; Ketten, 1995). However, explosives are no longer used for marine seismic research or commercial seismic surveys, and have been replaced entirely by airguns or related non-explosive pulse generators. Airgun pulses are less energetic and have slower rise times, and there is no specific evidence that they can cause serious 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 (Malakoff, 2002; Cox *et al.*,, 2006), has raised the possibility that beaked whales exposed to strong pulsed sounds may be especially susceptible to injury and/or behavioral reactions that can lead to stranding (e.g., Hildebrand, 2005; Southall *et al.*, 2007).

Specific sound-related processes that lead to strandings and mortality are not well documented, but may include: (1) swimming in avoidance of a sound into shallow water; (2) a change in behavior (such as a change in diving behavior) that might contribute to tissue damage, gas bubble formation, hypoxia, cardiac arrhythmia, hypertensive hemorrhage or other forms of trauma; (3) a physiological change such as a vestibular response leading to a behavioral change or stress-induced hemorrhagic diathesis, leading in turn to tissue damage; and (4) tissue damage directly from sound exposure, such as through acoustically mediated bubble formation and growth or acoustic resonance of tissues. There are increasing indications that gas-bubble disease (analogous to the bends), induced in supersaturated tissue by a behavioral response to acoustic exposure, could be a pathologic mechanism for the strandings and mortality of some deep-diving cetaceans exposed to sonar. However, the evidence for this remains circumstantial and associated with exposure to naval mid-frequency sonar, not seismic surveys (Cox *et al.*, 2006; Southall *et al.*, 2007).

Seismic pulses and mid-frequency sonar signals are quite different, and some mechanisms by which sonar sounds have been hypothesized to affect beaked whales are unlikely to apply to airgun pulses. Sounds produced by airgun arrays are broadband impulses with most of the energy below 1 kHz. Typical military mid-frequency sonars emit non-impulse sounds at frequencies of 2 10 kHz, generally with a relatively narrow bandwidth at any one time. A further difference between seismic surveys and naval exercises is that naval exercises can involve sound sources on more than one vessel. Thus, it is not appropriate to assume that there is a direct connection between the effects of military sonar and seismic surveys on marine mammals. However, evidence that sonar signals can, in special circumstances, lead (at least indirectly) to physical damage and mortality (e.g., Balcomb and Claridge, 2001; NOAA and USN, 2001; Jepson *et al.*, 2003; Fernandez *et al.*, 2004, 2005; Hildebrand, 2005; Cox *et al.*, 2006) suggests that caution is warranted when dealing with exposure of marine mammals to any high-intensity pulsed sound.

There is no conclusive evidence of cetacean strandings or deaths at sea as a result of exposure to seismic surveys, but a few cases of strandings in the general area where a seismic survey was ongoing have led to speculation concerning a possible link between seismic surveys and strandings. Suggestions that there was a link between seismic surveys and strandings of humpback whales in Brazil (Engel *et al.*, 2004) were not well founded (IAGC, 2004; IWC, 2007). In September 2002, there was a stranding of two Cuvier's beaked whales (*Ziphius cavirostris*) in the Gulf of California, Mexico, when the L-DEO vessel R/V *Maurice Ewing* was operating a 20–airgun, 8490–in^3 airgun array in the general area. The link between the stranding and the seismic surveys was inconclusive and not based on any physical evidence (Hogarth, 2002; Yoder, 2002). Nonetheless, the Gulf of California incident plus the beaked whale strandings near naval exercises involving use of mid-frequency sonar suggests a need for caution in conducting seismic surveys in areas occupied by beaked whales until more is known about effects of seismic surveys on those species (Hildebrand, 2005). No injuries of beaked whales are anticipated during the proposed study because of: (1) the 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.

Possible Effects of Multibeam Echosounder (MBES) Signals

The Simrad EM120 12–kHz MBES will be operated from the source vessel continuously during the planned study. Sounds from the MBES are very short pulses, occurring for 2 15 ms once every 5 20 s, depending on water depth. Most of the energy in the sound pulses emitted by this MBES is at frequencies near 12 kHz, and the maximum source level is 242 dB re 1 µPa•m (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 Simrad EM120 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 to receive the multiple pulses that might result in sufficient exposure to cause TTS.

Navy sonars that have been linked to avoidance reactions and stranding of cetaceans: (1) generally have longer pulse duration than the Simrad EM120, and (2) are often directed close to omnidirectionally versus more downward for the Simrad EM120. 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 naval sonar.

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

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

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

Because of the unlikelihood of an animal being exposed to more than one or two very brief pulses, NMFS does not expect the operation of the MBES to result in the harassment of any marine mammals.

Possible Effects of the Sub-bottom Profiler Signals

An SBP may be operated from the source vessel at times during the planned study. Sounds from the sub-bottom profiler 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 3.5 kHz, and the beam is directed downward in a narrow beam with a spacing of up to 15 and a fan width up to 30 . The sub-bottom profiler on the *Langseth* has a maximum source level of 204 dB re 1 µPa•m. Kremser *et al.* (2005) noted that the probability of a cetacean swimming through the area of exposure when a bottom profiler emits a pulse is small-even for an SBP more powerful than that on the *Langseth* if the animal was in the area, it would have to pass the transducer at close range and in order to be subjected to sound levels that could cause TTS.

Marine mammal communications will not be masked appreciably by the sub-bottom profiler 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 baleen whales, the SBP 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. However, the pulsed signals from the SBP are considerably weaker than those from the MBES. Therefore, behavioral responses would not be expected unless marine mammals were to approach very close to the source. This is not expected to occur because of the mitigation measures and the likely avoidance behaviors of marine mammals.

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.

Possible Effects of the Acoustic Release Signals

The acoustic release transponder used to communicate with the OBS uses frequencies of 9 13 kHz. Once the OBS is ready to be retrieved, an acoustic release transponder interrogates the OBS at a frequency of 9 11 kHz, and a response is received at a frequency of 9 13 kHz. These signals will be used very intermittently. The source level of the release signal is 190 dB (re 1 µPa at 1 m). An animal would have to pass by the OBS at close range when the signal is emitted in order to be exposed to any pulses at that level. The sound is expected to undergo a spreading loss of approximately 40 dB in the first 100 m (328 ft). Thus, any animals located 100 m (328 ft) or more from the signal will be exposed to very weak signals (less than 150 dB) that are not expected to have any effects. The signal is used only for short intervals to interrogate and trigger the release of the OBS and consists of pulses rather than a continuous sound. Given the short duration use of this signal and rapid attenuation in seawater it is unlikely that the acoustic release signals would significantly affect marine mammals or sea turtles through masking, disturbance, or hearing impairment. Any effects likely would be negligible given the brief exposure at presumable low levels.

Proposed Monitoring and Mitigation Measures

Monitoring

L-DEO proposes to sponsor marine mammal monitoring during the present project, in order to implement the proposed mitigation measures that require real-time monitoring, and to satisfy the anticipated monitoring requirements of the IHA. L-DEO's proposed Monitoring Plan is described below this section. L-DEO understands that this monitoring plan will be subject to review by NMFS, and that refinements may be required. The monitoring work described here has been planned as a self-contained project independent of any other related monitoring projects that may be occurring simultaneously in the same regions. L-DEO is prepared to discuss coordination of its monitoring program with any related work that might be done by other groups insofar as this is practical and desirable.

Vessel-based Visual Monitoring

Marine mammal observers (MMOs) will be based aboard the seismic source vessel and will watch for marine mammals and turtles near the vessel during daytime airgun operations and during any start-ups at night. The MMOs will also watch for marine mammals and turtles near the seismic vessel for at least 30 minutes (min) prior to the start of airgun operations after an extended shut down. When feasible, MMOs will also observe during daytime periods when the seismic system is not operating for comparison of sighting rates and behavior with versus without airgun operations. Based on MMOs' observations, the airguns will be powered down or shut down when marine mammals are observed within or about to enter a designated exclusion zone (EZ). The EZ is a region in which a possibility exists of adverse effects on animal hearing or other physical effects.

During seismic operations in the Lau Basin, at least three MMOs will be based aboard the *Langseth*. MMOs will be appointed by L-DEO with NMFS' concurrence. At least one MMO, and when practical two MMOs, will monitor marine mammals and turtles near the seismic vessel during ongoing daytime operations and nighttime start ups of the airguns. Use of two simultaneous observers will increase the proportion of the animals present near the source vessel that are detected. MMOs will be on duty in shifts of duration no longer than 4 hours (h). Other crew will also be instructed to assist in detecting marine mammals and turtles 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 and turtle observations. When stationed on the observation platform, the eye level will be approximately 18 m (59 ft) above sea level, and the observer will have a good view around the entire vessel. During daytime, the MMOs will scan the area around the vessel systematically with reticle binoculars (e.g., 7 50 Fujinon), Big-eye binoculars (25 150), and with the naked eye. During darkness, night vision devices (NVDs) will be available (ITT F500 Series Generation 3 binocularimage 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 observers to estimate distances visually, but are generally not useful in measuring distances to animals directly; that is done primarily with the reticles in the binoculars.

The vessel-based monitoring will provide data to estimate the numbers of marine mammals exposed to various received sound levels, to document any apparent disturbance reactions or lack thereof, and thus to estimate the numbers of mammals potentially ''taken'' by harassment. It will also provide the information needed in order to power down or shut down the airguns at times when mammals and turtles are present in or near the safety radii. When a sighting is made, the following information about the sighting will be recorded:

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

2. Time, location, heading, speed, activity of the vessel, sea state, visibility, and sun glare.

The data listed under (2) will also be recorded at the start and end of each observation watch, and during a watch whenever there is a change in one or more of the variables.

All observations and power-downs or shut downs will be recorded in a standardized format. Data will be entered into a custom database using a notebook computer. The accuracy of the data entry will be verified by computerized validity data 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.

Results from the vessel-based observations will provide:

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

2. Information needed to estimate the number of marine mammals potentially taken by harassment, which must be reported to NMFS per terms of MMPA authorizations or regulations.

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

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

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 that the visual observers can be advised when cetaceans are detected. When bearings (primary and mirrorimage) 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 the winch to the main computer lab where the acoustic station and signal conditioning and processing system will be located. The lead-in from the hydrophone array is approximately 400 m (1312 ft) long, and the active part of the hydrophone array is approximately 56 m (184 ft) long. The hydrophone array is typically towed at depths less than 20 m (66 ft).

The towed hydrophones will be monitored 24 h per day while at the seismic survey area during airgun operations, and during most periods when the *Langseth* is underway while the airguns are not operating. One 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 h at a time. Besides the visual MMOs, an additional MMO with primary responsibility for PAM will also be aboard. 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 while visual observations are in progress, the acoustic MMO will contact the visual MMO immediately, to alert him/her to the presence of cetaceans (if they have not already been seen), and to allow a power down or shut down to be initiated, if required. The information regarding the call will be entered into a database. 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.

Mitigation

L-DEO's mitigation procedures are based on protocols used during previous L-DEO seismic research cruises as approved by NMFS, and on best practices recommended in Richardson *et al.* (1995), Pierson *et al.* (1998), and Weir and Dolman (2007). The measures are described in detail below this section.

Proposed Safety Zones

As noted earlier, L-DEO modeled received sound levels for the 36–airgun array 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. Based on the modeling for deep water, the distances from the source where sound levels are predicted to be 190, 180, and 160 dB re 1 FPa (rms) were determined (Table 1). The 180- and 190–dB radii vary with tow depth of the airgun array and range up to 1120 m and 340 m, respectively. The 180- and 190–dB levels are shut-down criteria applicable to cetaceans and pinnipeds, respectively, as specified by NMFS (2000); these levels were used to establish the safety zones. If the MMO detects marine mammal(s) or turtle(s) within or about to enter the appropriate safety radii, the airguns will be powered down (or shut down if necessary) immediately (see below).

Mitigation During Operations

Mitigation measures that will be adopted during the L-DEO survey include: (1) speed or course alteration, provided that doing so will not compromise operational safety requirements; (2) power-down procedures; (3) shut-down procedures; (4) ramp-up procedures; and (5) special procedures for species of particular concern.

Speed or Course Alteration – If a marine mammal or sea turtle is detected outside the safety zone and, based on its position and the relative motion, is likely to enter the safety zone, the vessel's speed and/or direct course may be changed. This would be done if practicable while minimizing the effect on the planned science objectives. The activities and movements of the marine mammal or sea turtle (relative to the seismic vessel) will then be closely monitored to determine whether the animal is approaching the applicable safety zone. If the animal appears likely to enter the safety zone, 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 that use hydrophone streamers, the source vessel is unable to change speed or course and one or more alternative mitigation measures (see below) will need to be implemented.

Power-down Procedures – A power-down involves decreasing the number of airguns in use such that the radius of the 180–dB (or 190–dB) zone is decreased to the extent that marine mammals or turtles are no longer in or about to enter the safety zone. A power-down of the airgun array can also occur when the vessel is moving from one seismic line to another. During a power-down for mitigation, one airgun will be operated. The continued operation of one airgun is intended to alert marine mammals and turtles 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 or turtle is detected outside the safety zone but is likely to enter the safety radius, and if the vessel's speed and/or course cannot be changed to avoid having the animal enter the safety radius, the airguns will be powered down before the animal is within the safety radius. Likewise, if a mammal or turtle is already within the safety zone 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 or turtle is detected within or near the smaller safety radius around that single airgun (Table 1), it will be shut down (see next subsection).

Following a power-down, airgun activity will not resume until the marine mammal or turtle has cleared the safety zone. The animal will be considered to have cleared the safety zone if it: (1) is visually observed to have left the safety zone; or (2) has not been seen within the zone for 15 min in the case of small odontocetes; or (3) has not been seen within the zone for 30 min in the case of mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, and beaked whales; or (4) the vessel has moved outside the safety zone for turtles, i.e., approximately 5 to 20 min, depending on the sighting distance, vessel speed, and tow-depth.

Shut-down Procedures – During a power down, the operating airgun(s) will be shut down if a marine mammal or turtle is seen within or approaching the exclusion zone for a single airgun. Shut-downs will be implemented (1) if an animal enters the exclusion zone of the single airgun after a power-down has been initiated, or (2) if an animal is initially seen within the exclusion zone of a single airgun when more than one airgun (typically the full array) is operating. Airgun activity will not resume until the marine mammal or turtle has cleared the EZ, or until the visual marine mammal observer (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 described in the preceding subsection.

Ramp-up Procedures – A ramp-up procedure will be followed when the airgun array begins operating after a specified 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 9 min. This period is based on the largest modeled 180–dB radius for the 36–airgun array (see Table 1) in relation to the planned speed of the *Langseth* while shooting the airguns. Similar periods (approximately 8 10 min) were used during previous L-DEO surveys.

Ramp-up will begin with the smallest gun 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–min period over a total duration of about 35 min. During ramp-up, the MMOs will monitor the safety zone and if marine mammals or turtles are sighted, a course/speed change, power down, or shut down will be implemented as though the full array were operational.

If the complete safety zone 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 outer part of the safety zone 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 and turtles 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 sea turtle or marine mammal is sighted within or near the applicable safety zones during the day or close to the vessel at night.

Shutdown if Injured or Dead Whale is Found – In the unanticipated event that any cases of marine mammal injury or mortality are found and are judged likely to have resulted from these activities, L-DEO will cease operating seismic airguns and report the incident to the Office of Protected Resources, NMFS immediately.

Reporting

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

All injured or dead marine mammals (regardless of cause) must be reported to NMFS as soon as practicable. Report should include species or description of animal, condition of animal, location, time first found, observed behaviors (if alive) and photo or video, if available.

Estimated Take by Incidental Harassment

Because of the mitigation measures that will be required and the likelihood that some cetaceans will avoid the area around the operating airguns of their own accord, NMFS does not expect any marine mammals to approach the sound source close enough to be injured (Level A harassment). All anticipated takes would be ''takes by Level B harassment'', as described previously, involving temporary behavioral modifications or low-level physiological effects.

Estimates of the numbers of marine mammals that might be affected are based on consideration of the number of marine mammals that could be disturbed appreciably by approximately 3,650 km of seismic surveys during the proposed seismic program in the Lau Basin, Tonga. Few systematic aircraft- or ship-based surveys have been conducted for marine mammals in offshore waters of the South Pacific Ocean, and the species of marine mammals that occur there are not well known. L-DEO's estimates are based on species accounts in part derived from Reeves *et al.* (1999), who summarized distribution information from the area served by the South Pacific Regional Environment Programme (SPREP). The SPREP region covers a vast area of the Pacific Ocean between the Tropic of Capricorn and the Equator from Papua New Guinea (140° E) to Pitcairn Island (130° W).

It should be noted that the estimates of exposures to various sound levels assume that the surveys will be completed; in fact, the planned number of line-kilometers has been increased by 25 percent to accommodate lines that may need to be repeated, equipment testing, etc. Furthermore, any marine mammal sightings within or near the designated safety zone will result in the power or shut down of seismic operations as a mitigation measure. Thus, the following estimates of the numbers of marine mammals potentially exposed to 160–dB sounds are precautionary, and probably overestimate the actual numbers of marine mammals that might be involved. These estimates assume that there will be no weather, equipment, or mitigation delays, which is highly unlikely.

The anticipated radii of influence of the MBES and SBP are less than those for the airgun array. It is assumed that, during simultaneous operations of the airgun array and the other sources, any marine mammals close enough to be affected by the MBES or SBP would already be affected by the airguns. However, whether or not the airguns are operating simultaneously with the other sources, marine mammals are expected to exhibit no more than short-term and inconsequential responses to the MBES and SBP given their characteristics (e.g., narrow downward-directed beam) and other considerations (see Possible Effects of Multibeam Echosounder Signals and Possible Effects of the Sub-bottom Profiler Signals). Such reactions are not considered to constitute ''taking'' (NMFS 2001). Therefore, no additional allowance is included for animals that might be affected by sound sources other than airguns.

Density Estimates

The basis for estimating the densities of marine mammals in the proposed study area is discussed in section VII of L-DEO's application. The density estimates used in this assessment are from one of Longhurst's (2007) biogeographic provinces north of the survey area that is oceanographically similar to the province in which the seismic activities will take place. Some of the surveys conducted by Ferguson and Barlow (2001) in the Eastern Tropical Pacific (ETP) during 1986 1996 are in Longhurst's (2007) North Pacific Tropical Gyre Province, which is similar to the South Pacific Subtropical Gyre (SPSG), in which the proposed seismic survey will occur. The similarities are: (1) they are both low-nitrate, lowchlorophyll regions of the oceans with numerous coral reefs, and (2) upwelled nutrients by islands are used by corals and do not increase pelagic productivity. The species assemblages that occur in the southwest Pacific Ocean will be different than those sighted during the surveys in the ETP. However, the overall abundance of species groups with generally similar habitat requirements are expected to be roughly similar.

Potential Number of Exposures to Sound Levels at or above 160 dB

L-DEO's ''best estimate'' of the potential number of exposures of cetaceans, absent any mitigation measures, to seismic sounds with received levels at or above 160 dB re 1 μPa (rms) is 18,735 (Table 2). L-DEO's ''maximum estimate'' of the potential number of exposures of cetaceans, with mitigation measures, to seismic sounds with received levels at or above 160 dB re 1 μPa(rms) is 10,173 (Table 2). It is assumed that marine mammals exposed to airgun sounds this strong might change their behavior sufficiently to be considered ''taken by harassment''.

The number of potential exposures to sound levels at or above 160 dB re 1 μPa (rms) were calculated by multiplying the expected average species density (see section VII of L-DEO's application) times the anticipated minimum area (17,525 km^2, 10,889 mi2) to be ensonified to that level during airgun operations including overlap.

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, and then calculating the total area within the buffers. Areas where overlap occurred (because of closely-spaced lines) were included when estimating the number of exposures.

Number of Individual Cetaceans Exposed to Sound Levels at or above 160 dB

L-DEO's ''best estimate'' of the potential number of different individuals that could be exposed to airgun sounds with received levels at or above 160 dB re 1 μPa (rms) on one or more occasions is 4,997. That total includes 11 baleen whales, four of which are considered endangered under the ESA: one humpback whale, one blue whale, one sei whale, and one fin whale, which would represent small numbers of the regional populations (Table 2). In addition, six sperm whales (also listed as endangered under the ESA) could be exposed during the survey, as well as 48 beaked whales (Table 2).

The spinner dolphin is estimated to be the most common species in the area, with a best estimate of 1,714 spinner dolphins exposed to sound levels at or above 160 dB re 1 μPa(rms).

Based on numbers of animals encountered during previous L-DEO seismic surveys, the likelihood of the successful implementation of the required mitigation measures, and the likelihood that some animals will avoid the area around the operating airguns, NMFS believes that L-DEOs airgun seismic testing program may result in the Level B harassment of some lower number of individual marine mammals (a few times each) than is indicated by the column titled, Maximum Estimate of Exposures - Request, in Table 2. L-DEO has asked for authorization for take of their ''maximum estimate'' of numbers for each species. Though NMFS believes that take of the requested numbers is unlikely, we still find these numbers small relative to the population sizes.

Potential Effects on Habitat

The proposed seismic survey 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.

The *Langseth* will deploy and retrieve approximately 55–64 OBS. The OBS anchors will remain upon equipment recovery. Although OBS placement will disrupt a very small area of seafloor habitat and may disturb benthic invertebrates, the impacts are expected to be localized and transitory. The vessel will deploy the OBS in such a way that creates the least disturbance to the area. Thus, it is not expected that the placement of OBS would have adverse effects beyond naturally occurring changes in this environment, and any effects of the planned activity on marine mammal habitats and food resources are expected to be negligible.

Effects on Fish and Invertebrates – One reason for the adoption of airguns as the standard energy source for marine seismic surveys is that, unlike explosives, they have not been associated with large-scale fish kills. However, existing information on the impacts of seismic surveys on marine fish and invertebrate populations is very limited.

There are three types of potential effects of exposure to seismic surveys: (1) pathological, (2) physiological, and (3) behavioral. Pathological effects involve lethal and temporary or permanent sublethal injury. Physiological effects involve temporary and permanent primary and secondary stress responses, such as changes in levels of enzymes and proteins. Behavioral effects refer to temporary and (if they occur) permanent changes in exhibited behavior (e.g., startle and avoidance behavior). The three categories are interrelated in complex ways. For example, it is possible that certain physiological and behavioral changes could potentially lead to an ultimate pathological effect on individuals (i.e., mortality).

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

The existing body of information on the impacts of seismic survey sound on marine invertebrates is also very limited. However, benthic invertebrates in the Lau Basin are not expected to be affected by seismic operations, as sound levels from the airguns will diminish dramatically by the time the sound reaches the ocean floor at a depth of approximately 2250 m (7382 ft).

There is some unpublished and very limited evidence of the potential for adverse effects on invertebrates. Based on the physical structure of their sensory organs, marine invertebrates appear to be specialized to respond to particle displacement components of an impinging sound field and not to the pressure component (Popper *et al.*, 2001). The only information available on the impacts of seismic surveys on marine invertebrates involves studies of individuals; there have been no studies at the population scale. Thus, available information provides limited insight on possible real-world effects at the regional or ocean scale. The most important aspect of potential impacts concerns how exposure to seismic survey sound ultimately affects invertebrate populations and their viability, including availability to fisheries. More detailed information on studies of potential impacts of sounds on fish and invertebrates is provided in Appendix E of L-DEO's application.

Negligible Impact Determination

NMFS has preliminarily determined, provided that the aforementioned mitigation and monitoring measures are implemented, that the impact of conducting a seismic program in the southwest Pacific Ocean may result, at worst, in a temporary modification in behavior and/or low-level physiological effects (Level B Harassment) of small numbers of certain species of marine mammals. While behavioral and avoidance reactions may be made by these species in response to the resultant noise from the airguns, these behavioral changes are expected to have a negligible impact on the affected species and stocks of marine mammals.

While the number of potential incidental harassment takes will depend on the distribution and abundance of marine mammals in the area of seismic operations, the number of potential harassment takings is estimated to be relatively small in light of the population size (see Table 2). NMFS anticipates the actual take of individuals to be lower than the numbers depicted in the table, because those numbers do not reflect either the implementation of the mitigation numbers or the fact that some animals will avoid the sound at levels lower than those expected to result in harassment. Additionally, mitigation measures require that the *Langseth* avoid any areas where marine mammals are concentrated.

In addition, no take by death and/or serious injury is anticipated, and the potential for temporary or permanent hearing impairment will be avoided through the incorporation of the required mitigation measures described in this document. This conclusion is supported by: (1) the likelihood that, given sufficient notice through slow ship speed and ramp-up of the seismic array, marine mammals are expected to move away from a noise source that it is annoying prior to its becoming potentially injurious; (2) TTS is unlikely to occur, especially in odontocetes, until levels above 180 dB re 1 μPa (rms) are reached; (3) the fact that injurious levels of sound are only likely very close to the vessel; and (4) the monitoring program developed to avoid injury will be sufficient to detect (using visual detection and PAM), with reasonable certainty, all marine mammals within or entering the identified safety zones.

Endangered Species Act (ESA)

Under section 7 of the ESA, the National Science Foundation (NSF) has begun consultation on this proposed seismic survey. NMFS will also consult internally 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 an IHA.

National Environmental Policy Act (NEPA)

On September 22, 2005 (70 FR 55630), NSF published a notice of intent to prepare a Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OES) to evaluate the potential environmental impacts associated with the use of seismic sources in support of NSF-funded research by U.S. academic scientists. NMFS agreed to be a cooperating agency in the preparation of the EIS/OEIS. This EIS/OEIS has not been completed. Therefore, in order to meet NSF's and NMFS' NEPA requirements for the proposed activity and issuance of an IHA to L-DEO, the NSF has prepared an Environmental Assessment of a Marine Geophysical Survey by the *Langseth* in the southwest Pacific Ocean off the coast of Tonga. NMFS is reviewing that document and 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. NMFS has posted NSF's EA on its website at *http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications*.

Preliminary Conclusions

Based on the preceding information, and provided that the proposed mitigation and monitoring are incorporated, NMFS has preliminarily concluded that the proposed activity will incidentally take, by level B behavioral harassment only, small numbers of marine mammals. The provision requiring that the activities not have an unmitigable adverse impact on the availability of the affected species or stock for subsistence uses does not apply for this proposed action. No take by Level A harassment (injury) or death is anticipated and harassment takes should be at the lowest level practicable due to incorporation of the mitigation measures proposed in this document.

Proposed Authorization

NMFS proposes to issue an IHA to L-DEO for a marine seismic survey in the southwest Pacific Ocean during January February, 2009, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated.

Dated: November 18, 2008.

James H. Lecky,

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

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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

[Docket Number: 0811191487–81488–01]

RIN: 0648–XL97

National Weather Service (NWS); NOAA Science Advisory Board's Environmental Information Services Working Group

AGENCY: National Weather Service (NWS), National Oceanic and Atmospheric Administration (NOAA), Department of Commerce (DOC).

ACTION: Notice of solicitation for members of the NOAA Science Advisory Board's Environmental Information Services Working Group.

SUMMARY: The Under Secretary of Commerce for Oceans and Atmosphere requested the NOAA Science Advisory Board (SAB) to obtain input from a standing working group, the Environmental Information Services Working Group (EISWG), as a mechanism to address interactions between NOAA and its Partners. The initial focus of the EISWG is to advise on issues raised and enhance effective collaboration between the National Weather Service and its partners. The composition of the Working Group will reflect those interests.

The EISWG will be composed of 15–18 members, who, by reason of knowledge, experience or training, are especially qualified to represent users of NOAA environmental information services, including, but not limited to, the commercial weather industry (both value-added and end-users), academia, and the media. Membership may also include representatives of federal, state and regional government agencies and non-governmental agencies. NOAA is requesting nominations for membership in the SAB EISWG.

DATES: Nominations must be received by January 23, 2009.

ADDRESSES: Nominations should be submitted electronically to (*noaa.sab.eiswg@noaa.gov*).

FOR FURTHER INFORMATION CONTACT: Jennifer Sprague, 301–713–0217.