The SFPUC proposes to address the effects of construction of WSIP projects through separate regulatory review and permitting processes. If an ITP is issued by the FWS and NMFS prior to the completion of environmental review of any WSIP projects in the Alameda watershed, FWS and NMFS will review the proposed WSIP project for consistency with the Plan. If either FWS or NMFS determines that the future operations and maintenance of the proposed WSIP project are not consistent with the Plan, an amendment to the Plan will be required.

Under the proposed Plan, the effects on covered species resulting from the Covered Activities are expected to be minimized and mitigated to the maximum extent practicable through implementation of a conservation program that includes conservation actions and monitoring, which will be fully described in the proposed Plan. This conservation program will focus on providing for the long-term management of biological communities in the Plan area that support Covered Species. The conservation strategy will implement best management practices throughout the watershed to minimize impacts from all SFPUC Covered Activities. The conservation strategy will provide mitigation for both temporary and ongoing impacts on Covered Species in the form of habitat enhancement, restoration, and, if necessary, protection of additional habitat.

Environmental Impact Statement/ Report

The EIS/EIR will consider the proposed action, the issuance of section 10(a)(1)(B) permits under the Act, and several alternatives, representing varying levels of conservation, impacts from covered activities, the list of covered species, or a combination of these factors. Additionally, a No Action alternative will be included. Under the No Action alternative the Services would not issue section 10(a)(1)(B) permits. In addition, the EIS/EIR will identify potentially significant direct, indirect, and cumulative impacts on biological resources, land use, air quality, water quality, water resources, socioeconomics, and other environmental resources that could occur with the implementation of the proposed actions and alternatives. A detailed description of the impacts of the proposed action and each alternative will be included in the EIS/EIR. For all potentially significant impacts, the EIS/ EIR will identify avoidance, minimization, and mitigation measures to reduce these impacts, where feasible, to a level below significance.

The primary purpose of the scoping process is for the public to assist the Services and the San Francisco Planning Department in developing the EIS/EIR by identifying important issues and alternatives related to the proposed action. FWS and NMFS propose to serve as co-lead Federal agencies under NEPA for preparation of the EIS. The San Francisco Planning Department will be the lead agency for preparation of the EIR under CEQA.

The Services request that comments be specific. In particular, we request information regarding: the direct, indirect, and cumulative impacts that implementation of the proposed Plan could have on endangered and threatened and other covered species, and their communities and habitats; other possible alternatives that meet the purpose and need; potential adaptive management and/or monitoring provisions; funding issues; existing environmental conditions in the plan area; other plans or projects that might be relevant to this proposed project; and minimization and mitigation efforts.

Written comments from interested parties are invited to ensure that the full range of issues related to the permit requests is identified. Comments will only be accepted in written form. You may submit written comments by mail, electronic mail to NMFS, facsimile transmission, or in person (see **ADDRESSES**). Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment including your personal identifying information may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Reasonable Accommodation

Persons needing reasonable accommodations to attend and participate in the public meeting should contact Sheila Larsen at (916) 414-6600. To allow sufficient time to process requests, please call no later than one week before the public meeting. Information regarding this proposed action is available in alternative formats upon request.

Dated: December 15, 2008.

Richard E. Sayers, Jr.,

Acting Deputy Regional Director, Deputy Regional Director, California and Nevada Region, Sacramento, California.

Dated: December 16, 2008.

Angela Somma,

Chief, Endangered Species Division, National Marine Fisheries Service, Office of Protected Resources.

[FR Doc. E8–30374 Filed 12–19–08; 8:45 am]

BILLING CODES 4310–55–S, 3510–22–S

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XL89

Incidental Takes of Marine Mammals During Specified Activities; Marine Geophysical Survey in Southeast Asia, March–July 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), a part of Columbia University, for an Incidental Harassment Authorization (IHA) to take small numbers of marine mammals, by harassment, incidental to conducting a marine seismic survey in Southeast (SE) Asia during March-July 2009. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS requests comments on its proposal to authorize L-DEO to incidentally take, by Level B harassment only, small numbers of marine mammals during the aforementioned activity.

DATES: Comments and information must be received no later than January 21, 2009.

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–XL89@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: Howard Goldstein or Ken Hollingshead, Office of Protected Resources, NMFS, (301) 713–2289.

SUPPLEMENTARY INFORMATION:

Background

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of marine mammals by 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 October 27, 2008, NMFS received an application from L-DEO for the taking, by Level B harassment only, of small numbers of marine mammals incidental to conducting, under cooperative agreement with the National Science Foundation (NSF), a marine seismic survey in SE Asia. The funding for the Taiwan Integrated Geodynamics Research (TAIGER) survey is provided by the NSF. The proposed survey will encompass the area 17 30'-26 30' N, 113 30'-126 E within the Exclusive Economic Zones (EEZ) of Taiwan, China, Japan, and the Philippines, and on the high seas, and is scheduled to occur from March 21 to July 14, 2009. Some minor deviation from these dates is possible, depending on logistics and weather.

Taiwan is one of only a few sites of arc-continent collision worldwide; and one of the primary tectonic environments for large scale mountain building. The primary purpose of the TAIGER project is to investigate the processes of mountain building, a fundamental set of processes which plays a major role in shaping the face of the Earth. The vicinity of Taiwan is particularly well-suited for this type of study, because the collision can be observed at different stages of its evolution, from incipient, to mature, and finally to post-collision.

As a result of its location in an ongoing tectonic collision zone, Taiwan experiences a great number of earthquakes, most are small, but many are large and destructive. This project will provide a great deal of information about the nature of the earthquakes around Taiwan and will lead to a better assessment of the earthquake hazards in the area. The information obtained from this study will help the people and the earthquake hazards in the area. The information obtained from this study will help the people and government of Taiwan to better prepare for future seismic events and may thus mitigate some of the loss of life and economic disruptions that will inevitably occur.

The proposed action is planned to take place in the territorial seas and EEZ's of foreign nations, and will be continuous with the activity that takes place on the high seas. NMFS does not authorize the incidental take of marine mammals in the territorial seas of foreign nations, as the MMPA does not apply in those waters. However, NMFS still needs to calculate the level of incidental take in territorial seas as part of the proposed issuance of an IHA in regards to NMFS' analysis of small numbers and negligible impact determination.

Description of the Specified Activity

The planned survey will involve one source vessel, the R/V *Marcus G. Langseth* (*Langseth*), which will occur in SE Asia. The *Langseth* will deploy an array of 36 airguns (6,600 in^3) as an energy source at a tow depth of 6–9 m (20–30 ft). The receiving system will consist of a hydrophone streamer and approximately 100 ocean bottom seismometers (OBSs). The *Langseth* will deploy an 8 km (5 mi) long streamer for most transects requiring a streamer; however, a shorter streamer (500 m to 2km or 1,640 ft to 1.2 mi) will be used during surveys in Taiwan (Formosa) Strait. As the airgun array is towed along the survey lines, the hydrophone streamer will receive the returning acoustic signals and transfer the data to the on-board processing system. The OBSs record the returning acoustic signals internally for later analysis. The OBSs to be used for the TAIGER program will be deployed and retrieved numerous times by a combination of 4 or 5 Taiwanese support vessels, as well as the *Langseth*. The *Langseth* will also retrieve 20 OBSs that were deployed in the study area during previous years to record earthquake activity.

Approximately 100 OBSs will be deployed during the survey. OBSs will likely be deployed and retrieved by the *Langseth* as well as a combination of 4 to 5 Taiwanese vessels. The Taiwanese vessels to be used include two 30 m (98.4 ft) vessels (the R/V *Ocean Researcher 2* and the R/V *Ocean Researcher 3*) and two vessels greater than 60 m (196.8 ft) in length (R/V *Fisheries Research I* and the Navy ship *Taquan*). The R/V *Ocean Research I* may also be used if the *Langseth* is not used to deploy OBSs. The OBS deployment spacing will vary depending on the number of instruments available and shiptime. The nominal spacing is 15 km (9.3 mi), but this will vary from as little as 5 km (3.1 mi) to perhaps as much as 25 km (15.5 mi). The OBSs will be deployed and recovered several (2 to 4) times. 60 of the 100 OBSs may be deployed from the *Langseth*. All OBSs will be retrieved at the end of the study.

Up to 3 different types of OBSs may be used during the 2009 program. The Woods Hole Oceanographic Institution (WHOI) ''D2'' OBS has a height of approximately 1 m (3.3 ft) and a maximum diameter of 50 cm. The anchor is made of hot-rolled steel and weighs 23 kg (50.7 lbs). The anchor dimensions are 2.5 x 30.5 x 38.1 cm. The LC4x4 OBS from the Scripps Institution of Oceanography (SIO) has a volume of approximately 1 m^3 (3.3 ft^2), with an anchor that consists of a large piece of steel grating (approximately 1 m^2 or 3.3 ft^2). Taiwanese OBSs will also be used; their anchor is in the shape of an 'x' with dimensions of 51–76 cm^2 (1.7–2.5 ft^2). 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. The burn wire release assembly is then activated, and the instrument is released from the anchor to float to the surface.

The planned seismic survey will consist of approximately 15,902 km (9,881 mi) of transect lines within the South and East China Seas as well as the Philippine Sea, with the majority of the survey effort occurring in the South China Sea. The survey will take place in water depths ranging from approximately 25 to 6,585 m (82–21,598 ft), but most of the survey effort (approximately 80 percent) will take place in water greater than 1,000 m (3,280 ft), 13 percent will take place in intermediate depth waters (100–1,000 m or 328–3,280 ft), and 7 percent will occur in shallow depth water (less than 100 m or 328 ft).

All planned geophysical data acquisition activities will be conducted by L-DEO with onboard assistance by the scientists who have proposed the study. The scientific team consists of Dr. Francis Wu (State University of New York at Binghamton) and Dr. Kirk McIntosh (University of Texas at Austin, Institute of Geophysics). The vessel will be self-contained, and the crew will live aboard the vessel for the entire cruise.

In addition to the operations of the airgun array, a 12 kHz Simrad EM 120 multibeam echosounder (MBES) and a 3.5 kHz sub-bottom profiler (SBP) will be operated from the *Langseth* continuously throughout the TAIGER cruise.

Vessel Specifications

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

Acoustic Source Specifications

Seismic Airguns

During the proposed survey, the airgun array to be used will consist of 36 airguns, with a total volume of approximately 6,600 in^3. The airgun array will consist of a mixture of Bolt 1500LL and 1900LL airguns. The airguns array will be configured as 4 identical linear arrays or ''strings'' (see Figure 2 in L-DEO's application). Each string will have 10 airguns; the first and last airguns in the strings are spaced 16 m (52.5 ft) apart. Nine airguns in each string will be fired simultaneously, while the tenth is kept in reserve as a spare, to be turned on in case of failure of another airgun. The 4 airgun strings will be distributed across an approximate area of 24 x 16 m (78.7 x 52.5 ft) behind the *Langseth* and will be towed approximately 140 m (459 ft) behind the vessel. The shot interval will be relatively short (approximately 25–50 m or 82–164 ft or 10–25 s) for multi-channel seismic surveying with the hydrophone streamer, and relatively long (approximately 100–125 m or 328–410 ft or 45–60 s) when recording data on the OBSs. The firing pressure of the array is 1,900 psi. During firing, a brief (approximately 0.1 s) pulse of sound is emitted. The airguns will be silent during the intervening periods.

The tow depth of the array will be 6–9 m (20–30 ft). The depth at which the source is towed (particularly a large source) affects the maximum near-field output and the shape of its frequency spectrum. If the source is towed at 9 m (30 ft), the effective source level for sound propagating in near-horizontal directions is higher than if the array is towed at shallow depths (see Figure 3–5 of L-DEO's application). However, the nominal source levels of the array (or the estimates of the sound that would be measured from a theoretical point source emitting the same total energy as the airgun array) at various tow depths are nearly identical. In L-DEO's calculations, a tow depth of 9 m is assumed at all times.

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

Multibeam Echosounder

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

Sub-bottom Profiler

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

Source and Volume	Tow Depth (m)	Water Depth	Predicted RMS Distances (m)		
			190 dB	180 dB	160 dB
Single Bolt airgun 40 in^3	6-9*	Deep	12	40	385
		Intermediate	18	60	578
		Shallow	150	296	1050
4 strings 36 airguns 6600 in^3	6-7	Deep	220	710	4670
		Intermediate	330	1065	5189
		Shallow	1600	2761	6227
	8-9	Deep	300	950	6000
		Intermediate	450	1425	6667
		Shallow	2182	3694	8000

Table 1. Predicted distances to which sound levels >190, 180, and 160 dB re 1 μPa might be received in shallow (<100 m; 328 ft), intermediate (100-1,000 m; 328-3,280 ft), and deep (>1,000 m; 3,280 ft) water from the 36 airgun array, as well as a single airgun, used during the Central American SubFac and STEEP Gulf of Alaska survey, and planned during the TAIGER SE Asia survey. *The tow depth has minimal effect on the maximum near-field output and the shape of the frequency spectrum for the single 40 in3 airgun; thus, the predicted safety radii are essentially the same at each tow depth. The most precautionary distances (i.e., for the deepest tow depth, 9m) are shown

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

Proposed Dates, Duration, and Region of Activity

The survey will encompass the area 17° 30'-26 30' N, 113° 30'-126 E within the EEZs of Taiwan, China, Japan, and the Philippines. The vessel will approach mainland Taiwan within 1 km (0.6 mi) and China within 10 km (6.2 mi). The closest approach to the Ryuku Islands will be 16 km (9.9 mi). Although the survey will occur at least 32 km (29.9 mi) from Luzon, Philippines, survey lines will take place approximately 8 km (5 mi) from some of the Babuyan and Batan islands. Water depths in the survey area range from approximately 25 to 6,585 m. The TAIGER program consists of 4 legs, each starting and ending in Kao-hsiung, Taiwan. The first leg is expected to occur from approximately March 21 to April 19, 2008 and will include the survey lines in the South China Sea. The second leg is scheduled for April 20 to June 7 and will include survey lines in Luzon Strait and the Philippine Sea. The third leg (approximately June 8–20) will involve OBS recovery by the *Langseth* only; no seismic acquisition will occur during this leg. The fourth leg, consisting of the survey lines immediately around Taiwan, is scheduled to occur from June 21 to July 14, 2009. The program will consist of approximately 103 days of seismic acquisition. The exact dates of the activities depend on logistics and weather conditions.

Description of Marine Mammals in the Proposed Activity Area

A total of 34 cetacean species, including 25 odontocete (dolphins and small- and large-toothed whales) species and 9 mysticetes (baleen whales) are known to occur in the proposed TAIGER study area (see Table 2 of L-DEO's application). Cetaceans and pinnipeds are managed by NMFS and are the subject of this IHA application. Information on the occurrence, distribution, population size, and conservation status for each of the 34 marine mammal species that may occur in the proposed project area is presented in the Table 2 of L-DEO's application as well as here in the table below (Table 2). The status of these species is based on the U.S. Endangered Species Act (ESA), the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, and Convention on International Trade in Endangered Species (CITES). Several species are listed as Endangered under the ESA, including the Western North Pacific gray, North Pacific right, sperm, humpback, fin, sei, and blue whales. In addition, the Indo-Pacific humpback dolphin is listed as Near Threatened and the finless porpoise is listed as Vulnerable under the 2008 IUCN Red List of Threatened Species (IUCN, 2008).

Although the dugong may have inhabited waters off Taiwan, it is no longer thought to occur there (March *et al.*, n.d.; Chou, 2004; Perrin *et al.*, 2005). Similarly, although the dugong was once widespread through the Philippines, current data suggest that it does not inhabit the Batan or Babuyan Islands or northwestern Luzon (Marsh *et al.*, n.d.; Perrin *et al.*, 2005), where seismic operations will occur. However, the dugong does occur off northeastern Luzon (Marsh *et al.*, n.d.; Perrin *et al.*, 2005) outside the study area. In China, it is only known to inhabit the waters off Guangxi and Guangdong and the west coast of Hanain Island (Marsh *et al.*, n.d.; Perrin *et al.*, 2005), which do not occur near the study area. It is rare in the Ryuku Islands, but can be sighted in Okinawa, particularly off the east coast of the island (Yoshida and Trono, 2004; Shirakihara *et al.*, 2007); some individuals may have previously occurred in the southern most of the Ryuku Islands, Yaeyama (Marsh *et al.*, n.d.), but these animals have not been documented there recently (Shirakihara *et al.*, 2007).

Wang *et al.* (2001a) noted that during the spring/summer off southern Taiwan, the highest number of marine mammal sightings and species occur during April and June. The number of sightings per survey effort and the number of species were highest directly west of the southern tip of Taiwan and northeast off the southern tip.

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

TABLE 2. THE OCCURRENCE, HABITAT, REGIONAL ABUNDANCE, CONSERVATION STATUS, BEST AND MAXIMUM DENSITY ESTIMATES, NUMBER OF MARINE MAMMALS THAT COULD BE EXPOSED TO SOUND LEVEL AT OR ABOVE 160DB RE 1μPA, BEST ESTIMATE OF NUMBER OF INDIVIDUALS EXPOSED, AND BEST ESTIMATE OF NUMBER OF EXPOSURES PER MARINE MAMMAL IN OR NEAR THE PROPOSED SEISMIC SURVEY AREA IN SE ASIA. SEE TABLES 2-4 IN L-DEO'S APPLICATION FOR FURTHER DETAIL.

Species	Occurrence in Study Area in SE Asia	Habitat	Regional Population Size	ESA[a]	Density/ 1000km[b] (best)	Density/ 1000km[c] (max)
Mysticetes						
Western North Pacific gray whale (*Eschrichtius robustus*)	Rare	Coastal	131[d]	EN	0	0
North Pacific right whale (*Eubalaena japonica*)	Rare	Pelagic and coastal	Less than 100[e]	EN	0	0
Humpback whale (*Megaptera novaeangliae*)	Uncommon	Mainly near-shore waters and banks	938-1107[f]	EN	0.89	1.33
Minke whale (*Balaenoptera acutorostrata*)	Uncommon	Pelagic and coastal	25,000[g]	NL	0.03	0.04
Bryde's whale (*Balaenoptera brydei*)	Common	Pelagic and coastal	20,000-30,000[e,h]	NL	0.27	0.41
Omura's whale (*Balaenoptera omurai*)	Uncommon	Pelagic and coastal	N.A.	NL	0.03	0.04
Sei whale (*Balaenoptera borealis*)	Uncommon	Primarily off-shore, pelagic	7,260-12,620[i]	EN	0.03	0.04
Fin whale (*Balaenoptera physalus*)	Uncommon	Continental slope, mostly pelagic	13.620-18.680[j]	EN	0.03	0.04
Blue whale (*Balaenoptera musculus*)	Uncommon	Pelagic and coastal	N.A.	EN	0.03	0.04
Odontocetes						
Sperm whale (*Physeter macrocephalus*)	Uncommon	Usually pelagic and deep seas	26,674[k]	NL	0.03	0.04
Pygmy sperm whale (*Kogia breviceps*)	Uncommon	Deep waters off shelf	N.A.	NL	0	0
Dwarf sperm whale (*Kogia sima*)	Common?	Deep waters off the shelf	11,200[e]	NL	4.25	6.68
(Kogia sp.)	Common?	Deep waters off the shelf	N.A.	NL	0.26	0.40
Cuvier's beaked whale (*Ziphius cavirostris*)	Likely Common	Pelagic	20,000[e]	NL	0.34	0.75
Longman's beaked whale (*Indopacetus pacificus*)	Rare	Deep water	N.A.	NL	N.A.	N.A.
Blainville's beaked whale (*Mesoplodon densirostris*)	Uncommon?	Pelagic	25,300[l]	NL	0.89	1.60

TABLE 2. THE OCCURRENCE, HABITAT, REGIONAL ABUNDANCE, CONSERVATION STATUS, BEST AND MAXIMUM DENSITY ESTIMATES, NUMBER OF MARINE MAMMALS THAT COULD BE EXPOSED TO SOUND LEVEL AT OR ABOVE 160DB RE 1μPA, BEST ESTIMATE OF NUMBER OF INDIVIDUALS EXPOSED, AND BEST ESTIMATE OF NUMBER OF EXPOSURES PER MARINE MAMMAL IN OR NEAR THE PROPOSED SEISMIC SURVEY AREA IN SE ASIA. SEE TABLES 2-4 IN L-DEO'S APPLICATION FOR FURTHER DETAIL.—Continued

Species	Occurrence in Study Area in SE Asia	Habitat	Regional Population Size	ESA[a]	Density/ 1000km[b] (best)	Density/ 1000km[c] (max)
Ginkgo-toothed beaked whale (*Mesoplodon ginkgodens*)	Rare	Pelagic	N.A.	NL	N.A.	N.A.
(Mesoplodon sp.)	Uncommon?	Pelagic	N.A.	NL	1.55	1.60
Unidentified beaked whale	Rare	Pelagic	N.A.	NL	0.72	0.94
Rough-toothed beaked dolphin (*Steno bredanensis*)	Common	Deep water	146,000 ETP[e]	NL	1.33	5.44
Indo-Pacific humpback dolphin (*Sousa chinensis*)	Uncommon	Coastal	1,680 China + Taiwan[e]	NL	24.30	35.36
Common bottlenose dolphin (*Tursiops truncatus*)	Common	Coastal and oceanic, shelf break	243,500 ETP[e]	NL	24.30	35.36
Indo-Pacific bottlenose dolphin (*Tursiops aduncus*)	Common?	Coastal and shelf waters	N.A.	NL	43.60	65.40
Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)	Rare	Coastal and pelagic	930,000-990,000[e]	NL	N.A.	N.A.
Pantropical spotted dolphin (*Stenella attenuata*)	Common	Coastal and pelagic	800,000 ETP[e]	NL	120.80	140.97
Spinner dolphin (*Stenella longirostris*)	Common	Coastal and pelagic	800,000 ETP[e]	NL	54.84	88.89
Striped dolphin (*Stenella coeruleoalba*)	Common	Coastal and pelagic	1,000,000 ETP[e]	NL	0.20	0.32
Fraser's dolphin (*Lagenodelphis hosei*)	Common	Waters greater than 1,000 m	289,000 ETP[e]	NL	96.84	124.14
Short-beaked common dolphin (*Delphinus delphis*)	Rare	Shelf and pelagic, seamounts	3,000,000 ETP[e]	NL	N.A.	N.A.
Long-beaked common dolphin (*Delphinus capensis*)	Uncommon	Coastal	N.A.	NL	0.05	0.12
Risso's dolphin (*Grampus griseus*)	Common	Pelagic	175,000 ETP[e]	NL	41.88	67.18
Melon-headed whale (*Peponocephala electra*)	Common?	Oceanic	45,000 ETP[e]	NL	13.37	20.86
Pygmy killer whale (*Feresa attenuata*)	Uncommon	Deep, pantropical waters	39,000 ETP[e]	NL	2.01	3.16
False killer whale (*Pseudorca crassidens*)	Common?	Pelagic	40,000[n]	NL	4.56	4.77

TABLE 2. THE OCCURRENCE, HABITAT, REGIONAL ABUNDANCE, CONSERVATION STATUS, BEST AND MAXIMUM DENSITY ESTIMATES, NUMBER OF MARINE MAMMALS THAT COULD BE EXPOSED TO SOUND LEVEL AT OR ABOVE 160DB RE 1μPA, BEST ESTIMATE OF NUMBER OF INDIVIDUALS EXPOSED, AND BEST ESTIMATE OF NUMBER OF EXPOSURES PER MARINE MAMMAL IN OR NEAR THE PROPOSED SEISMIC SURVEY AREA IN SE ASIA. SEE TABLES 2-4 IN L-DEO'S APPLICATION FOR FURTHER DETAIL.—Continued

Species	Occurrence in Study Area in SE Asia	Habitat	Regional Population Size	ESA[a]	Density/ 1000km[b] (best)	Density/ 1000km[c] (max)
Killer whale (*Orcinus orca*)	Uncommon?	Widely distributeds	8,500 ETP[e]	NL	1.00	1.73
Short-finned pilot whale (*Globicephala macrorhynchus*)	Common?	Mostly pelagic, relief topography	500,000 ETP[e]	NL	3.83	6.43
Finless porpoise (*Neophocaena phocaenoides*)	Common?	Coastal	5,220-10,220 Japan + HK[e]	NL	4.36	6.54
Sirenians						
Dugong (*Dugong dugon*)	Uncommon?	Coastal	N.A.	EN	N.A.	N.A.

N.A. - Data not available or species status was not assessed, ETP - Eastern Tropical Pacific, HK = Hong Kong
[a] U.S. Endangered Species Act: EN = Endangered, T = Threatened, NL = Not listed
[b] Best estimate as listed in Table 3 of the application.
[c] Maximum estimate as listed in Table 3 of the application.
[d] Vladimirov *et al.* (2008)
[e] North Pacific unless otherwise indicated (Jefferson *et al.*, 2008)
[f] Western North Pacific (Calambokidis et al., 2008)
[g] Northwest Pacific and Okhotsk Sea (IWC, 2007a)
[h] Kitakado et al. (2008)
[i] Tillman (1977)
[j] Ohsumi and Wada (1974)
[k] Western North Pacific (Whitehead, 2002b)
[l] ETP; all Mesoplodon spp. (Wade and Gerrodette, 1993)
[m] IUCN states that this species should be re-assessed following taxonomic classification of the two forms. The chinensis-type would be considered vulnerable (IUCN, 2008)
[n] ETP (Wade and Gerrodette, 1993)

Potential Effects on Marine Mammals

Potential Effects of Airguns

The sounds from airguns might result in one or more of the following: tolerance, masking of natural sounds, behavioral disturbances, temporary or permanent hearing impairment, and non-auditory physical or physiological effects (Richardson *et al.*, 1995; Gordon *et al.*, 2004; Nowacek *et al.*, 2007; Southall *et al.*, 2007). Permanent hearing impairment, in the unlikely event that it occurred, would constitute injury, but temporary threshold shift (TTS) is not an injury (Southall *et al.*, 2007). With the possible exception of some cases of temporary threshold shift in harbor seals, it is unlikely that the project would result in any cases of temporary or especially permanent hearing impairment, or any significant non-auditory physical or physiological effects. Some behavioral disturbance is expected, but this would be localized and short-term.

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

Tolerance

Numerous studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers. For a summary of the characteristics of airgun pulses, see Appendix B (3) of L-DEO's application. Numerous studies have shown that marine mammals at distances more than a few kilometers from operating seismic vessels often show no apparent response-see Appendix B (5) 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 the mammal group. Although various baleen whales, toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to airgun pulses under some conditions, at other times, mammals of all three types have shown no overt reactions. In general, pinnipeds usually seem to be more tolerant of exposure to airgun pulses than are cetaceans, with relative responsiveness of baleen and toothed whales being variable.

Masking

Obscuring of sounds of interest by interfering sounds, generally at similar frequencies, is known as masking. Masking effects of pulsed sounds (even from large arrays of airguns) on marine mammal calls and other natural sounds are expected to be limited, although there are few specific data of relevance. Because of the intermittent nature and low duty cycle of seismic pulses, animals can emit and receive sounds in the relatively quiet intervals between pulses. However in exceptional situations, reverberation occurs for much or all of the interval between pulses (Simard *et al.*, 2005; Clark and Gagnon, 2006). Some baleen and toothed whales are known to continue calling in the presence of seismic pulses. The airgun sounds are pulsed, with quiet periods between the pulses, and whale calls often can be heard between the seismic pulses (Richardson *et al.*, 1986; McDonald *et al.*, 1995; Greene *et al.*, 1999; Nieukirk *et al.*, 2004; Smultea *et al.*, 2004; Holst *et al.*, 2005a,b, 2006). In the northeast 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 cease calling when exposed to pulses from a very distant seismic ship (Bowles *et al.*, 1994), a more recent study reports that sperm whales off northern Norway continued calling in the presence of seismic pulses (Madsen *et al.*, 2002). That has also been shown during recent work in the Gulf of Mexico and Caribbean Sea (Smultea *et al.*, 2004; Tyack *et al.*, 2006). Masking effects of seismic pulses are expected to be negligible in the case of the small odontocetes given the intermittent nature of seismic pulses. Dolphins and porpoises commonly are heard calling while airguns are operating (Gordon *et al.*, 2004; Smultea *et al.*, 2004; Holst *et al.*, 2005a,b; Potter *et al.*, 2007). Also, the sounds important to small odontocetes are predominantly at much higher frequencies than the airgun sounds, thus further 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. Masking effects on marine mammals are discussed further in Appendix B (4) of L-DEO's application.

Disturbance Reactions

Disturbance includes a variety of effects, including subtle changes in behavior, more conspicuous changes in activities, and displacement. Reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, and many other factors. If a marine mammal responds to an underwater sound by changing its behavior or moving a small distance, the response may or may not rise to the level of ''harassment,'' or affect the stock or the species as a whole. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on animals or on the stock or species could potentially be significant. Given the many uncertainties in predicting the quantity and types of impacts of noise on marine mammals, it is common practice to estimate how many mammals are likely to be present within a particular distance of industrial activities, or exposed to a particular level of industrial sound. This practice potentially overestimates the numbers of marine mammals that are affected in some biologically-important manner.

The sound exposure thresholds that affect marine mammals behaviorally are based on behavioral observations during studies of several species. However, information is lacking for many species. Detailed studies have been done on humpback, gray, bowhead, and sperm whales and on ringed seals. Less detailed data are available for some other species of baleen whales, small toothed whales, and sea otters, 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 (5) of L-DEO's application, baleen whales exposed to strong noise pulses from airguns often react by deviating from their normal migration route and/or interrupting their feeding activities and moving away from the sound source. In the case of the migrating gray and bowhead whales, the observed changes in behavior appeared to be of little or no biological consequence to the animals. They simply avoided the sound source by displacing their migration route to varying degrees, but within the natural boundaries of the migration corridors.

Studies of gray, bowhead, and humpback whales have demonstrated that received levels of pulses in the 160–170 dB re 1 μPa rms range seem to cause obvious avoidance behavior in a substantial fraction of the animals exposed. In many areas, seismic pulses from large arrays of airguns diminish to those levels at distances ranging from 4–15 km (2.8–9 mi) from the source. A substantial proportion of the baleen whales within those distances may show avoidance or other strong disturbance reactions to the airgun array. Subtle behavioral changes sometimes become evident at somewhat lower received levels, and studies summarized in Appendix B(5) 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 the 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, 2,678–in^3 array, and to a single 20–in^3 airgun with a source level of 227 dB re 1 μPa m peak-to-peak. McCauley *et al.* (1998) documented that initial avoidance reactions began at 5–8 km (3.1–5 mi) from the array, and that those reactions kept most pods approximately 3–4 km (1.9–2.5 mi) from the operating seismic boat. McCauley *et al.* (2000) noted localized displacement during migration of 4–5 km (2.5–3.1 mi) by traveling pods and 7–12 km (4.3–7.5 mi) by cow-calf pairs. Avoidance distances with respect to the single airgun were smaller (2 km (1.2 mi)) but consistent with the results from the full array in terms of received sound levels. The mean avoidance distance from the airgun corresponded to a received sound level of 140 dB re 1 μPa (rms); that was the level at which humpbacks started to show avoidance reactions to an approaching airgun. The standoff range, i.e., the closest point of approach of the whales to the airgun, corresponded to a received level of 143 dB re 1 μPa (rms). The initial avoidance response generally occurred at distances of 5–8 km (3.1–5 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 (328–1,312 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). Some humpbacks seemed ''startled'' at received levels of 150–169 dB re 1 ?Pa on an approximate rms basis. Malme *et al.* (1985) concluded that there was no clear evidence of avoidance, despite the possibility of subtle effects, at received levels up to 172 re 1 µPa on an approximate rms basis.

It has been suggested that South Atlantic humpback whales wintering off Brazil may be displaced or even strand upon exposure to seismic surveys (Engel *et al.*, 2004). The evidence for this was circumstantial 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 results from direct studies of humpbacks exposed to seismic surveys in other areas and seasons. After allowance for data from subsequent years, there was ''no observable direct correlation'' between strandings and seismic surveys (IWC, 2007:236).

There are no data on reactions of right whales to seismic surveys, but results from the closely-related bowhead whale show that their responsiveness can be quite variable depending on the activity (migrating vs. feeding). Bowhead whales migrating west across the Alaskan Beaufort Sea in autumn, in particular, are unusually responsive, with substantial avoidance occurring out to distances of 20–30 km (12.4–18.6 mi) from a medium-sized airgun source at received sound levels of around 120–130 dB re 1 µPa (rms) (Miller *et al.*, 1999; Richardson *et al.*, 1999; see Appendix B (5) of L-DEO's application). However, more recent research on bowhead whales (Miller *et al.*, 2005a; Harris *et al.*, 2007) corroborates earlier evidence that, during the summer feeding season, bowheads are not as sensitive to seismic sources. Nonetheless, subtle but statistically significant changes in surfacing-respiration-dive cycles were evident upon statistical analysis (Richardson *et al.*, 1986). In summer, bowheads typically begin to show avoidance reactions at a received level of about 160–170 dB re 1 µPa (rms) (Richardson *et al.*, 1986; Ljungblad *et al.*, 1988; Miller *et al.*, 2005a).

Reactions of migrating and feeding (but not wintering) gray whales to seismic surveys have been studied. Malme *et al.* (1986, 1988) studied the responses of feeding Eastern Pacific gray whales to pulses from a single 100 in^3 airgun off St. Lawrence Island in the northern Bering Sea. Malme *et al.* (1986, 1988) estimated, based on small sample sizes, that 50 percent of feeding gray whales ceased feeding at an average received pressure level of 173 dB re 1 µPa on an (approximate) rms basis, and that 10 percent of feeding whales interrupted feeding at received levels of 163 dB. Those findings were generally consistent with the results of experiments conducted on larger numbers of gray whales that were migrating along the California coast (Malme *et al.*, 1984; Malme and Miles, 1985), and with observations of Western Pacific gray whales feeding off Sakhalin Island, Russia, when a seismic survey was underway just offshore of their feeding area (Gailey *et al.*, 2007; Johnson *et al.*, 2007; Yazvenko *et al.* 2007a,b), along with data on gray whales off British Columbia (Bain and Williams, 2006).

Various species of Balaenoptera (blue, sei, fin, Bryde's, 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, at times of good sightability, sighting rates for mysticetes (mainly fin and sei whales) were similar when large arrays of airguns were shooting and not shooting (Stone, 2003; Stone and Tasker, 2006). However, these whales tended to exhibit localized avoidance, remaining significantly (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 vs. 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 direction during seismic vs. non-seismic periods (Moulton *et al.*, 2005, 2006a,b).

Data on short-term reactions (or lack of reactions) of cetaceans to impulsive noises do not necessarily provide information about long-term effects. It is not known whether impulsive noises affect reproductive rate or distribution and habitat use in subsequent days or years. However, gray whales continued to migrate annually along the west coast of North America with substantial increases in the population over recent years, despite intermittent seismic exploration and much ship traffic in that area for decades (see 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 prior year (Johnson *et al.*, 2007). Bowhead whales 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). In any event, brief exposures to sound pulses from the proposed airgun source are highly unlikely to result in prolonged effects.

Toothed Whales – Little systematic information is available about reactions of toothed whales to noise pulses. Few studies similar to the more extensive baleen whale/seismic pulse work summarized above have been reported for toothed whales. However, systematic studies on sperm whales have been done (Jochens and Biggs, 2003; Tyack *et al.*, 2003; Jochens *et al.*, 2006; Miller *et al.*, 2006), and there is an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies (e.g., Stone, 2003; Smultea *et al.*, 2004; Moulton and Miller, 2005; Bain and Williams, 2006; Holst *et al.*, 2006; Stone and Tasker, 2006; Potter *et al.*, 2007; Weir, 2008).

Seismic operators and marine mammal observers sometimes see dolphins and other small toothed whales near operating airgun arrays, but in general there seems to be a tendency for most delphinids to show some avoidance of operating seismic vessels (Goold, 1996a,b,c; Calambokidis and Osmek, 1998; Stone, 2003; Moulton and Miller, 2005; Holst *et al.*, 2006; Stone and Tasker, 2006; Weir, 2008). However, some dolphins seem to be attracted to the seismic vessel and floats, and some ride the bow wave of the seismic vessel even when large airgun arrays are firing (Moulton and Miller, 2005). Nonetheless, there have been indications that small toothed whales sometimes tend to head away or to maintain a somewhat greater distance from the vessel, when a large array of airguns is operating than when it is silent (Stone and Tasker, 2006; Weir, 2008). In most cases, the avoidance radii for delphinids appear to be small, on the order of 1 km (0.62 mi) or less, and some individuals show no apparent avoidance. The beluga is a species that (at least at times) shows long-distance avoidance of seismic vessels. Aerial surveys during seismic operations in the southeastern Beaufort Sea during summer recorded much lower sighting rates of beluga whales within 10–20 km (6.2–12.4 mi) compared with 20–30 km (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 and beluga whales exhibited changes in behavior when exposed to strong pulsed sounds similar in duration to those typically used in seismic surveys (Finneran *et al.*, 2000, 2002, 2005; Finneran and Schlundt, 2004). The animals tolerated high received levels of sound (pk-pk level >200 dB re 1 μPa) before exhibiting aversive behaviors. For pooled data at 3, 10, and 20 kHz, sound exposure levels during sessions with 25, 50, and 75 percent altered behavior were 180, 190, and 199 dB re 1 μPa^2, respectively (Finneran and Schlundt, 2004).

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

Most studies of sperm whales exposed to airgun sounds indicate that this species shows considerable tolerance of airgun pulses (Stone, 2003; Moulton *et al.*, 2005, 2006a; Stone and Tasker, 2006; Weir, 2008). In most cases, the whales do not show strong avoidance and continue to call (see Appendix B in L-DEO's EA). However, controlled exposure experiments in the Gulf of Mexico indicate that foraging effort is somewhat altered upon exposure to airgun sounds (Jochens *et al.*, 2006).

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

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

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

Hearing Impairment and Other Physical Effects

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

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

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

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

Temporary Threshold Shift – TTS is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter, 1985). While experiencing TTS, the hearing threshold rises and a sound must be stronger in order to be heard. At least in terrestrial mammals, TTS can last from minutes or hours to (in cases of strong TTS) days. For sound exposures at or somewhat above the TTS threshold, hearing sensitivity in both terrestrial and marine mammals recovers rapidly after exposure to the noise ends. Few data on sound levels and durations necessary to elicit mild TTS have been obtained for marine mammals, and none of the published data concern TTS elicited by exposure to multiple pulses of sound. Available data on TTS in marine mammals are summarized in Southall *et al.* (2007).

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

≥175–180 dB SEL or ≥190 dB re 1 μPa (rms) would be smaller.

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

For baleen whales, there are no data, direct or indirect, on levels or properties of sound required to induce TTS. The frequencies to which baleen whales are most sensitive are lower than those for odontocetes, and natural background noise levels at those low frequencies tend to be higher. As a result, auditory thresholds of baleen whales within their frequency band of best hearing are believed to be higher (less sensitive) than are those of odontocetes at their best frequencies (Clark and Ellison, 2004). From this, it is suspected that received levels causing TTS onset may also be higher in baleen whales. In any event, no cases of TTS are expected given three considerations: (1) the relatively low abundance of baleen whales expected in the planned study areas; (2) the strong likelihood that baleen whales would avoid the approaching airguns (or vessel) before being exposed to levels high enough for there to be any possibility of TTS; and (3) the mitigation measures that are planned.

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

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

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

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

There is no specific evidence that exposure to pulses of airgun sound can cause PTS in any marine mammal, even with large arrays of airguns. However, given the possibility that mammals close to an airgun array might incur TTS, there has been further speculation about the possibility that some individuals occurring very close to airguns might incur PTS. Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage in terrestrial mammals. Relationships between TTS and PTS thresholds have not been studied in marine mammals, but are assumed to be similar to those in humans and other terrestrial mammals. PTS might occur at a received sound level at least several decibels above that inducing mild TTS if the animal were exposed to strong sound pulses with rapid rise time (see Appendix B (6) of L-DEO's application). The specific difference between the PTS and TTS thresholds has not been measured for marine mammals exposed to any sound type. However, based on data from terrestrial mammals, a precautionary assumption is that the PTS threshold for impulse sounds (such as airgun pulses as received close to the source) is at least 6 dB higher than the TTS threshold on a peak-pressure basis.

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

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

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

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

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

Strandings and Mortality

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

Seismic pulses and mid-frequency sonar pulses are quite different. Sounds produced by airgun arrays are broadband with most of the energy below 1 kHz. Typical military mid-frequency sonars operate at frequencies of 2–10 kHz, generally with a relatively narrow bandwidth at any one time. Thus, it is not appropriate to assume that there is a direct connection between the effects of military sonar and seismic surveys on marine mammals. However, evidence that sonar pulses can, in special circumstances, lead to physical damage and mortality (Balcomb and Claridge, 2001; NOAA and USN, 2001; Jepson *et al.*, 2003; Fernandez *et al.*, 2004, 2005a; Cox *et al.*, 2006), even if only indirectly, suggests that caution is warranted when dealing with exposure of marine mammals to any high-intensity pulsed sound.

There is no conclusive evidence of cetacean strandings as a result of exposure to seismic surveys. Speculation concerning a possible link between seismic surveys and strandings of humpback whales in Brazil (Engel *et al.*, 2004) was not well founded based on available data (IAGC, 2004; IWC, 2006). In September 2002, there was a stranding of two Cuvier's beaked whales in the Gulf of California, Mexico, when the L-DEO vessel R/V *Maurice Ewing* (*Ewing*) was operating a 20–gun, 8,490–in^3 array in the general area. The link between the stranding and the seismic survey was inconclusive and not based on any physical evidence (Hogarth, 2002; Yoder, 2002). Nonetheless, that plus the incidents involving beaked whale strandings near naval exercises involving use of mid-frequency sonar suggests a need for caution when conducting seismic surveys in areas occupied by beaked whales. No injuries of beaked whales are anticipated during the proposed study because of (1) the high likelihood that any beaked whales nearby would avoid the approaching vessel before being exposed to high sound levels, (2) the proposed monitoring and mitigation measures, and (3) differences between the sound sources operated by L-DEO and those involved in the naval exercises associated with strandings.

Potential Effects of Other Acoustic Devices

Multibeam Echosounder Signals

The Simrad EM 120 12–kHz MBES will be operated from the source vessel at some times during the planned study. Sounds from the MBES are very short pulses, occurring for 2–15 ms once every 5–20 s, depending on water depth. Most of the energy in the sound pulses emitted by the MBES is at frequencies centered at 12 kHz, and the maximum source level is 242 dB re 1 μPa (rms). The beam is narrow (1°) in fore-aft extent and wide (150°) in the cross-track extent. Each ping consists of nine successive fan-shaped transmissions (segments) at different cross-track angles. Any given mammal at depth near the trackline would be in the main beam for only one or two of the nine segments. Also, marine mammals that encounter the MBES are unlikely to be subjected to repeated pulses because of the narrow fore-aft width of the beam and will receive only limited amounts of pulse energy because of the short pulses. Animals close to the ship (where the beam is narrowest) are especially unlikely to be ensonified for more than one 2–15 ms pulse (or two pulses if in the overlap area). Kremser *et al.* (2005) noted that the probability of a cetacean swimming through the area of exposure when an MBES emits a pulse is small. The animal would have to pass the transducer at close range and be swimming at speeds similar to the vessel in order in order to receive the multiple pulses that might result in sufficient exposure to cause TTS. Burkhardt *et al.* (2007) concluded that immediate direct auditory injury was possible only if a cetacean dived under the vessel into the immediate vicinity of the transducer.

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

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

Behavioral reactions of free-ranging marine mammals to sonars and other sound sources appear to vary by species and circumstance. Observed reactions have included silencing and dispersal by sperm whales (Watkins *et al.*, 1985), increased vocalizations and no dispersal by pilot whales (Rendell and Gordon, 1999), and the previously-mentioned beachings by beaked whales. During exposure to a 21–25 kHz whale-finding sonar with a source level of 215 dB re 1 μPa, gray whales showed slight avoidance (approximately 200 m or 656 ft) behavior (Frankel, 2005). However, all of those observations are of limited relevance to the present situation. Pulse durations from those sonars were much longer than those of the MBES, and a given mammal would have received many pulses from the naval sonars. During L-DEO's operations, the individual pulses will be very short, and a given mammal would not receive many of the downward-directed pulses as the vessel passes by.

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

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

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

Sub-bottom Profiler Signals

A SBP will be operated from the source vessel during the planned study. Sounds from the SBP are very short pulses, occurring for 1- 4 ms once every second. Most of the energy in the sound pulses emitted by the SBP is at mid frequencies, centered at 3.5 kHz. The beamwidth is approximately 30° and is directed downward. The SBP on the *Langseth* has a maximum source level of 204 dB re 1 μPam. Kremser *et al.* (2005) noted that the probability of a cetacean swimming through the area of exposure when a bottom profiler emits a pulse is small, and if the animal was in the area, it would have to pass the transducer at close range in order to be subjected to sound levels that could cause TTS.

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

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

It is unlikely that the SBP produces pulse levels strong enough to cause hearing impairment or other physical injuries even in an animal that is (briefly) in a position near the source. The SBP is usually operated simultaneously with other higher-power acoustic sources. Many marine mammals will move away in response to the approaching higher-power sources or the vessel itself before the mammals would be close enough for there to be any possibility of effects from the less intense sounds from the SBP. In the case of mammals that do not avoid the approaching vessel and its various sound sources, mitigation measures that would be applied to minimize effects of other sources would further reduce or eliminate any minor effects of the SBP.

NMFS believes that to avoid the potential for permanent physiological damage (Level A harassment), cetaceans and pinnipeds should not be exposed to pulsed underwater noise at received levels exceeding, respectively, 180 and 190 dB re 1 μPa (rms). The precautionary nature of these criteria is discussed in Appendix B (6) of L-DEO's application, including the fact that the minimum sound level necessary to cause permanent hearing impairment is higher, by a variable and generally unknown amount, than the level that induces barely-detectable TTS and the level associated with the onset of TTS is often considered to be a level below which there is no danger of permanent damage. NMFS also assumes that cetaceans or pinnipeds exposed to levels exceeding 160 dB re 1 μPa (rms) may experience Level B harassment.

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An SBP will 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. The beamwidth is approximately 30° and is directed downward. The SBP on the *Langseth* has a maximum source level of 204 dB re 1 μPam. Kremser *et al.* (2005) noted that the probability of a cetacean swimming through the area of exposure when a bottom profiler emits a pulse is small, and if the animal was in the area, it would have to pass the transducer at close range in order to be subjected to sound levels that could cause TTS.

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Possible Effects of Acoustic Release Signals

The acoustic release transponder used to communicate with the OBSs uses frequencies of 9–13 kHz. These signals will be used very intermittently. It is unlikely that the acoustic release signals would have significant effects on marine mammals through masking, disturbance, or hearing impairment. Any effects likely would be negligible given the brief exposure at presumable low levels.

Estimated Take by Incidental Harassment

All anticipated takes would be ''takes by harassment,'' involving temporary changes in behavior. The proposed mitigation measures are expected to minimize the possibility of injurious takes. (However, as noted earlier, there is no specific information demonstrating that injurious ''takes'' would occur even in the absence of the planned mitigation measures.) The sections below describe methods to estimate ''take by harassment'', and present estimates of the numbers of marine mammals that might be affected during the proposed TAIGER seismic program. The estimates of ''take by harassment'' are based on consideration of the number of marine mammals that might be disturbed appreciably by operations with the 36 airgun array to be used during approximately 15,902 km of seismic surveys in the waters of the SE Asia study area. The main sources of distributional and numerical data used in deriving the estimates are described below.

Empirical data concerning 190, 180, 170, and 160 dB re 1 µPa isopleth distances in deep and shallow water were acquired for various airgun configurations during the acoustic calibration study of the *Ewing*'s 20–airgun 8,600 in^3 array in 2003 (Tolstoy *et al.*, 2004a,b). The results showed that radii around the airguns where the received level was 180 dB re 1 µPa rms, the threshold for estimating Level B harassment applicable to cetaceans (NMFS, 2000), varied with water depth. Similar depth-related variation is likely for the 190–dB re 1 µPa threshold for estimating Level B harassment applicable to cetaceans and the 190–dB re 1 µPa threshold applicable to pinnipeds, although these were not measured. The L-DEO model does not allow for bottom interactions, and thus is most directly applicable to deep water and to relatively short ranges.

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

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

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

Using the modeled distances and various correction factors, Table 1 (from L-DEO's application) shows the distances at which 4 rms sound levels are expected to be received from the 36–airgun array and a single airgun in three different water depths.

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

No systematic aircraft- or ship-based surveys have been conducted for marine mammals in waters near Taiwan, and the species of marine mammals that occur there are not well known. A few surveys have been conducted from small vessels (approximately 10–12 m or 33–40 ft long) with low observation platforms (approximately 3 m or 10 ft above sea level) as follows:

- Off the east central coast of Taiwan to a maximum of approximately 20 km (12.4 mi) from shore in water depths up to approximately 1,200 m deep between June 1996 and July 1997 (all cetacean; Yang *et al.*, 1999);
- Off the south coast of Taiwan to a distance of approximately 50 km (mi) and depths greater than 1,000 m (3,280 ft) during April 13–September 9, 2000 (all cetaceans; Wang *et al.*, 2001a);
- Off the west coast of Taiwan close to shore during early April-early August, 2002–2006 (Indo-Pacific humpback dolphins; Wang *et al.*, 2007); and
- Around and between the Babuyan Islands off northern Philippines in waters less than 1,000 m deep during late February-May 2000–2003 (humpback whales; Acebes *et al.*, 2007).

The only density calculated by the authors was for the Indo-Pacific humpback dolphin (Wang *et al.*, 2007). In addition, a density estimate was also available for the Indo-Pacific bottlenose dolphin (Yang *et al.*, 2000 in Perrin *et al.*, 2005).

In the absence of any other density data, L-DEO used the survey effort and sightings in Yang *et al.* (1999) and Wang *et al.* (2001a) to estimate densities of marine mammals in the TAIGER study area. To correct for detection bias (bias associated with diminishing sightability with increasing lateral distance from the trackline), L-DEO used mean group sizes given by or calculated from Wang *et al.* (2001a, 2007) and Yang *et al.*, (1999), and a value for *f*(0) of 5.32 calculated from the data and density equation in Wang *et al.* (2007); Yang *et al.* (1999), and Wang *et al.* (2001a) did not give a value for *f*(0), but they used a vessel and methods similar to those of Wang *et al.* (2007). To correct for availability and perception bias, which are attributable to the less than 100 percent probability of sighting an animals present along the survey trackline, L-DEO used g(0) values calculated using surfacing and dive data from Erickson (1976), Barlow and Sexton (1996), Forney and Barlow (1998), and Barlow (1999): 0.154 for *Mesoplodon* sp., 0.102 for Cuvier's beaked whale, 0.193 for the dwarf sperm whale and *Kogia* sp., 0.238 for the killer whale, and 1.0 for delphinids.

The surveys of Yang *et al.* (1999) and Wang *et al.* (2001a) were carried out in areas of steep slopes and complex bathymetric features, where many cetacean species are known to concentrate. It did not seem reasonable to extrapolate those densities to the overall survey area, which is predominantly in areas of deep water without complex bathymetry. For latter areas, L-DEO used density data from two 5° x 5° blocks in the eastern tropical Pacific Ocean (ETP) surveyed by Ferguson and Barlow (2001): Blocks 87 and 88², bounded by 20° N–25° N (the same latitudes as the proposed survey area and 115° W–125 W, in deep water and just offshore from Mexico. L-DEO then calculated an overall estimate weighted by the estimated lengths of seismic lines over complex bathymetry or slope (approximately 1,250 km or 777 mi) and over deep, flat, or gently sloping bottom (approximately 14,652 km or 9,104 mi).

The density estimate for the Indo-Pacific hump-backed dolphin is from Wang *et al.* (2007) and applies only to the population's limited range on the west coat of Taiwan. No density data were available for the Pacific white-sided or short-beaked common dolphin for the study area. As these species are rare in the area, densities are expected to be near zero. In addition, density data were unavailable for striped and long-beaked common dolphins. As these two species were not seen during the above-mentioned surveys and are considered uncommon in the TAIGER study area, L-DEO assigned these two species 10 percent of the density estimate of the delphinid occurring in similar habitat in the area with the lowest density (i.e., pygmy killer whale). Also no density estimate was available for finless porpoise. As this species was not sighted during surveys of southern Taiwan in 2000 (Wang *et al.*, 2001a), L-DEO assigned it 10 percent of the lowest density (i.e., Indo-Pacific bottlenose dolphin). Density data were unavailable for Longman's beaked and ginkgo-toothed beaked whales; however, these two species are represented by densities for unidentified beaked whales.

Large whales were not sighted during the surveys by Yang *et al.* (1999) or Wang *et al.* (2001a). The only available abundance estimate for large whales in the area (except that for humpbacks, see below) is that of Shimada *et al.* (2008), who estimated abundances of Bryde's whales in several blocks in the northwestern Pacific based on surveys in 1998–2002, the closest of which to the proceed survey area is the block bounded by 10° N–25° N and 130° E–137.5° E. The resulting abundance and area were used to calculate density. Sperm, sei, Omura's, fin, minke, and blue whales are less common than Bryde's whales in these waters, so L-DEO assigned a density of 10 percent of that calculated for Bryde's whale. North Pacific right, and Western North Pacific gray whales are unlikely to occur in the TAIGER study area, thus, densities were estimated to be zero.

For humpback whales in the Babuyan Islands, L-DEO used the population estimate of Acebes *et al.* (2007) and applied it to an area of approximately 78,000 km², extending from the north coast of Luzon to just south of Orchid Island to derive a density estimate. That area is a historically well-documented breeding ground that whaling records indicate was used until at least the 1960s (Acebes *et al.*, 2007), and an area where humpbacks have been sighted more recently.

There is some uncertainty about the representatives of the density data and the assumptions used in the calculations. For example, the timing of the surveys of Indo-Pacific humpback dolphins (early April-early August) and humpback whales (late February-May) overlaps the timing of the proposed surveys, but the Bryde's whale surveys (August and September), and those of Yang *et al.* (1999) (year-round) include different seasons, and would not be as representative if there are seasonal density differences. Perhaps the greatest uncertainty results from using survey results from the northeast Pacific Ocean. However, the approach used here is believed to be the best available approach. Also, to provide some allowance for these uncertainties, ''maximum estimates'' as well as ''best estimates'' of the densities present and numbers of marine mammals potentially affected have been derived. Best estimates for most species are based on average densities from the surveys of Yang *et al.* (1999), Wang *et al.* (2001a), and Ferguson and Barlow (2001), weighted by effort, whereas maximum estimates are based on the higher of the two densities from the Taiwan surveys and the eastern Pacific survey blocks. For the sperm whales, mysticetes, two delphinids (Indo-Pacific humpback and Indo-Pacific bottlenose dolphins), as well as for the finless porpoise, the maximum estimates are the best estimates multiplied by 1.5. Densities calculated or estimated as described above are given in Table 3 of L-DEO's application.

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

It should be noted that the following estimates of takes by harassment assume that the surveys will be fully completed. As is typical during offshore ship surveys, inclement weather and equipment malfunctions are likely to cause delays and may limit the number of useful line-km to seismic operations that can be undertaken. Furthermore, any marine mammal sightings within or near the designated EZ will result in the power-down or shut-down of seismic operations as a mitigation measure. Thus, the following estimates of the numbers of marine mammals exposed to 160–dB sounds probably overestimate the actual numbers of marine mammals that might be involved. These estimates assume that there will be no weather, equipment, or mitigation delays, which is highly unlikely.

The number of different individuals that may be exposed to airgun sounds with received levels ≥160 dB re 1 μPa (rms) on one or more occasions was estimated by considering the total marine area that would be within the 160–dB radius around the operating airgun array on at least one occasion. The number of possible exposures (including repeated exposures of the same individuals) can be estimated by considering the total marine area that would be within the 160 dB radius around the operating airguns, including areas of overlap. In the proposed survey, the seismic lines are widely spaces in the survey area, and are further spaced in time because the proposed survey, the seismic lines are widely spaced in the survey area, and are further spaced in time because the proposed survey is planned in discrete legs separated by several days. Thus, an individual mammal would not be exposed numerous times during the survey; the areas including overlap are 1.1–1.3 times the areas excluding overlap, depending on the leg, so the numbers of exposures are not discussed further. Moreover, it is unlikely that a particular animal would stay in the area during the entire survey.

The number of different individuals potentially exposed to received levels ≥160 dB re 1 μPa (rms) was calculated by multiplying:

- The expected species density, either ''mean'' (i.e., best estimate) or ''maximum,'' times
- The anticipated minimum area to be ensonified to that level during airgun operations excluding 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 (depending on water and tow depth) and then calculating the total area within the buffers. Areas where overlap occurred were limited and included only once to determine the area expected to be ensonified when estimating the number of individuals exposed.

Applying the approach described above, approximately 168,315 km^2 (104,586 mi^2) would be within the 160–dB isopleth on one or more occasions during the survey. Because this approach does not allow for turnover in the mammal populations in the study area during the course of the survey, the actual number of individuals exposed could be underestimated. However, the approach assumes that no cetaceans will move away from or toward the trackline as the *Langseth* approaches in response to increasing sound levels prior to the time the levels reach 160 dB, which will result in overestimates for those species known to avoid seismic vessels.

TABLE 3. THE ESTIMATES OF THE POSSIBLE NUMBERS OF MARINE MAMMALS EXPOSED TO SOUND LEVELS GREATER THAN OR EQUAL TO 160 DB DURING L-DEO'S PROPOSED SEISMIC SURVEY IN SE ASIA IN MARCH-JULY 2009. THE PROPOSED SOUND SOURCE CONSISTS OF A 36-AIRGUN, 6,600 IN3, ARRAY. RECEIVED LEVELS ARE EXPRESSED IN DB RE 1 μPA (RMS) (AVERAGED OVER PULSE DURATION), CONSISTENT WITH NMFS' PRACTICE. NOT ALL MARINE MAMMALS WILL CHANGE THEIR BEHAVIOR WHEN EXPOSED TO THESE SOUND LEVELS, BUT SOME MAY ALTER THEIR BEHAVIOR WHEN LEVELS ARE LOWER (SEE TEXT). SEE TABLES 2-4 IN L-DEO'S APPLICATION FOR FURTHER DETAIL.

Species	# of Individuals Exposed (best)[1]	# of Individuals Exposed (max)[1]	Approx. % Regional Population (best) [2]
Mysticetes			
Western North Pacific gray whale (*Eschrichtius robustus*)	0	0	0
Western North Pacific right whale (*Eubalaena japonica*)	0	0	0
Humpback whale (*Megaptera novaeangliae*)	10	14	0.94
Minke whale (*Balaenoptera acutorostrata*)	5	8	0.02
Bryde's whale (*Balaenoptera brydei*)	51	77	020
Omura's whale (*Balaenoptera omurai*)	5	8	N.A.
Sei whale (*Balaenoptera borealis*)	5	8	0.05
Fin whale (*Balaenoptera physalus*)	5	8	0.03

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Species	# of Individuals Exposed (best)[1]	# of Individuals Exposed (max)[1]	Approx. % Regional Population (best) [2]
Blue whale (*Balaenoptera musculus*)	5	8	N.A.
Mysticetes			
Sperm whale (*Physeter macrocephalus*)	5	8	0.02
Pygmy sperm whale (*Kogia breviceps*)	0	0	N.A.
Dwarf sperm whale (*Kogia sima*)	806	1267	7.19
Kogia sp.	49	76	N.A.
Cuvier's beaked whale (*Ziphius cavirostris*)	64	143	0.32
Longman's beaked whale (*Indopacetus pacificus*)	0	0	N.A.
Blainville's beaked whale (*Mesoplodon densirostris*)	168	303	0.66
Ginkgo-toothed beaked whale (*Mesoplodon ginkgodens*)	0	0	N.A.
Mesoplodon sp. (unidentified) [3]	294	303	1.16
Unidentified beaked whale [4]	137	178	N.A.
Rough-toothed dolphin (*Steno bredanensis*)	252	1,031	0.17
Indo-Pacific humpback dolphin (*Sousa chinensis*)	68	99	4.03
Common bottlenose dolphin (*Tursiops truncatus*)	4,606	6,704	1.89
Indo-Pacific bottlenose dolphin (*Tursiops aduncus*)	677	6,704	N.A.
Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)	0	0	0
Pantropical spotted dolphin (*Stenella attenuata*)	22,902	26,726	2.86
Spinner dolphin (*Stenella longirostris*)	10,397	16,835	1.30
Striped dolphin (*Stenella coeruleoalba*)	38	60	0.01
Fraser's dolphin (*Lagenodelphis hoseia*)	18,359	23,534	6.35
Short-beaked common dolphin (*Delphinus delphis*)	0	0	0
Long-beaked common dolphin (*Delphinus capensis*)	10	23	0.01

TABLE 3. THE ESTIMATES OF THE POSSIBLE NUMBERS OF MARINE MAMMALS EXPOSED TO SOUND LEVELS GREATER THAN OR EQUAL TO 160 DB DURING L-DEO'S PROPOSED SEISMIC SURVEY IN SE ASIA IN MARCH-JULY 2009. THE PROPOSED SOUND SOURCE CONSISTS OF A 36-AIRGUN, 6,600 IN3, ARRAY. RECEIVED LEVELS ARE EXPRESSED IN DB RE 1 µPA (RMS) (AVERAGED OVER PULSE DURATION), CONSISTENT WITH NMFS' PRACTICE. NOT ALL MARINE MAMMALS WILL CHANGE THEIR BEHAVIOR WHEN EXPOSED TO THESE SOUND LEVELS, BUT SOME MAY ALTER THEIR BEHAVIOR WHEN LEVELS ARE LOWER (SEE TEXT). SEE TABLES 2-4 IN L-DEO'S APPLICATION FOR FURTHER DETAIL.—Continued

Species	# of Individuals Exposed (best)[1]	# of Individuals Exposed (max)[1]	Approx. % Regional Population (best) [2]
Risso's dolphin (*Grampus griseus*)	7,940	12,736	4.54
Melon-headed whale (*Peponocephala electra*)	2,534	3,954	5.63
Pygmy killer whale (*Feresa attenuata*)	380	599	0.98
l killer whale (*Pseudorca crassidens*)	865	905	2.16
Killer whale (*Orcinus orca*)	189	329	2.23
Short-finned pilot whale (*Globicephala macrorhynchus*)	727	1,220	0.15
Finless porpoise (*Neophocaena phocaenoides*)	68	101	0.66
Sirenians			
Dugong (*Dugong dugon*)	0	0	N.A.

N.A. - Data not available or species status was not assessed

[1] Best estimate and maximum estimate density are from Table 3 of L-DEO's application. There will be no seismic acquisition data during Leg 3 of the survey; this, it is not included here in this table.

[2] Regional population size estimates are from Table 2.

[3] Requested takes include Blainville's, and ginkgo-toothed beaked whales.

[4] Requested takes include Cuvier's, Blainville's, ginkgo-toothed, and Longman's beaked whales.

Table 4 of L-DEO's application shows the best and maximum estimates of the number of exposures and the number of individual marine mammals that potentially could be exposed to greater than or equal to 160 dB re 1 µPa (rms) during the different legs of the seismic survey if no animals moved away from the survey vessel.

The ''best estimate'' of the number of individual marine mammals that could be exposed to seismic sounds with received levels greater than or equal to 160 dB re 1 µPa (rms) (but below Level A harassment thresholds) during the survey is shown in Table 4 of L-DEO's application and Table 3 (shown above). The ''best estimate'' total includes 86 baleen whale individuals, 25 of which are listed as Endangered under the ESA: 10 humpback whales (0.94 percent of the regional population), 5 sei whales (0.05 percent), 5 fin whales (0.03 percent), and 5 blue whales (regional population unknown). These estimates were derived from the best density estimates calculated for these species in the area (see Table 4 of L-DEO's application). In addition, 5 sperm whales (0.02 percent of the regional population) as well as 68 Indo-Pacific humpback dolphins (4.03 percent population, but 68.7 percent of the eastern Taiwan Strait (ETC) population), 68 finless porpoise (0.7 percent), and 663 beaked whales including Longman's and ginkgo-toothed beaked whales. Most (97.7 percent) of the cetaceans potentially exposed are delphinids; pantropical spotted, Fraser's, and spinner dolphins are estimated to be the most common species in the area, with best estimates of 22,902 (2.86 percent of the regional population), 18,359 (6.35 percent), and 10,397 (1.3 percent) exposed to greater or equal to 160 dB re µPa (rms) respectively.

Potential Effects on Marine Mammal Habitat

The proposed L-DEO 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, as described above. The following sections briefly review effects of airguns on fish and invertebrates, and more details are included in L-DEO's application and EA, respectively.

Potential 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 populations is very limited (see Appendix D of L-DEO's EA). There are three types of potential effects on fish and invertebrates from exposure to seismic surveys: (1) pathological, (2) physiological, and (3) behavioral. Pathological effects involve lethal and temporary or permanent sub-lethal injury. Physiological effects involve temporary and permanent primary and secondary stress responses, such as changes in levels of enzymes and proteins. Behavioral effects refer to temporary and (if they occur) permanent changes in exhibited behavior (e.g., startle and avoidance behavior). The three categories are interrelated in complex ways. For example, it is possible that certain physiological and behavioral changes potentially could 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 aspect of potential impacts relates to how exposure to seismic survey sound affects marine fish populations and their viability, including their availability to fisheries.

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

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

Little is known about the mechanisms and characteristics of damage to fish that may be inflicted by exposure to seismic survey sounds. Few data have been presented in the peer-reviewed scientific literature. As far as we know, there are only two valid papers with proper experimental methods, controls, and careful pathological investigation implicating sounds produced by actual seismic survey airguns with adverse anatomical effects. One such study indicated anatomical damage and the second indicated TTS in fish hearing. The anatomical case is McCauley *et al.* (2003), who found that exposure to airgun sound caused observable anatomical damage to the auditory maculae of ''pink snapper'' (*Pagrus auratus*). This damage in the ears had not been repaired in fish sacrificed and examined almost 2 months after exposure. On the other hand, Popper *et al.* (2005) documented only TTS (as determined by auditory brainstem response) in 2 of 3 fish species from the Mackenzie River Delta. This study found that broad whitefish (*Coreogonus nasus*) that received a sound exposure level of 177 dB re 1 μPa^2.s showed no hearing loss. During both studies, the repetitive exposure to sound was greater than would have occurred during a typical seismic survey. However, the substantial low-frequency energy produced by the airgun arrays [less than approximately 400 Hz in the study by McCauley *et al.* (2003) and less than approximately 200 Hz in Popper *et al.* (2005)] likely did not propagate to the fish because the water in the study areas was very shallow (approximately 9 m in the former case and less than 2 m in the latter). Water depth sets a lower limit on the lowest sound frequency that will propagate (the ''cutoff frequency'') at about one-quarter wavelength (Urick, 1983; Rogers and Cox, 1988).

In water, acute injury and death of organisms exposed to seismic energy depends primarily on two features of the sound source: (1) the received peak pressure, and (2) the time required for the pressure to rise and decay (Hubbs and Rechnitzer, 1951; Wardle *et al.*, 2001). Generally, the higher the received pressure and the less time it takes for the pressure to rise and decay, the greater the chance of acute pathological effects. Considering the peak pressure and rise/decay time characteristics of seismic airgun arrays used today, the pathological zone for fish and invertebrates would be expected to be within a few meters of the seismic source (Buchanan *et al.*, 2002). Numerous other studies provide examples of no fish mortality upon exposure to seismic sources (Falk and Lawrence, 1973; Holliday *et al.*, 1987; La Bella *et al.*, 1996; Santulli *et al.*, 1999; McCauley *et al.*, 2000a, 2000b; Bjarti, 2002; Hassel *et al.*, 2003; Popper *et al.*, 2005).

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

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

Some studies have reported, some equivocally, that mortality of fish, fish eggs, or larvae can occur close to seismic sources (Kostyuchenko, 1973; Dalen and Knutsen, 1986; Booman *et al.*, 1996; Dalen *et al.*, 1996). Some of the reports claimed seismic effects from treatments quite different from actual seismic survey sounds or even reasonable surrogates. Saetre and Ona (1996) applied a 'worst-case scenario' mathematical model to investigate the effects of seismic energy on fish eggs and larvae. They concluded that mortality rates caused by exposure to seismic surveys are so low, as compared to natural mortality rates, that the impact of seismic surveying on recruitment to a fish stock must be regarded as insignificant.

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

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

The proposed seismic program for 2009 is predicted to have negligible to low physical effects on the various stags of fish and invertebrates for its relatively short duration (approximately 103 days) and unique survey lines extent. Therefore, physical effects of the proposed program on fish and invertebrates would not be significant.

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

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

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

For marine invertebrates, behavioral changes could potentially affect such aspects as reproductive success, distribution, susceptibility to predation, and catchability by fisheries. Studies of squid indicated startle responses (McCauley *et al.*, 2000a,b). In other cases, no behavioral impacts were noted (e.g., crustaceans in Christian *et al.*, 2003, 2004; DFO, 2004). There have been anecdotal reports of reduced catch rates of shrimp shortly after exposure to seismic surveys; however, other studies have not observed any significant changes in shrimp catch rate (Andriguetto-Filho *et al.*, 2005). Parry and Gason (2006) reported no changes in rock lobster CPUE during or after seismic surveys off western Victoria, Australia, from 1978–2004. Any adverse effects on crustacean and cephalopod behavior or fisheries attributable to seismic survey sound depend on the species in question and the nature of the fishery (season, duration, fishing method). Additional information regarding the behavioral effects of seismic on invertebrates is contained in Appendix D in NSF's EA

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

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

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

Subsistence Activities

There is no legal subsistence hunting for marine mammals in the waters of Taiwan, China, or the Philippines, so the proposed activities will not have any impact on the availability of the species or stocks for subsistence users. Today, Japan still hunts whales and dolphins for ''scientific'' purposes. Up until 1990, a drive fishery of false killer whales occurred in the Penghu Islands, Taiwan, where dozens of whales were taken. Although killing and capturing of cetaceans has been prohibited in Taiwan since August 1990 under the Wildlife Conservation Law (Zhou *et al.*, 1995; Chou, 2004), illegal harpooning still occurs (Perrin *et al.*, 2005). Until the 1990's, there was a significant hunt of around 200 to 300 dolphins annually in the Philippines. Catches included dwarf sperm, melon-headed, and short-finned pilot whales, as well as bottlenose, spinner, Fraser's, and Risso's dolphins (Rudolph and Smeenk, 2002). Reports also indicate that perhaps 5 Bryde's whales were caught annually (Rudolph and Smeenk, 2002), although the last Bryde's whales were caught in 1996 (Reeves, 2002). Successive bans on the harvesting of whales and dolphins were issued by the Philippine Government during the 1990's.

Proposed Mitigation and Monitoring

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

Mitigation measures that will be adopted during the proposed TAIGER 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; (5) spatial and temporal avoidance of sensitive species and areas, provided that doing so will not compromise operational safety requirements; and (6) special procedures for situations or species of concern, e.g., emergency shutdown procedures if a North Pacific right whale or a Western Pacific gray whale is sighted from any distance (see ''shut-down procedures'' and ''special procedures for species of concern,'' below) and minimization of approaches to slopes and submarine canyons, if possible, because of sensitivity for beaked whales. The thresholds for estimating take are also used in connection with proposed mitigation.

Vessel-based Visual Monitoring

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

During seismic operations in SE Asia, at least 3 MMVOs will be based aboard the *Langseth*. MMVOs will be appointed by L-DEO with NMFS concurrence. At least one MMVO and when practical two, will monitor the EZ for marine mammals during ongoing daytime operations and nighttime startups of the airguns. Use of two simultaneous MMVOs will increase the effectiveness of detecting animals near the sound source. MMVO(s) will be on duty in shift of duration no longer than 4 hours. The vessel crew will also be instructed to assist in detecting marine mammals and implementing mitigation measures (if practical). Before the start of the seismic survey the crew will be given additional instruction regarding how to do so.

The *Langseth* is a suitable platform for marine mammal observations. When stationed on the observation platform, the eye level will be approximately 18 m (58 ft) above sea level, and the observer will have a good view around the entire vessel. During the daytime, the MMVO(s) will scan the area around the vessel systematically with reticle binoculars (e.g., 7x50 Fujinon), Big-eye binoculars (25x150), and with the naked eye. During darkness, night vision devices will be available (ITT F500 Series Generation 3 binocular-image intensifier or equivalent), when required. Laser rangefinding binoculars (Leica LRF 1200 laser rangefinder or equivalent) will be available to assist with distance estimation. Those are useful in training MMVOs to estimate distances visually, but are generally not useful in measuring distances to animals directly; that is done primarily with the reticles on the binocular's lenses.

Speed or Course Alteration – If a marine mammal is detected outside the safety radius and based on its position and the relative motion, is likely to enter the EZ, 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(s) (relative to the seismic vessel) will then be closely monitored to determine whether the animal(s) is approaching the applicable EZ. If the animal appears likely to enter the EZ, further mitigative actions will be taken, i.e., either further course alterations or a power-down or shut-down of the airguns. Typically, during seismic operations, major course and speed adjustments are often impractical when towing long seismic streamers and large source arrays, thus alternative mitigation measures (see below) will need to be implemented.

Power-down Procedures – A power-down involves reducing the number of airguns in use such that the radius of the of the 180 dB or 190 dB zone is decreased to the extent that marine mammals are no longer in or about to enter the EZ. A power-down of the airgun array can also occur when the vessel is moving from one seismic line to another. During a power-down for mitigation, one airgun will be operated. The continued operation of one airgun is intended to alert marine mammals to the presence of the seismic vessel in the area. In contrast, a shut-down occurs when all airgun activity is suspended.

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

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

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

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

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

During airgun operations following a power-down (or shut-down) whose duration has exceeded the limits specified above and subsequent animal departures, the airgun array will be ramped-up gradually. Ramp-up procedures are described below.

Shut-down Procedures – The operating airguns(s) will be shut-down if a marine mammal is detected within or approaching the EZ for a single airgun source. Shut-downs will be implemented (1) if an animal enters the EZ of the single airgun after a power-down has been initiated, or (2) if an animal is initially seen within the EZ of a single airgun when more than one airgun (typically the full array) is operating. Airgun activity will not resume until the marine mammal has cleared the EZ, or until the MMVO is confident that the animal has left the vicinity of the vessel. Criteria for judging that the animal has cleared the EZ will be as described in the preceding subsection.

Considering the conservation status for North Pacific right whales and Western North Pacific gray whales, the airgun(s) will be shut down immediately if either of these species are observed, regardless of the distance from the *Langseth*. Ramp-up will only begin if the right or gray whale has not been seen for 30 min.

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 8 minutes. This period is based on the largest modeled 180 dB radius for the 36–airgun array (see Table 1 of L-DEO's application and Table 1 here) in relation to the planned speed of the *Langseth* while shooting. Similar periods (approximately 8–10 minutes) were used during previous L-DEO surveys.

Ramp-up will begin with the smallest airgun in the array (40 in^3). Airguns will be added in a sequence such that the source level of the array will increase in steps not exceeding 6 dB per 5 min period over a total duration of approximately 35 minutes. During ramp-up, the MMVOs will monitor the EZ, and if marine mammals are sighted, a course/speed change, power-down, or shut-down will be implemented as though the full array were operational.

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

Temporal and Spatial Avoidance – The *Langseth* will not acquire seismic data in the humpback winter concentration areas during the early part of the seismic program, if practicable. North Pacific humpback whales are known to winter and calve around Ogasawara and Ryuku Islands in southern Japan and in the Babuyan Islands in Luzon Strait in the northern Philippines (Perry *et al.*, 1999a; Acebes *et al.*, 2007; Calambokidis *et al.*, 2008). In the Luzon Strait, the whales may arrive in the area as early as November and leave in May or even June, with a peak occurrence during February through March or April (Acebes *et al.*, 2007). The *Langseth* will attempt to avoid these wintering areas at the time of peak occurrence, by surveying the lines near the Ryuku Islands and Babuyan Islands as late as possible during each leg of the cruise.

Due to the conservation status of Indo-Pacific humpback dolphins in Taiwan Strait, seismic operations will not occur in water depths less than 20 m (65.6 ft) and within at least 2 km (1.2 mi) from the Taiwanese shore. Also, when possible, seismic surveying will only take place at least 8–10 km (5–6.2 mi) from the Taiwanese coast, particularly the central western coast (approximately from Taixi to Tongshiao), to minimize the potential of exposing these threatened dolphins to SPLs greater than 160 dB re 1 μPa (rms).

Procedures for Species of Concern – Several species of concern could occur in the study area. Special mitigation procedures will be used for these species as follows:

(1) The airguns will be shut down if a North Pacific right whale and/or Western Pacific gray whale is sighted at any distance from the vessel;

(2) Because of the sensitivity of beaked whales, approach to slopes and submarine canyons will be minimized, if possible, during the proposed survey.

Passive Acoustic Monitoring

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

The PAM system consists of hardware (i.e., hydrophones) and software. The ''wet end'' of the system consists of a low-noise, towed hydrophone array that is connected to the vessel by a ''hairy'' faired cable. The array will be deployed from a winch located on the back deck. A deck cable will connect from the winch to the main computer lab where the acoustic station and signal condition and processing system will be located. The lead-in from the hydrophone array is approximately 400 m (1,312 ft) long, and the active part of the hydrophone is approximately 56 m (184 ft) long. The hydrophone array is typically towed at depths less than 20 m (65.6 ft).

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

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

L-DEO will coordinate the planned marine mammal monitoring program associated with the TAIGER seismic survey in SE Asia with other parties that may have interest in the area and/or be conducting marine mammal studies in the same region during the proposed seismic survey. L-DEO and NSF will coordinate with Taiwan, China, Japan, and the Philippines, as well as applicable U.S. agencies (e.g., NMFS), and will comply with their requirements.

Proposed Reporting

MMVO Data and Documentation

MMVOs will record data to estimate the numbers of marine mammals exposed to various received sound levels and to document apparent disturbance reactions or lack thereof. Data will be used to estimate numbers of animals potentially 'taken' by harassment (as defined in the MMPA). They will also provide information needed to order a shutdown of the seismic source when a marine mammal or sea turtles is within or near the EZ.

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

(1) Species, group size, and 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 seismic source or vessel (e.g., none, avoidance, approach, paralleling, etc.); and behavioral pace.

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

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

All observations, as well as information regarding seismic source shutdown, will be recorded in a standardized format. Data accuracy will be verified by the MMVOs at sea, and preliminary reports will be prepared during the field program and summaries forwarded to the operating institution's shore facility and to NSF weekly or more frequently. MMVO observations will provide the following information:

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

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

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

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

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

All injured or dead marine mammals (regardless of cause) will 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.

Endangered Species Act (ESA)

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

National Environmental Policy Act (NEPA)

NSF prepared an Environmental Assessment (EA) of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in Southeast Asia, March-July 2009. NMFS will either adopt NSF's EA or conduct a separate NEPA analysis, as necessary, prior to making a determination of the issuance of the IHA.

Preliminary Determinations

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

For reasons stated previously in this document, this determination is supported by: (1) the likelihood that, given sufficient notice through relatively slow ship speed, marine mammals are expected to move away from a noise source that is annoying prior to its becoming potentially injurious; (2) the fact that cetaceans would have to be closer than 950 m (0.6 mi) in deep water, 1,425 m (0.9 mi) at intermediate depths, and 3,694 m (2.3 mi) in shallow water when the full array is in use at a 9 m (29.5 ft) tow depth from the vessel to be exposed to levels of sound (180 dB) believed to have even a minimal chance of causing TTS; (3) the fact that marine mammals would have to be closer than 6,000 m (3.7 mi) in deep water, 6,667 m (4.1 mi) at intermediate depths, and 8,000 m (4.9 mi) in shallow water when the full array is in use at a 9 m (29.5 ft) tow depth from the vessel to be exposed to levels of sound (160 dB) believed to have even a minimal chance at causing TTS; and (4) the likelihood that marine mammal detection ability by trained observers is high at that short distance from the vessel. As a result, no take by injury or death is anticipated, and the potential for temporary or permanent hearing impairment is very low and will be avoided through the incorporation of the proposed mitigation measures.

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

Proposed Authorization

As a result of these preliminary determinations, NMFS proposes to issue an IHA to L-DEO for conducting a marine geophysical survey in Southeast Asia from March-July, 2009, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated.

Dated: December 15, 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

RIN 0648–XL46

Magnuson-Stevens Act Provisions; General Provisions for Domestic Fisheries; Application for Exempted Fishing Permit (EFP)

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

ACTION: Notification of a proposal for an EFP to conduct experimental fishing; request for comments.

SUMMARY: The Assistant Regional Administrator for Sustainable Fisheries, Northeast Region, NMFS (Assistant Regional Administrator) has made a preliminary determination that the subject EFP application submitted by Wallace and Associates contains all the required information and warrants further consideration. The proposed EFP would extend the previously authorized EFP for an additional year to continue testing the safety and efficacy of harvesting surfclams and ocean quahogs from the Atlantic surfclam and ocean quahog Georges Bank (GB) Closure Area using a harvesting protocol developed by state and Federal regulatory agencies and endorsed by the U.S. Food and Drug Administration (FDA). The Assistant Regional Administrator has also made a preliminary determination that the activities authorized under the EFP would be consistent with the goals and objectives of the Atlantic Surfclam and Ocean Quahog regulations and Fishery Management Plan (FMP). However, further review and consultation may be necessary before a final determination is made to issue the EFP. Therefore, NMFS announces that the Assistant Regional Administrator proposes to recommend that an EFP be issued that would allow one commercial fishing vessel to conduct fishing operations that are otherwise restricted by the regulations governing the fisheries of the Northeastern United States. The EFP would allow for an exemption from the Atlantic surfclam and ocean quahog GB Closure Area. Regulations under the Magnuson-Stevens Fishery Conservation and Management Act require publication of this notification to provide interested parties the opportunity to comment on applications for proposed EFPs.

DATES: Comments on this document must be received on or before January 6, 2009.

ADDRESSES: Comments on this notice may be submitted by e-mail.

The mailbox address for providing e-mail comments is *DA8278@noaa.gov*. Include in the subject line of the e-mail comment the following document identifier: ‘‘Comments on GB PSP Closed Area Exemption.’’ Written comments should be sent to Patricia A. Kurkul, Regional Administrator, NMFS, Northeast Regional Office, 55 Great Republic Drive, Gloucester, MA 01930. Mark the outside of the envelope ‘‘Comments on GB PSP Closed Area Exemption.’’ Comments may also be sent via facsimile (fax) to (978) 281–9135.

Copies of supporting documents referenced in this notice are available from Timothy Cardiasmenos, Fishery Policy Analyst, National Marine Fisheries Service, 55 Great Republic Drive, Gloucester, MA 01930, and are available via the Internet at *http://www.nero.noaa.gov/sfd/clams*.

FOR FURTHER INFORMATION CONTACT: Timothy Cardiasmenos, Fishery Policy Analyst, phone 978–281–9204.

SUPPLEMENTARY INFORMATION: Truex Enterprises of New Bedford, MA, first submitted an application for an EFP on March 30, 2006, and public comment was solicited via the **Federal Register** on June 19, 2006 (71 FR 35254). On October 2, 2006, the applicant submitted additional information seeking to add states where the product harvested under the EFP could be landed. Comments for the revised EFP were published on November 14, 2006 (71 FR 66311). At that time, due to lack of concurrence on the Protocol for Onboard Screening and Dockside Testing for PSP Toxins in Molluscan Shellfish (Protocol) from the state of landing, the EFP was not issued. The applicant subsequently received concurrence from the state of landing and the state where the product is to be processed for the Protocol and EFP, and an EFP was authorized through the end of calendar year 2008.

The current applicant, Wallace & Associates, of Cambridge, MD, request an extension of the previously authorized EFP to allow the catch and retention for sale of Atlantic surfclams and ocean quahogs from within the Atlantic surfclam and ocean quahog GB Closure Area. This area, located east of 69°00′ W. long. and south of 42°20′ N. lat., has been closed since May 25, 1990. This closure was implemented based on advice from the FDA after samples of surfclams from the area tested positive for the toxins (saxotoxins) that cause Paralytic Shellfish Poisoning (PSP). These toxins are produced by the alga *Alexandrium fundyense*, which can form blooms commonly referred to as red tides. Red tide blooms, also known as harmful algal blooms (HABs), can produce toxins that accumulate in filter-feeding shellfish. Shellfish contaminated with the saxotoxin, if eaten in large enough quantity, can cause illness or death from PSP. Due, in part, to the inability to test and monitor this area for the presence of PSP, this closure was made permanent through Amendment 12 to the FMP in 1999.

The primary goal of the proposed study is to test the efficacy of the Protocol that was developed by state and Federal regulatory agencies to test for presence of saxotoxins in shellfish, and which has been in a trial period through previous EFP’s since 2006. This protocol would facilitate the harvest of shellfish from waters susceptible to HABs, which produce the saxotoxins, but that are not currently under rigorous water quality monitoring programs by either state or Federal management agencies. The Protocol details procedures and reporting for harvesting, testing, and landing of shellfish harvested from areas that are susceptible to HABs prior to the shellfish from entering commerce. A copy of the Protocol is available from the NMFS Northeast Region website: *http://www.nero.noaa.gov/sfd/clams*.

The proposed project would conduct a trial for the sampling protocol in an exemption zone within the larger 1990 GB Closure Area with the F/V Sea Watcher I (Federal permit #410565, O.N. 1160720). The exemption zone would not include any Northeast multispecies or essential fish habitat year-round closure areas. This proposed exempted fishing activity would occur during the 2009 calendar year, using surfclam and ocean quahog quota allocated to Truex Enterprises under the Federal individual transferable quota (ITQ) program. The applicant has estimated a harvest of 176,000 bushels (9,370,240 L) of surfclams and 80,000 bushels (4,259,200 L) of ocean quahogs from the exemption area. The exemption area has been tested in cooperation with the FDA