SCHEDULE OF ANCILLARY MEETINGS—Continued

Enforcement Consultants	As necessary.
Friday, June 13, 2008	.
Council Secretariat	7 a.m..
California State Delegation	7 a.m..
Oregon State Delegation	7 a.m..
Washington State Delegation	7 a.m..
Groundfish Advisory Subpanel	8 a.m..
Groundfish Management Team	8 a.m..
Enforcement Consultants	As necessary.

Although non-emergency issues not contained in this agenda may come before this Council for discussion, those issues may not be the subject of formal Council action during this meeting. Council action will be restricted to those issues specifically listed in this notice and any issues arising after publication of this notice that require emergency action under Section 305(c) of the Magnuson-Stevens Fishery Conservation and Management Act, provided the public has been notified of the Council's intent to take final action to address the emergency.

Special Accommodations

These meetings are physically accessible to people with disabilities. Requests for sign language interpretation or other auxiliary aids should be directed to Ms. Carolyn Porter at (503) 820–2280 at least 5 days prior to the meeting date.

Dated: May 19, 2008.

Emily Menashes,

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

[FR Doc. E8–11580 Filed 5–22–08; 8:45 am]

BILLING CODE 3510–22–S

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XG64

Small Takes of Marine Mammals Incidental to Specified Activities; Low-Energy Marine Seismic Survey in the Northeast Pacific Ocean, June–July 2008

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

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

SUMMARY: NMFS has received an application from University of Texas, Institute of Geophysics (UTIG) for an Incidental Harassment Authorization (IHA) to take marine mammals incidental to conducting a low-energy marine seismic survey in the Northeast Pacific Ocean during June-July, 2008. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an IHA to UTIG to incidentally take, by Level B harassment only, several species of marine mammals during the aforementioned activity.

DATES: Comments and information must be received no later than June 23, 2008.

ADDRESSES: Comments on the application should be addressed to P. Michael Payne, Chief, Permits, Conservation and Education Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910–3225. The mailbox address for providing email comments is *PR1.0648XB70@noaa.gov*. NMFS is not responsible for e-mail comments sent to addresses other than the one provided here. Comments sent via e-mail, including all attachments, must not exceed a 10–megabyte file size.

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

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

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

SUPPLEMENTARY INFORMATION:

Background

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

Authorization shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring, and reporting of such takings are set forth. NMFS has defined ''negligible impact'' in 50 CFR 216.103 as ''...an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.''

Section 101(a)(5)(D) of the MMPA established an expedited process by which citizens of the U.S. can apply for an authorization to incidentally take small numbers of marine mammals by harassment. Except with respect to certain activities not pertinent here, the MMPA defines ''harassment'' as:

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

Section 101(a)(5)(D) establishes a 45–day time limit for NMFS review of an application followed by a 30–day public notice and comment period on any proposed authorizations for the incidental harassment of marine mammals. Within 45 days of the close of the comment period, NMFS must either approve or deny the authorization.

Summary of Request

On March 4, 2008, NMFS received an application from UTIG for the taking, by Level B harassment only, of several species of marine mammals incidental to conducting, with research funding from the National Science Foundation (NSF), a bathymetric and seismic survey program approximately 100 km (approximately 62 mi) off the Oregon coast in the Northeast Pacific Ocean during June-July, 2008. The purpose of the research program is to investigate the methane vent systems that exist offshore Oregon. These systems release methane by active venting at the seafloor. They can also form relatively high concentrations of methane hydrate in the sub seafloor, up to 150 m (492 ft) below the sea bottom. The goal is to image these systems in detail to understand how vent structure directs methane from the subsurface to be vented into the oceans, or potentially stored in the subsurface as methane hydrate. Methane is a significant greenhouse gas, and methane release from vents or from hydrate has a significant potential to affect the Earth's climate. Hydrates are also a potentially significant source of energy. Also included in the research is the use of a multibeam echosounder and sub-bottom profiler.

Description of the Proposed Activity

The seismic survey will involve one vessel, the *R/V Thomas G. Thompson* (*Thompson*), which is scheduled to depart from Seattle, Washington on June 30, 2008 and return on July 19, 2008. The exact dates of the activities may vary by a few days because of weather conditions, scheduling, repositioning, streamer operations and adjustments, GI airguns deployment, or the need to repeat some lines if data quality is substandard. The proposed ultra-high resolution 3–dimensional (3–D) seismic surveys around the methane vent systems of Hydrate Ridge, will take place off the Oregon coast in the northeastern Pacific Ocean. The overall area within which the seismic surveys will occur is located between approximately 44° and 45° N. and 124.5° and 126° W (Figure 1 in the application). The surveys will occur approximately 100 km (approximately 62 mi) offshore from Oregon in water depths between approximately 650 and 1,200 m (2,132 and 3,936 ft), entirely within the Exclusive Economic Zone (EEZ) of the U.S.

The seismic survey will image the subsurface structures that control venting. The vent systems control whether the methane is directly released into the ocean and atmosphere or stored in methane hydrate. Methane hydrate storage has the potential for rapid dissociation and release into the ocean or atmosphere. The subsurface structure that will be imaged will determine the mechanisms involved in methane venting. The results will be applicable to the numerous vent systems that exist on continental margins worldwide. The data will also be used to design observatories that can monitor and assess the methane fluxes and mechanisms of methane release that operate on Hydrate Ridge.

The *Thompson* will deploy two low-energy Generator-Injector (GI) airguns (guns) as an energy source (with a discharge volume of 40–60 in^3 for each gun or a total of 80–120 in^3) , and a P-Cable system. The 12 m (39.5 ft) long P-Cable system is supplied by Northampton Oceanographic Center in the U.K. The towed system will consist of at least 12 streamers (and possibly up to 24) spaced approximately 12.5 m (41 ft) apart and each containing 11 hydrophones, all summed to a single channel. The energy to the GI guns is compressed air supplied by compressors on board the source vessel. As the GI guns are towed along the survey lines, the P-Cable system will receive the returning acoustic signals.

The seismic program will consist of three survey grids: two of the surveys each cover a 15 km2 area and the third covers a 25 km^2 (see Figure 1 in UTIG's application). The line spacing within the three survey grids will either be 75 m (246 ft) (if 12 streamers are used) or 150 m (492 ft) (if 24 streamers are used). The total line km to be surveyed in the grids at the 75 m spacing is 975 km (605.8 mi), including turns. Water depths at the seismic survey locations range from 650 to 1,200 m (2132 to 3936 ft). Most (92 percent) of the survey will take place over intermediate (100–1,000 m) water depths; the remaining 8 percent will be in water deeper than 1,000 m. If time permits, an additional 300 line km will be surveyed along the outside edges of the three grids. The GI guns are expected to operate for a total of approximately 150 hours during the cruise. There will be additional seismic operations associated with equipment testing, start-up, and repeat coverage of any areas where initial data quality is sub-standard.

In addition to the operations of the two GI guns and P-cable system, a Simrad EM300 30 kHz multibeam echosounder, and a Knudsen 12 kHz 320BR sub-bottom profiler will be used during the proposed cruise.

Vessel Specifications

The *Thompson* has a length of 83.5 m (274 ft), a beam of 16 m (52.5 ft), and a maximum draft of 5.8 m (19 ft). The ship is powered by twin 360°-azimuth stern thrusters a single 3,000–hp DC motor and a water-jet bow thruster powered by a 1,600–hp motor. The motors are driven by up to three 1,500–kW and three 715–kW generators; normal operations use two 1,500–kW and one 750–kW generator, but this changes with ship speed, sea state, and other variables. An operation speed of 6.5 km/h (3.5 knots) will be used during seismic acquisition. When not towing seismic survey gear, the *Thompson* cruises at 22.2 km/h (12 knots) and has a maximum speed of 26.9 km/h (14.5 knots). It has a normal operating range of approximately 24,400 km (8,264 mi).

Acoustic Source Specifications

Seismic Airguns

The vessel *Thompson* will tow two GI guns and a P-Cable system of 12 to 24, 12 m long streamers containing hydrophones along predetermined survey grids. Seismic pulses will be emitted at intervals of 3.5 s, which corresponds to a shot interval of approximately 6.3 m (20.7 ft) at a speed of 3.5 knots (6.5 km/h). The generator chamber of a GI gun, the one responsible for introducing the sound pulse into the ocean, is 40–60 in3. The second injector chamber (40–60 in3) injects air into the previously-generated bubble to maintain its shape and does not introduce more sound into the water. The two 40–60 in3 GI guns will be towed 29 m (95.1 ft) behind the *Thompson*, at a depth of 1.5–3 m (4.9–9.8 ft). The dominant frequency components are 0–188 Hz.

The sound pressure field of two 105 in^3 GI guns has been modeled by the Lamont-Doherty Earth Observatory (L-DEO) of Columbia University in relation to distance and direction from the GI guns. The model does not allow for bottom interactions and is most directly applicable to close distances and/or deep water. Because the L-DEO model is for a pair of larger GI guns with a total discharge of up to 210 in^3, the values overestimate the distances for two GI guns with a discharge of up to 120 in3, as planned for use during the proposed study. This source, which is directed downward, was found to have an output (0–peak) of 237 dB re 1 µPam.

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, 2000). 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.

Sub-bottom Profiler

The *Thompson* will utilize a Simrad EM300 30–kHz Multibeam Echosounder (MBES) as the primary bottom-mapping echosounder during the cruise. The Simrad EM300 transducer is hull-mounted within a transducer pod that is located midship. The system's normal operating frequency is approximately 30 kHz. The transmit fan-beam is split into either three or nine narrower beam sectors with independent active steering to correct for vessel yaw. Angular coverage is 36 degrees (in Extra Deep Mode, for use in water depths 3,000 to 6,000 m) or 150 degrees (in shallower water). The total angular coverage of 36 or 150 degrees consists of the 3 or 9 beams transmitted at slightly different frequencies. The sectors are frequency coded between 30 and 34 kHz and they are transmitted sequentially at each ping. Except in very deep water where the total beam is 36 x 1, the composite fan beam will overlap slightly if the vessel yaw is less than the fore-aft width of the beam (1,2, or 4, respectively). Achievable swath width on a flat bottom will normally be approximately 5x the water depth. The maximum source level is 237 dB re 1 µPa•m (rms) (Hammerstand, 2005). In deep water (500–3,000 m) a pulse length of 5 ms is normally used. At intermediate depths (100–1,000 m), a pulse length of 2 ms is used, and in shallow water (<300 m), a pulse length of 0.7 ms is used. The ping rate is mainly limited by the round trip travel time in the water up to a ping rate of 10 pings/s in shallow water.

The *Thompson* will also utilize the Knudsen Engineering Model 320BR sub-bottom profiler, which is a dual-frequency echosounder designed to operate at 3.5 and/or 12 kHz. It is used to provide data about the sedimentary features that occur below the sea floor. The energy from the sub-bottom profiler is directed downward (in an 80–degree cone) via a 12 kHz transducer (EDO 323B) or a 3.5 kHz array of 16 ORE 137D transducers in a 4 x 4 arrangement. The maximum power output of the 320BR is 10 kilowatts for the 3.5 kHz section and 2 kilowatts for the 12 kHz section.

The pulse length for the 3.5 kHz section of the 320BR is 0.8–24 ms, controlled by the system operator in regards to water depth and reflectivity of the bottom sediments, and will usually be 12 or 24 ms in this survey. The system produces one sound pulse and then waits for its return before transmitting again. Thus, the pulse interval is directly dependent upon water depth, and in this survey the interval is estimated to be every 4.5–8 sec. Using the Sonar Equations and assuming 100 percent efficiency in the system (impractical in real world applications), the source level for the 320BR is calculated to be 211 dB re 1 µPa-m. In practice, the system is rarely operated above 80 percent power level.

Safety Radii

NMFS has determined that for acoustic effects, using acoustic thresholds in combination with corresponding safety radii is the most effective way to consistently apply measures to avoid or minimize the impacts of an action, and to quantitatively estimate the effects of an action. Thresholds are used in two ways: (1) to establish a mitigation shut-down or power down zone, i.e., if an animal enters an area calculated to be ensonified above the level of an established threshold, a sound source is powered down or shut down; and (2) to calculate take, in that a model may be used to calculate the area around the sound source that will be ensonified to that level or above, then, based on the estimated density of animals and the distance that the sound source moves, NMFS can estimate the number of marine mammals that may be ‘‘taken’’. NMFS believes that to avoid 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). NMFS also assumes that cetaceans or pinnipeds exposed to levels exceeding 160 dB re 1 µPa (rms) may experience Level B Harassment.

Received sound levels have been modeled by L-DEO for a number of airgun configurations, including one 45–in^3 GI gun, in relation to distance and direction from the airgun(s). The model does not allow for bottom interactions and is most directly applicable to deep water. Based on the modeling, estimates of the maximum distances from the GI gun where sound levels of 190, 180, and 160 dB re 1 µPa (rms) are predicted to be received in deep (>1000–m, 3280–ft) water are 8, 23, and 220 m (26.2, 75.5, and 721.8 ft), respectively and 12, 35, and 330 m (39.4, 115, and 1,082.7 ft), respectively for intermediate water depths (100–1000m, 328–3,280 ft). Because the model results are for a 2.5–m (8.2–ft) tow depth, the above distances slightly underestimate the distances for the 45–in^3 GI gun towed at 4–m (13–ft) depth.

Empirical data concerning the 180– and 160– dB distances have been acquired based on measurements during the acoustic verification study conducted by L-DEO in the northern Gulf of Mexico from 27 May to 3 June 2003 (Tolstoy *et al.* 2004). Although the results are limited, the data showed that radii around the airguns where the received level would be 180 dB re 1 µPa (rms) vary with water depth. Similar depth-related variation is likely in the 190 dB distances applicable to pinnipeds. Correction factors were developed for water depths 100–1,000 m (328–3,280 ft) and <100 m (328 ft). The proposed survey will occur in depths 650–1,200 m (2,132–3,936 ft), so the correction factors for the latter are not relevant here.

The empirical data indicate that, for deep water (>1,000 m, 3,280 ft), the L-DEO model tends to overestimate the received sound levels at a given distance (Tolstoy *et al.*, 2004). However, to be precautionary pending acquisition of additional empirical data, it is proposed that safety radii during airgun operations in deep water will be the values predicted by L-DEO's model (above). Therefore, the assumed 180– and 190–dB radii are 69 m and 20 m (226.3 and 65.6 ft), respectively.

Empirical measurements were not conducted for intermediate depths (100–1,000 m, 328–3,280 ft). On the expectation that results will be intermediate between those from shallow and deep water, a 1.5x correction factor is applied to the estimates provided by the model for deep water situations. This is the same factor that was applied to the model estimates during L-DEO cruises in 2003. The assumed 180- and 190–dB radii in intermediate-depth water are 104 m and 30 m (341.1 and 98.4 ft), respectively.

The GI guns will be shut down immediately when cetaceans or pinnipeds are detected within or about to enter the measured 180–dB (rms) or 190–dB (rms) radius, respectively.

Description of Marine Mammals in the Activity Area

Thirty-two marine mammal species, including 19 odontocete (dolphins and small and large toothed whales) species, seven mysticete (baleen whales) species, five pinniped species, and the sea otter, may occur or have been documented to occur in the marine waters off Oregon and Washington, excluding extralimital sightings or strandings (Table 1 here). Six of the species that may occur in the project area are listed under the U.S. Endangered Species Act (ESA) as endangered, including sperm, humpback, blue, fin, sei, and North Pacific right whales. In addition, the southern resident killer whale stock is also listed as endangered, but is unlikely to be seen in offshore waters of Oregon. The threatened Steller sea lion could also occur in the project area. However, the threatened northern sea otter is only known to occur in coastal waters and is not expected in the project area (the sea otter is under the jurisdiction of the U.S. Fish and Wildlife Service.

Gray whales are also not expected in the project area because their occurrence off Oregon is limited to very shallow, coastal waters. The California sea lion, Steller sea lion, and harbor seal are also mainly coastal and are not expected at the survey locations. Information on habitat and abundance of the species that may occur in the study area are given in Table 1 below. Vagrant ringed seals, hooded seals, and ribbon seals have been sighted or stranded on the coast of California (see Mead, 1981; Reeves *et al.*, 2002) and presumably passed through Oregon waters. A vagrant beluga was seen off the coast of Washington (Reeves *et al.*, 2002).

The six species of marine mammals expected to be most common in the deep pelagic or slope waters of the project area, where most of the survey sites are located, include the Pacific white-sided dolphin, northern right whale dolphin, Risso's dolphin, short-beaked common dolphin, Dall's porpoise, and northern fur seal (Green *et al.*, 1992, 1993; Buchanan *et al.*, 2001; Barlow, 2003; Carretta *et al.*, 2006).

The sperm, pygmy sperm, mesoplodont species, Baird's beaked, and Cuvier's beaked whales and the northern elephant seal are considered pelagic species, but are generally uncommon in the waters near the survey area. 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 UTIG's application.

Species	Habitat	Abundance[1]	Rqstd Take
Mysticetes			
North Pacific right whale (*Eubalaena japonica*) *	Inshore, occasionally offshore	N.A.[2]	0
Humpback whale (*Megaptera novaeangliae*) *	Mainly nearshore waters and banks	1391	1
Minke whale (*Balaenoptera acutorostrata*)	Pelagic and coastal	1015	1
Sei whale (*Balaenoptera borealis*) *	Primarily offshore, pelagic	56	0
Fin whale (*Balaenoptera physalus*) *	Continental slope, mostly pelagic	3279	1
Blue whale (*Balaenoptera musculus*) *	Pelagic and coastal	1744	0
Odontocetes			
Sperm whale (*Physeter macrocephalus*) *	Usually pelagic and deep seas	1233	2
Pygmy sperm whale (*Kogia breviceps*)	Deep waters off the shelf	247	2
Dwarf sperm whale (*Kogia sima*)	Deep waters off the shelf	N.A.	0
Cuvier's beaked whale (*Ziphius cavirostris*)	Pelagic	1884	0
Baird's beaked whale (*Berardius bairdii*)	Pelagic	228	1
Blainville's beaked whale (*Mesoplodon densirostris*)	Slope, offshore	1247 [3]	0
Hubb's beaked whale (*Mesoplodon carlhubbsi*)	Slope, offshore	1247 [3]	0
Stejneger's beaked whale (*Mesoplodon stejnegeri*)	Slope, offshore	1247 [3]	0
Mesoplodon sp. (*Unidentified*)	Slope, offshore	1247	1
Offshore bottlenose dolphin (*Tursiops truncatus*)	Offshore, slope	5,065	0
Striped dolphin (*Stenella coeruleoalba*)	Off continental shelf	13,934	0
Short-beaked common dolphin (*Delphinus delphis*)	Shelf and pelagic, seamounts	449,846	7
Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)	Offshore, slope	59,274	6
Northern right whale dolphin (*Lissodelphis borealis*)	Slope, offshore waters	20,362	5
Risso's dolphin (*Grampus griseus*)	Shelf, slope, seamounts	16,066	3
False killer whale (*Pseudorca crassidens*)	Pelagic, occasionally inshore	N.A.	0
Killer whale (*Orcinus orca*)	Widely distributed	466 (Offshore)	1

Species	Habitat	Abundance[1]	Rqstd Take
Short-finned pilot whale (*Globicephala macrorhynchus*)	Mostly pelagic, high-relief topography	304	0
Harbor porpoise (*Phocoena phocoena*)	Coastal and inland waters	39,586 (OR/WA)	0
Dall's porpoise (*Phocoenoides dalli*)	Shelf, slope, offshore	99,517	47
Pinnipeds			
Northern fur seal (*Callorhinus ursinus*)	Pelagic, offshore	688,028 [2]	19
California sea lion (*Zalophus californianus californianus*)	Coastal, shelf	237,000-244,000	NA
Northern elephant seal (*Mirounga angustirostris*)	Coastal, pelagic when migrating	101,000 (CA)	2

Table 1. Species expected to be encountered (and potentially harassed) during UTIG's NE Pacific Ocean cruise.
N.A. B Data not available or species status was not assessed.
* Species are listed as threatened or endangered under the Endangered Species Act.
[1] Abundance given for U.S., Eastern North Pacific, or California/Oregon/Washington Stock, whichever is included in the 2005 U.S. Pacific Marine Mammal Stock Assessments (Carretta *et al.* 2006), unless otherwise stated.
[2] Angliss and Outlaw (2005).
[3] All mesoplodont whales

Potential Effects of Airguns

The effects of sounds from airguns might include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, and temporary or permanent hearing impairment or non-auditory physical or physiological effects (Richardson *et al.*, 1995; Gordon *et al.*, 2004). Given the small size of the GI guns planned for the proposed project, effects are anticipated to be considerably less than would be the case with a large array of airguns. It is very unlikely that there would be any cases of temporary or, especially, permanent hearing impairment or any significant non-auditory physical or physiological effects. Also, behavioral disturbance is expected to be limited to relatively short distances.

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 A of UTIG's application. However, it should be noted that most of the measurements of airgun sounds that have been reported concerned sounds from larger arrays of airguns, whose sounds would be detectable considerably farther away than the two GI guns planned for use in the proposed project.

Numerous other studies have shown that marine mammals at distances more than a few kilometers from operating seismic vessels often show no apparent response (see Appendix A (e) of UTIG's application). That is often true even in cases when the pulsed sounds appear to be readily audible to the animals based on measured received levels and the hearing sensitivity of that mammal group. Although various baleen whales, toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to airgun pulses under some conditions, at other times mammals of all three types have shown no overt reactions. In general, pinnipeds and small odontocetes seem to be more tolerant of exposure to airgun pulses than are baleen whales. Given the relatively small, low-energy airgun source planned for use in this project, NMFS expects mammals to tolerate being closer to this source than for a larger airgun source typical of most seismic surveys. Mysticetes, odontocetes, pinnipeds and sea otters have all been seen commonly by observers aboard vessels conducting small-source seismic surveys, indicating some degree of tolerance of sounds from small airgun sources (e.g., Calambokidis *et al.*, 2002; Haley and Koski, 2004; Holst *et al.*, 2005a; Ireland *et al.*, 2005; MacLean and Koski, 2005; see also ''site survey'' portions of Stone, 2003 and Stone and Tasker, 2006).

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 very few specific data on this matter. Some whales are known to continue calling in the presence of seismic pulses. Their calls can be heard between the seismic pulses (e.g., Richardson *et al.*, 1986; McDonald *et al.*, 1995; Greene *et al.*, 1999; Nieukirk *et al.*, 2004; Smultea *et al.*, 2004). Although there has been one report that sperm whales cease calling when exposed to pulses from a very distant seismic ship (Bowles *et al.*, 1994), a recent study reports that sperm whales off northern Norway continued calling in the presence of seismic pulses (Madsen *et al.*, 2002c). Similar reactions have also been shown during recent work in the Gulf of Mexico (Tyack *et al.*, 2003; Smultea *et al.*, 2004). Given the small source planned for use here, there is even less potential for masking of baleen or sperm whale calls during the present study than in most seismic surveys. Masking effects of seismic pulses are expected to be negligible in the case of the smaller odontocete cetaceans, given the intermittent nature of seismic pulses and the relatively low source level of the airgun to be used here. Dolphins and porpoises are commonly heard calling while airguns are operating (Gordon *et al.*, 2004; Smultea *et al.*, 2004; Holst *et al.*, 2005a,b). Also, the sounds important to small odontocetes are predominantly at much higher frequencies than are airgun sounds. Masking effects, in general, are discussed further in Appendix A (d) of UTIG'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 (Richardson *et al.*, 1995; Wartzok *et al.*, 2004; Southall *et al.*, 2007). If a marine mammal responds to an underwater sound by changing its behavior or moving a small distance, the response may or may not rise to the level of harassment, let alone affect the stock or the species as a whole. Alternatively, if a sound source displaces marine mammals from an important feeding or breeding area, effects on the stock or species could potentially be more than negligible. 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 criteria used to estimate how many marine mammals might be disturbed to some biologically-important degree by a seismic program are based on behavioral observations during studies of several species. However, information is lacking for many species. Detailed studies have been done on humpback, gray, and bowhead whales and ringed seals. Less detailed data are available for some other species of baleen whales, sperm whales, and small toothed whales. Most of those studies have focused on the impacts resulting from the use of much larger airgun sources than those planned for use in the present project. Thus, effects are expected to be limited to considerably smaller distances and shorter periods of exposure in the present project than in most of the previous work concerning marine mammal reactions to airguns.

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 A (e) of UTIG's application, baleen whales exposed to strong noise pulses from airguns often react by deviating from their normal migration route and/or interrupting their feeding activities and moving away from the sound source. In the case of the migrating gray and bowhead whales, the observed changes in behavior appeared to be of little or no biological consequence to the animals. They simply avoided the sound source by displacing their migration route to varying degrees, but within the natural boundaries of the migration corridors.

Studies of gray, bowhead, and humpback whales have determined that received levels of pulses in the 160–170 dB re 1 μPa (rms) range seem to cause obvious avoidance behavior in a substantial fraction of the animals exposed. In many areas, seismic pulses from large arrays of airguns diminish to those levels at distances ranging from 4.5–14.5 km (2.8–9 mi) from the source. A substantial proportion of the baleen whales within those distances may show avoidance or other strong disturbance reactions to the airgun array. Subtle behavioral changes sometimes become evident at somewhat lower received levels, and recent studies, reviewed in Appendix A (e) of UTIG's application, have shown that some species of baleen whales, notably bowheads and humpbacks, at times show strong avoidance at received levels lower than 160–170 dB re 1 μPa (rms). Reaction distances would be considerably smaller during the present project, in which the 160–dB radius is predicted to be approximately 0.22 or 0.33 km (0.14 or 0.21 mi), as compared with several kilometers when a large array of airguns is operating.

Responses of humpback whales to seismic surveys have been studied during migration and on the summer feeding grounds, and there has also been discussion of effects on the Brazilian wintering grounds. McCauley *et al.* (1998, 2000) studied the responses of humpback whales off Western Australia to a full-scale seismic survey with a 16–airgun, 2,678–in^3 array, and to a single 20–in^3 airgun with a source level of 227 dB re 1 μPa m. McCauley *et al.* (1998) documented that 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 but consistent with the results from the full array in terms of received sound levels. Mean avoidance distance from the airgun corresponded to a received sound level of 140 dB re 1 μPa (rms); that was the level at which humpbacks started to show avoidance reactions to an approaching airgun. The standoff range, i.e., the closest point of approach of the whales to the airgun, corresponded to a received level of 143 dB re 1 μPa (rms). 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 μPa on an approximate rms basis. Malme *et al.* (1985) conclude that there was no clear evidence of avoidance, despite the possibility of subtle effects, at received levels up to 172 re 1 μPa (approximately rms).

It has been suggested that South Atlantic humpback whales wintering off Brazil may be displaced or even strand upon exposure to seismic surveys (Engel *et al.*, 2004). The evidence for this was circumstantial, subject to alternative explanations (IAGC 2004), and not consistent with results from direct studies of humpbacks exposed to seismic surveys in other areas and seasons. After allowance for data from subsequent years, there was ''no observable direct correlation'' between strandings and seismic surveys (IWC 2007:236).

Results from bowhead whales show that responsiveness of baleen whales to seismic surveys can be quite variable depending on the activity (migrating vs. feeding) of the whales. Bowhead whales migrating west across the Alaskan Beaufort Sea in autumn, in particular, are unusually responsive, with substantial avoidance occurring out to distances of 20 30 km (12.4–18.6 mi) from a medium-sized airgun source, where received sound levels were on the order of 130 dB re 1 μPa (rms) (Miller *et al.*, 1999; Richardson *et al.*, 1999). However, more recent research on bowhead whales (Miller *et al.*, 2005a) corroborates earlier evidence that, during the summer feeding season, bowheads are not as sensitive to seismic sources. In summer, bowheads typically begin to show avoidance reactions at a received level of about 160–170 dB re 1 μPa (rms) (Richardson *et al.*, 1986; Ljungblad *et al.*, 1988; Miller *et al.*, 1999). There are no data on the reactions of wintering bowhead whales to seismic surveys. See Appendix A (e) of UTIG's application for more information regarding bowhead whale reactions to airguns.

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 and on observations of Western Pacific gray whales feeding off Sakhalin Island, Russia (Johnson *et al.*, 2007).

Various species of *Balaenoptera* (blue, fin, sei, and minke whales) have occasionally been reported in areas ensonified by airgun pulses. Sightings by observers on seismic vessels off the U.K. from 1997 to 2000 suggest that, at times of good sightability, numbers of rorquals seen are similar when airguns are shooting and not shooting (Stone, 2003). Although individual species did not show any significant displacement in relation to seismic activity, all baleen whales combined were found to remain significantly further from the airguns during shooting compared with periods without shooting (Stone, 2003; Stone and Tasker, 2006). In a study off Nova Scotia, Moulton and Miller (2005) found little or no difference in sighting rates and initial sighting distances of balaenopterid whales when airguns were operating vs. silent. However, there were indications that these whales were more likely to be moving away when seen during airgun operations.

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

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

Seismic operators and marine mammal observers sometimes see dolphins and other small toothed whales near operating airgun arrays, but in general there seems to be a tendency for most delphinids to show some limited avoidance of seismic vessels operating large airgun systems. However, some dolphins seem to be attracted to the seismic vessel and floats, and some ride the bow wave of the seismic vessel even when large arrays of airguns are firing. Nonetheless, there have been indications that small toothed whales sometimes tend to head away, or to maintain a somewhat greater distance from the vessel, when a large array of airguns is operating than when it is silent (Goold, 1996; Calambokidis and Osmek, 1998; Stone, 2003). In most cases, the avoidance radii for delphinids appear to be small, on the order of 1 km (0.62 mi) or less.

The beluga may be a species that (at least at times) shows long-distance avoidance of seismic vessels. Aerial surveys during seismic operations in the southeastern Beaufort Sea recorded much lower sighting rates of beluga whales within 10–20 km (6.2–12.4 mi) of an active seismic vessel. These results were consistent with the low number of beluga sightings reported by observers aboard the seismic vessel, suggesting that some belugas might be avoiding the seismic operations at distances of 10–20 km (6.2–12.4 mi) (Miller *et al.*, 2005a). Similarly, captive bottlenose dolphins and beluga whales exhibit 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). However, the animals tolerated high received levels of sound (pk-pk level >200 dB re 1 µPa) before exhibiting aversive behaviors.

Results for porpoises depend on species. Dall's porpoises seem relatively tolerant of airgun operations (MacLean and Koski, 2005; Bain and Williams, 2006), whereas 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 in general (Richardson *et al.*, 1995; Southall *et al.*, 2007).

Most studies of sperm whales exposed to airgun sounds indicate that this species shows considerable tolerance of airgun pulses. In most cases, the whales do not show strong avoidance, and they continue to call (see Appendix A of UTIG's application for review). However, controlled exposure experiments in the Gulf of Mexico indicate that foraging effort is apparently somewhat reduced upon exposure to airgun pulses from a seismic vessel operating in the area, and there may be a delay in diving to foraging depth.

There are no specific data on the behavioral reactions of beaked whales to seismic surveys. Most beaked whales tend to avoid approaching vessels of other types (Wursig *et al.*, 1998). They may also dive for an extended period when approached by a vessel (Kasuya, 1986). It is likely that these beaked whales would normally show strong avoidance of an approaching seismic vessel, but this has not been documented explicitly.Odontocete reactions to large arrays of airguns are variable and, at least for delphinids and some porpoises, seem to be confined to a smaller radius than has been observed for mysticetes (see Appendix A of UTIG's application for more information). Behavioral reactions of most odontocetes to the small GI gun source to be used here are expected to be very localized.

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

Additional details on the behavioral reactions (or the lack thereof) by all types of marine mammals to seismic vessels can be found in Appendix A (e) of UTIG'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. Current NMFS policy regarding exposure of marine mammals to high-level sounds is that cetaceans and pinnipeds should not be exposed to impulsive sounds of 180 and 190 dB re 1 μPa (rms), respectively (NMFS, 2000). Those criteria have been used in defining the safety (shut-down) radii planned for the proposed seismic survey. The precautionary nature of these criteria is discussed in Appendix A (f) of UTIG's application, including the fact that the minimum sound level necessary to cause permanent hearing impairment is higher, by a variable and generally unknown amount, than the level that induces barely-detectable temporary threshold shift (TTS) (which NMFS' criteria are based on) 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 is presently developing new noise exposure criteria for marine mammals that take account of the now-available scientific data on TTS, the expected offset between the TTS and permanent threshold shift (PTS) thresholds, differences in the acoustic frequencies to which different marine mammal groups are sensitive, and other relevant factors.

Because of the small size of the airgun source in this project (two 40–60 in^3 GI gun), alongwith the planned monitoring and mitigation measures, there is little likelihood that any marine mammals will be exposed to sounds sufficiently strong to cause hearing impairment. Several aspects of the planned monitoring and mitigation measures for this project are designed to detect marine mammals occurring near the GI guns (and multibeam echosounder and sub-bottom profiler), and to avoid exposing them to sound pulses that might, at least in theory, cause hearing impairment. In addition, many cetaceans are likely to show some avoidance of the area with high received levels of airgun sound (see above). In those cases, the avoidance responses of the animals themselves will reduce or (most likely) avoid any possibility of hearing impairment.

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

Temporary Threshold Shift (TTS) – TTS is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter, 1985). While experiencing TTS, the hearing threshold rises and a sound must be stronger in order to be heard. 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 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.

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 distances from the *Thompson*'s GI guns 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 1 of UTIG's application (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 69–104 m (226.3–341.1 ft) around the two GI guns. The specific radius depends on the depth of the water. 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. Such levels would be limited to distances within tens of meters of the small GI guns source to be used in this project.

For baleen whales, direct or indirect data do not exist on levels or properties of sound thatare required to induce TTS. The frequencies to which baleen whales are most sensitive are lower than those to which odontocetes are most sensitive, and natural background noise levels at those low frequencies tend to be higher. As a result, auditory thresholds of baleen whales within their frequency band of best hearing are believed to be higher (less sensitive) than are those of odontocetes at their best frequencies (Clark and Ellison, 2004). From this, it is suspected that received levels causing TTS onset may also be higher in baleen whales. In any event, no cases of TTS are expected given three considerations: (1) the 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 proposed to be implemented.

In pinnipeds, TTS thresholds associated with exposure to brief pulses (single or multiple) of underwater sound have not been measured. Initial evidence from prolonged exposures suggests 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; cf. Au *et al.*, 2000). The TTS threshold for pulsed sounds has been indirectly estimated as being an SEL of about 171 dB re $\mu Pa^2 \bullet s$ (Southall *et al.*, 2007), which would be equivalent to about 181–186 dB re 1 μPa (rms). Corresponding values for California sea lions and northern elephant seals are likely to be higher (Kastak *et al.*, 2005).

To avoid 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). Those sound levels were not considered to be the levels above which TTS might occur. Rather, they were the received levels above which, in the view of a panel of bioacoustics specialists convened by NMFS before TTS measurements for marine mammals started to become available, one could not be certain that there would be no injurious effects, auditory or otherwise, to marine mammals. 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 (PTS) – 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 A (f) of UTIG'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 and probably more than 6 dB.

On an SEL basis, Southall *et al.* (2007) estimate 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 an SEL of about 198 dB re 1 µPa^2.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 an SEL of about 186 dB re 1 µPa^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 not that, regardless of the SEL, there is concern about the possibility of PTS if a cetacean or pinniped received one or more pulses with peak pressure exceeding 230 or 218 dB 1 µPa (peak).

In the proposed project employing two 40 to 60–in^3 GI guns, marine mammals are highly unlikely to be exposed to received levels of seismic pulses strong enough to cause TTS, as they would probably need to be within a few tens of meters of the GI guns for that to occur. Given the higher level of sound necessary to cause PTS, it is even less likely that PTS could occur. In fact, even the levels immediately adjacent to the GI guns may not be sufficient to induce PTS, especially since a mammal would not be exposed to more than one strong pulse unless it swam immediately alongside the GI guns 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 and sea turtles. The planned monitoring and mitigation measures, including visual monitoring and shut downs of the GI guns when mammals are seen within or about to enter the ''safety radii'' or exclusion zone (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. 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 the 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 the 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 the beaked whale stranding in the Canary Islands in 2002 during naval exercises. Fernandez *et al.* (2005a) showed those beaked whales did indeed have gas bubble-associated lesions, as well as fat embolisms. Fernandez *et al.* (2005b) also found evidence of fat embolism in three beaked whales that stranded 100 km (62 mi) north of the Canaries in 2004 during naval exercises. Examinations of several other stranded species have also revealed evidence of gas and fat embolisms (Arbelo *et al.*, 2005; Jepson *et al.*, 2005a; Mendez *et al.*, 2005). Most of the afflicted species were deep divers. There is speculation that gas and fat embolisms may occur if cetaceans ascend unusually quickly when exposed to aversive sounds, or if sound in the environment causes the destablization of existing bubble nuclei (Potter, 2004; Arbelo *et al.*, 2005; Fernandez *et al.*, 2005a; Jepson *et al.*, 2005b; Cox *et al.*, 2006). Even if gas and fat embolisms can occur during exposure to mid-frequency sonar, there is no evidence that that type of effect occurs in response to airgun sounds.

In general, little is known about the potential for seismic survey sounds to cause auditory impairment or other physical effects in marine mammals. Available data suggest that such effects, if they occur at all, would be limited to short distances and probably to projects involving large arrays of airguns. However, 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 other physical effects. Also, the planned mitigation measures, including shut downs of the GI guns, 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 serious injury, death, or stranding even in the case of large airgun arrays. However, the association of mass strandings of beaked whales with naval exercises and, in one case, an L-DEO seismic survey, 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 A of UTIG'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 research vessel *Maurice 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, the preceding example plus the incidents involving beaked whale strandings near naval exercises suggests a need for caution in conducting seismic surveys in areas occupied by beaked whales. No injuries of beaked whales are anticipated during the proposed study because of the proposed monitoring and mitigation measures.

The proposed project will involve a much smaller sound source than used in typical seismic surveys. That, along with the monitoring and mitigation measures that are planned, are expected to minimize any possibility for strandings and mortality.

Potential Effects of Other Acoustic Devices

Multibeam Echosounder Signals

A Simrad EM300 30–kHz MBES will be operated from the source vessel during approximately two days of the proposed study. Sounds from the MBES are very short pulses occurring for 2–5 ms, at a ping rate of up to 10 pings/s depending on depth. Given the minimum water depth in the study area (650 m; 2–way travel time ≥0.9 s), the pulse repetition rate is not likely to exceed 1 ping/s. Most of the energy in the sound pulses emitted by the MBES is at freqencies near 30 kHz within the audible range for odontocetes and at least some pinnipeds, but probably not for baleen whales (Southall *et al.*, 2007). The beam is narrow (1–4°) in fore-aft extent and wide (150°) in the cross-track extent. Each ping consists of nine beams transmitted at slightly different frequencies. Any given mammal at depth near the trackline would be in the main beam for only one or two of the nine segments. Also, marine mammals that encounter the Simrad EM300 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 5 ms pulse (or two pulses if in the overlap area). Similarly, Kremser *et al.* (2005) noted that the probability of a cetacean swimming through the area of exposure when MBES emits a pulse is small due to the narrow beam being emitted. The animal would have to pass the transducer at close range and be swimming at speeds similar to the vessel in order to be subjected to sound levels that could cause TTS. Burkhardt *et al.* (2007) concluded that immediate direct 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 than the Simrad EM300, 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. Possible effects of an MBES on marine mammals are outlined below.

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 (30 kHz) do not overlap with the frequencies in the calls or with the functional hearing range, which would avoid any possibility of masking.

Behavioral reactions of free ranging marine mammals to echosounders and other sound sources appear to vary by species and circumstance. Observed reactions have included silencing and dispersal by sperm whales (Watkins *et al.*, 1985), increased vocalizations and no dispersal by pilot whales (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 μPam, gray whales showed slight avoidance (~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 UTIG'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. In the case of baleen whales, the MBES will operate at too high a frequency to have any effect.

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 UTIG, 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.

During a previous low-energy seismic survey from the *Thompson*, the EM300 MBES was in operation most of the time. Many cetaceans and small numbers of fur seals were seen by marine mammal visual observers (MMVOs) aboard the ship, but no specific information about MBES effects (if any) on mammals was obtained (Ireland *et al.*, 2005). These responses (if any) could not be distinguished from responses to the airgun (when operating) and to the ship itself.

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

Although the source level of the Simrad EM300 is not available, the maximum source level of a relatively powerful MBES (Simrad EM120) is 242 dB re 1 μPa_{rms}. At that source level, the received level for an animals within the MBES beam 100 m below the ship would be ~202 dB re 1 µPa (rms), assuming 40 dB of spreading loss over 100 m (circular spreading). Given the narrow beam, only one pulse is likely to be received by a given animal. The received energy from a single pulse of duration 5 ms would be about 179 dB 1 µPa•s, i.e., 202 dB+10 log (0.005 s). That would be below the TTS thresholds for an odontocete or pinniped exposed to a single non-impulsive sonar transmission (195 and ≥183 dB re 1 µPa•s, respectively) and even further below the anticipated PTS threshold (215 and ≥203 dB re 1 µPa•s, respectively) (Southall *et al.*, 2007). In contrast, an animal that was only 10 m below the MBES when a ping is emitted would be expected to receive a level 20 dB higher, i.e., 199 dB re 1 Pa s in the case of the EM120. That animal might incur some TTS (which would be fully recoverable), but the exposure would still be below the anticipated PTS threshold for both cetaceans and pinnipeds.

Chirp Echosounder Signals

A chirp echosounder or sub-bottom profiler will be operated from the source vessel at all times during the proposed study. Sounds from the sub-bottom profiler are very short pulses, occurring for up to 24 ms once every few seconds. Most of the energy in the sound pulses emitted by this sub-bottom profiler is at 12 kHz, and the beam is directed downward. The source level of the chirp is expected to be lower than that of the MBES. Kremser *et al.* (2005) noted that the probability of a cetacean swimming through the area exposure when an echosounder 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 sub-bottom profiler signals given their directionality and the brief period when an individual mammal is likely to be within its beam. Furthermore, in the case of most odontocetes, the sonar 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 sub-bottom profiler are likely to be similar to those for other pulsed sources if received at the same levels. However, the pulsed signals from the chirp are somewhat weaker than those from the MBES. Therefore, behavioral responses are not expected unless marine mammals are very close to the source.

Source levels of the chirp are much lower than those of the airguns and the MBES, which are discussed above. Thus, it is unlikely that the chirp 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 chirp is often 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 chirp. In the case of mammals that do not avoid the approaching vessel and its various sound sources, mitigation measures that would be applied to minimized effects of the higher-power sources would further reduce or eliminate any minor effects of the chirp.

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.) In the sections below, we describe methods to estimate ‘‘take by harassment’’, and present estimates of the numbers of marine mammals that might be affected during the proposed seismic survey in the northeast Pacific Ocean. The estimates are based on data concerning marine mammal densities (numbers per unit area) obtained during surveys off Oregon and Washington during 1996 and 2001 by NMFS Southwest Fisheries Science Center (SWFSC) and estimates of the size of the area where effects potentially could occur.

The following estimates are based on a consideration of the number of marine mammals that might be disturbed appreciably by operations with the two GI guns to be used during approximately 1275 line-km of surveys off the coast of Oregon in the northeastern Pacific Ocean. The anticipated radii of influence of the echosounders are less than those for the GI guns. It is assumed that, during simultaneous operations of the GI guns and echosounders, any marine mammals close enough to be affected by the echosounders would already be affected by the airgun. However, whether or not the GI guns are operating simultaneously with the echosounders, marine mammals are expected to exhibit no more than short-term and inconsequential responses to the echosounders, given their characteristics (e.g., narrow downward-directed beam) and other considerations described previously. Therefore, no additional allowance is included for animals that might be affected by the echosounders.

Extensive systematic aircraft- and ship-based surveys have been conducted for marine mammals offshore of Oregon and Washington (Bonnell *et al.*, 1992; Green *et al.*, 1992, 1993; Barlow, 1997, 2003; Barlow and Taylor, 2001; Calambokidis and Barlow, 2004; Barlow and Forney, 2007). The most comprehensive and recent density data available for cetacean species off slope and offshore waters of Oregon are from the 1996 and 2001 NMFS/SWFSC ‘‘ORCAWALE’’ or ‘‘CSCAPE’’ ship surveys as synthesized by Barlow and Forney (2007). The surveys were conducted up to approximately 550 km (342 mi) offshore from June or July to early November or December. Systematic, offshore, at-sea survey data for pinnipeds are more limited. The most comprehensive studies are reported by Bonnell *et al.* (1992) and Green *et al.* (1993) based on systematic aerial surveys conducted in 1989 1990 and 1992, primarily from coastal to slope waters with some offshore effort as well.

Oceanographic conditions, including occasional El Nino and La Nina events, influence the distribution and numbers of marine mammals present in the northeastern Pacific Ocean, including Oregon, resulting in considerable year-to-year variation in the distribution and abundance of many marine mammal species (Forney and Barlow, 1998; Buchanan *et al.*, 2001; Escorza-Trevino, 2002; Ferrero *et al.*, 2002; Philbrick *et al.*, 2003). Thus, for some species the densities derived from recent surveys may not be representative of the densities that will be encountered during the proposed seismic survey.

Table 3 in UTIG's application gives the average and maximum densities for each species or species group of marine mammals reported off Oregon and Washington (and used to calculate the take estimates in Table 1 here), corrected for effort, based on the densities reported for the 1996, 2001, and 2005 surveys (Barlow, 2003). The densities from these studies had been corrected, by the original authors, for both detectability bias and availability bias. Detectability bias is associated with diminishing sightability with increasing lateral distance from the trackline [f(0)]. Availability bias refers to the fact that there is less-than–100 percent probability of sighting an animal that is present along the survey trackline, and it is measured by g(0). Table 3 also includes mean density information for three of the five pinnipeds species that occur off Oregon and Washington and mean and maximum densities for one of those species, from Bonnell *et al.* (1992). Densities were not calculated for the other two species because of the small number of sightings on systematic transect surveys.

It should be noted that the following estimates of ''takes by harassment'' assume that the seismic surveys will be undertaken and completed; in fact, the planned number of line-kms has been increased by 25 percent to accommodate lines that may need to be repeated, equipment testing, etc. As is typical on offshore ship surveys, inclement weather, and equipment malfunctions may cause delays and may limit the number of useful line-kms of seismic operations that can be undertaken. Furthermore, any marine mammal sightings within or near the designated safety zones will result in the shut down of seismic operations as a mitigation measure. Thus, the following estimates of the numbers of marine mammals potentially exposed to 160 dB sounds are precautionary, and probably overestimate the actual numbers of marine mammals that might be involved. These estimates assume that there will be no weather, equipment, or mitigation delays, which is unlikely.

There is some uncertainty about the representativeness of the data and the assumptions used in the take calculations. However, the approach used here is believed to be the best available approach. Also, to provide some allowance for the uncertainties, ''maximum estimates'' as well as ''best estimates'' of the numbers potentially affected have been derived. Best and maximum estimates are based on the average and maximum estimates of densities reported by Barlow and Forney (2007) and Bonnel *et al.* (1992) described above. The estimated numbers of potential individuals exposed are based on the 160–dB re 1 µPa rms criterion for all cetaceans and pinnipeds, and also based on the 170–dB criterion for delphinids and pinnipeds only. It is assumed that marine mammals exposed to airgun sounds this strong might change their behavior sufficiently to be considered ''take by harassment''. UTIG has requested authorization for the take of the maximum estimates and NMFS has analyzed the maximum estimate for it's effect on the species or stock.

The number of different individuals that may be exposed to GI-gun sounds with received levels ≥160 dB re 1 µPa (rms) on one or more occasions can be estimated by considering the total marine area that would be within the 160 dB radius around the operating GI guns on at least one occasion. The proposed seismic lines do not run parallel to each other in close proximity, which minimizes the number of times an individual mammal may be exposed during the survey. However, it is unlikely that a particular animal would stay in the area during the entire survey. The best estimates in this section are based on the average of the densities from the 1996, 2001, and 2005 NMFS surveys, and maximum estimates are based on the higher estimate. Table 4 in UTIG's application (and used to calculate the take estimates in Table 1 here) shows the best and maximum estimates of the number of marine mammals that could potentially be affected during the seismic 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 the GI guns operations including overlap (exposures), or
- The anticipated minimum area to be ensonified to that level during GI gun operations excluding overlap (individuals).

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 or 170 dB buffer around each seismic line and then calculating the total area within the buffers. Areas where overlap occurred (because of intersecting lines) were included only once to determine the minimum area expected to be ensonified.

Applying the approach described above, approximately 189 km^2 would be within the 160 dB isopleth on one or more occasions during the survey, whereas approximately 1,391 km^2 is the area ensonified when overlap is included. 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 may be underestimated. However, this will be offset to some degree by the fact that the 160 dB (and other) distances assumed here actually apply to a pair of slightly larger GI guns to be used in the project. In addition, the approach assumes that no cetaceans will move away or toward the trackline as the *Thompson* approaches in response to increasing sound levels prior to the time the levels reach 160 dB. Another way of interpreting the estimates that follow is that they represent the number of individuals that are expected (in the absence of a seismic program) to occur in the waters that will be exposed to ≥160 dB re 1 µPa (rms).

The ''best estimate'' of the number of individual cetaceans that might be exposed to seismic sounds with received levels ≥160 dB re 1 µPa (rms) during the surveys is 42 (Table 4 in UTIG's application). The total does not include any endangered or beaked whales. Dall's porpoise is estimated to be the most common species exposed; the best estimates for those species are 28 (Table 4 in UTIG application). The best estimate of the number of exposures of cetaceans to seismic sounds with received levels ≥160 dB re 1 µPa (rms) during the survey is 536, including 1 humpback whale, 1 fin whale, and 2 sperm whales. Dall's porpoise was exposed most frequently, with a best estimate of 209 exposures.

The ''maximum estimate'' column in Table 4 of UTIG's application shows an estimated total of 85 cetaceans that might be exposed to seismic sounds ≥160 dB during the surveys. In most cases, those estimates are based on survey data, as described above. For endangered species, the 'maximum estimate' is the mean group size (from Barlow and Forney, in press) in cases where the calculated maximum number of individuals exposed was between 0.05 and the mean group size (humpback, fin, blue, and sperm whales). The numbers for which take authorization is requested, given in the far right column of Table 4 in UTIG's application are the maximum estimates. Based on the abundance numbers given in UTIG's application and Table 1 here for non-listed cetacean species, NMFS believes that the estimated take numbers are small relative to the stock sizes for these species (i.e., no more than 0.4 percent of any species).

The best and maximum estimates of the numbers of exposures to ≥170 dB for all delphinids during the surveys are 9 and 13, respectively. Corresponding estimates for Dall's porpoise are 17 and 29. The estimates are based on the predicted 170 dB radii around the GI guns to be used during the study and are considered to be more realistic estimates of the number of individual delphinids and Dall's porpoises that may be affected.

Only two of the five pinniped species discussed in Section III of UTIG's application the northern fur seal and the northern elephant seal are likely to occur in the offshore and slope waters; the other three species of pinnipeds known to occur regularly off Oregon and Washington the California sea lion, Steller sea lion, and harbor seal are infrequent there. This conclusion is based on results of extensive aerial surveys conducted from the coast to offshore waters of Oregon and Washington (Bonnell *et al.*, 1992; Green *et al.*, 1993; Buchanan *et al.*, 2001; Carretta *et al.*, 2007). However, the available density data are probably not truly representative of densities that could be encountered during surveys, as the data were averaged over a number of months and over coastal, shelf, slope, and offshore waters. These factors strongly influence the densities of these pinnipeds at sea, as all pinnipeds off Oregon and Washington exhibit seasonal and/or inshore offshore movements largely related to breeding and feeding (Bonnell *et al.*, 1992; Buchanan *et al.*, 2001; Carretta *et al.*, 2007).

Most pinnipeds, like delphinids, seem to be less sensitive to airgun sounds than are mysticetes. Thus, the numbers of pinnipeds likely to be exposed to received levels ≥170 dB re 1 μPa (rms) were also calculated, based on the estimated 170–dB radii in Table 1 of UTIG's application. For operations in deep water, the estimated 160 and 170 dB radii are very likely over-estimates of the actual 160- and 170–dB distances (Tolstoy *et al.*, 2004a,b). Thus, the resulting estimates of the numbers of pinnipeds exposed to such levels may be overestimated.

The methods described previously for cetaceans were also used to calculate exposure numbers for the one pinniped species likely to be in the survey area and whose densities were estimated by Bonnell *et al.* (1992). Based on the ''best'' densities, two northern fur seals are considered likely to be exposed to GI gun sounds ≥160 dB re 1 μPa (rms). The ''Maxim Estimate'' column in Table 4 of UTIG's application shows an estimated 19 northern fur seals that could be exposed to GI airgun sounds ≥160–dB or ≥170dB re 1 μPa (rms), respectively, during the survey. Also included are low maximum estimates for the northern elephant seals, a species that likely would be present but whose density was not calculated because of the small number of sightings on systematic transect surveys. The numbers of which ''take authorization'' is requested, given in the far right column of Table 4 of UTIG's application, are based on the maximum 160 dB estimates.

The proposed UTIG seismic survey in the northeastern Pacific Ocean involves towing two GI guns that introduce pulsed sounds into the ocean, as well as echosounder operations. A towed P-Cable system will be deployed to receive and record the returning signals. Routine vessel operations, other than the proposed GI gun operations, are conventionally assumed not to affect marine mammals sufficiently to constitute ''taking.'' No ''taking'' of marine mammals is expected in association with operations of the echosounders given the considerations discussed in section IV(1)(b) of UTIGS's application, i.e., sounds are beamed downward, the beam is narrow, and the pulses are extremely short.

Strong avoidance reactions by several species of mysticetes to seismic vessels have been observed at ranges up to 6–8 km (3.7–5 mi) and occasionally as far as 20–30 km (12.4–18.6 mi) from the source vessel when much larger airgun arrays have been used. However, reactions at the longer distances appear to be atypical of most species and situations and in any case apply to larger airgun systems than will be used in this project. If mysticetes are encountered, the numbers estimated to occur within the 160 dB isopleth in the survey area are expected to be very low. In addition, the estimated numbers presented in Table 4 of UTIG's application are considered overestimates of actual numbers because the estimated 160 and 170 dB radii used here are probably overestimates of the actual 160 and 170 dB radii at deep-water locations such as the present study areas (Tolstoy *et al.*, 2004a,b). In addition, the radii were based on a larger airgun source than the one proposed for use during the present survey.

Odontocete reactions to seismic pulses, or at least the reactions of delphinids and Dall's porpoises are expected to extend to lesser distances than are those of mysticetes. Odontocete low-frequency hearing is less sensitive than that of mysticetes, and delphinids and Dall's porpoises are often seen from seismic vessels. In fact, there are documented instances of dolphins and Dall's porpoises approaching active seismic vessels. However, delphinids and porpoises (along with other cetaceans) sometimes show avoidance responses and/or other changes in behavior when near operating seismic vessels.

Taking into account the mitigation measures that are proposed in UTIG's application, effects on cetaceans are generally expected to be limited to avoidance of the area around the seismic operation and short-term changes in behavior, falling within the MMPA definition of ''Level B harassment.'' Furthermore, the estimated numbers of animals potentially exposed to sound levels sufficient to cause appreciable disturbance are very low percentages of the regional population sizes. The best estimates of the numbers of individual cetaceans (33 for all species combined) that would be exposed to sounds ≥160 dB re 1 μPa (rms) during the proposed survey represent, on a species-by-species basis, no more than 0.11 pertcent of the regional populations (see Table 4 of UTIG's application). Dall's porpoise is the cetacean species with the highest estimated number of individuals exposed to ≥160 dB.

Varying estimates of the numbers of marine mammals that might be exposed to the GI guns sounds during the proposed summer 2008 seismic survey in the northeastern Pacific Ocean have been presented, depending on the specific exposure criterion (≥160 or ≥170 dB) and density criterion used (best or maximum). The request ''take authorization'' for each species is based on the estimated maximum number of individuals that might be exposed to ≥160 re 1 μPa (rms). That figure likely overestimates (in most cases by a large margin) the actual number of animals that will be exposed to and will react to the seismic sounds. The reasons for that conclusion are outlined above. The relatively short-term exposures are unlikely to result in any long-term negative consequences for the individuals or their populations.

The many cases of apparent tolerance by cetaceans of seismic exploration, vessel traffic, and some other human activities show that co-existence is possible. Mitigation measures such as controlled speed, course alteration, look outs, non-pursuit, and shut downs when marine mammals are seen within defined ranges should further reduce short-term reactions, and minimize any effects on hearing sensitivity. In all cases, the effects are expected to be short-term, with no lasting biological consequence.

Only two of the five pinniped species discussed in Section III of UTIG's application, the northern fur seal and northern elephant seal, are likely to occur in the offshore and slope waters of the study area. A best estimate of a single northern fur seal could be exposed to airgun sounds with received levels ≥160 dB re 1 μPa (rms). The numbers for which ''take authorization'' is requested are given in the far right column of Table 4 of UTIG's application. As for cetaceans, the estimated numbers of pinnipeds that may be exposed to received levels ≥160 dB are probably overestimates of the actual numbers that will be affected, and are very small proportions of the respective population sizes.

Potential Effects on Habitat

The proposed seismic surveys will not result in any permanent impact on habitats used by marine mammals or to the food sources they use. The main impact issue associated with the proposed activity will be temporarily elevated noise levels and the associated direct effects on marine mammals, as discussed above.

One of the reasons for the adoption of airguns as the standard energy source for marine seismic surveys was that, unlike explosives, they have not been associated with any appreciable fish kills. However, the existing body of information relating to the impacts of seismic surveys on marine fish (see Appendix B of UTIG's application) and invertebrate species is very limited. The various types of potential effects of exposure to seismic on fish and invertebrates can be considered in three categories: (1) pathological, (2) physiological, and (3) behavioral. Pathological effects include lethal and temporary or permanent sub-lethal damage to the animals, physiological effects include temporary and permanent primary and secondary stress responses, such as changes in levels of enzymes and proteins. Behavioral effects refer to temporary and categories are interrelated in complex ways. For example, it is possible that certain physiological and behavioral changes could potentially lead to the ultimate pathological effect on individual animals (i.e., mortality).

The specific received levels at which permanent adverse effects to fish potentially could occur are little studies and largely unknown. Furthermore, available information on the impacts of seismic surveys on marine fish and invertebrates is from studies of individuals or portions of a population; there have been no studies at the population scale. Thus, available information provides limited insight on possible real world effects at the ocean or population scale. This makes drawing conclusions about impacts on fish problematic because ultimately, the most important aspect of potential impacts relates to how exposure to seismic survey sound affects marine fish populations and their viability, including their availability to fisheries.

The following sections provide an general overview of the available information that exists on the effects of exposure to seismic surveys and other anthropogenic sound as relevant to fish and invertebrates. The information comprises results from scientific studies of varying degrees of soundness and some anecdotal information.

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 B of UTIG's application). For a given sound to result in hearing loss, the sound must exceed, by some specific amount, the hearing threshold of the fish for that sound (Popper, 2005). The consequences of temporary or permanent hearing loss in individual fish on a fish population is unknown; however, it likely depends on the number of individuals affected and whether critical behaviors involving sound (e.g., predator avoidance, prey capture, orientation and navigation, reproduction, etc.) are adversely affected.

Little is known about the mechanisms and characteristics of damage to fish that may be inflicted by exposure to seismic survey sounds. Few data have been presented in the peer-reviewed scientific literature. There are two valid papers with proper experimental methods, controls, and careful pathological investigation implicating sounds produced by actual seismic survey airguns with adverse anatomical effects. One such study indicated anatomical damage and the second indicated TTS in fish hearing. McCauley *et al.* (2003) found that exposure to airgun sound caused observable anatomical damage to the auditory maculae of ''pink snapper'' (*Pagrus auratus*). This damage in the ears had not been repaired in fish sacrificed and examined almost two months after exposure. On the other hand, Popper *et al.* (2005) documented only TTS (as determined by auditory brainstem response) in two of three fishes from the Mackenzie River Delta. This study found that broad whitefish (*Coregonus nasus*) that received a sound exposure level of 177 dB re 1 $\mu Pa^2 \bullet s$ showed no hearing loss. During both studies, the repetitive exposure to sound was greater than would have occurred during a typical seismic survey. However, the substantial low-frequency energy produced by the airgun arrays [less than approximately 400 Hz in the study by McCauley *et al.* (2003) and less than approximately 200 Hz in Popper *et al.* (2005)] likely did not propagate to the fish because the water in the study areas was very shallow (approximately 9 m, 29.5 ft, in the former case and <2 m, 6.6 ft, in the latter). Water depth sets a lower limit on the lowest sound frequency that will propagate (the ''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, 1952; 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.*, 2004). For the proposed survey, any injurious effects on fish would be limited to very short distances, especially considering the small source planned for use in this project (two 40–60–in^3 GI guns). 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, 2003; 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).

Some studies have reported that mortality of fish, fish eggs, or larvae can occur close to seismic sources (Kostyuchenko, 1973; Dalen and Knutsen, 1986; Booman *et al.*, 1996; Dalen *et al.*, 1996). Some of the reports claimed seismic effects from treatments quite different from actual seismic survey sounds or even reasonable surrogates. Saetre and Ona (1996) applied a ''worst-case scenario'' mathematical model to investigate the effects of seismic energy on fish eggs and larvae and concluded that mortality rates caused by exposure to seismic are so low compared to natural mortality that the impact of seismic surveying on recruitment to a fish stock must be regarded as insignificant.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 suggested that seismic survey sound has a limited pathological impact on early developmental stages of crustaceans (Pearson *et al.*, 1994; Christian *et al.*, 2003; DFO, 2004). However, the impacts appear to be either temporary or insignificant compared to what occurs under natural conditions. Controlled field experiments on adult crustaceans (Christian *et al.*, 2003, 2004; DFO, 2004) and adult cephalopods (McCauley *et al.*, 2000a,b) exposed to seismic survey sound have not resulted in any significant pathological impacts on the animals. It has been suggested that exposure to commercial seismic survey activities has injured giant squid (Guerra *et al.*, 2004), but there is no evidence to support such claims.

Physiological Effects – Physiological effects refer to cellular and/or biochemical responses of fish 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 B of UTIG's application for more information on the effects of airgun sounds on marine fish). Such stress could potentially affect animal populations by reducing reproductive capacity and adult abundance and increasing mortality.

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 sound) on fish behavior have been conducted on both uncaged and caged individuals (e.g., Chapman and Hawkings, 1969; Pearson *et al.*, 1992; Santulli *et al.*, 1999, Wardle *et al.*, 2001, Hassel *et al.*, 2003). Typically, in these studies fish exhibited 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 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; Løkkeborg, 1991; Skalski *et al.*, 1992; Engas *et al.*, 1996). In other airgun experiments, there was no change in 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 the Slotte *et al.* (2004).

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. Again, this study will employ a sound source that will generate low energy levels. Whereas egg and larval stages are not able to escape such exposures, juveniles and adults most likely would avoid it. In the case of eggs and larvae, it is likely that the numbers adversely affected by such exposure would not be that different from those succumbing to natural mortality. Limited data regarding physiological impacts on fish and invertebrates indicate that these impacts are short term and are most apparent after exposure at close range.

The proposed seismic program for 2008 is predicted to have negligible to low physical effects on the various life stages of fish and invertebrates for its relatively short duration (approximately 150 total hours at each of the three sites off the coast of Oregon) and approximately 975 km (606 mi) extent. Therefore, physical effects of the proposed program on the fish and invertebrates would be not significant.

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

Studies investigating the possible effects of seismic energy on fish and invertebrate behavior have been conducted on both uncaged and caged animals (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; Løkkeborg, 1991; Skalski *et al.*, 1992; Engas *et al.*, 1996). In other airgun experiments, there was no change in catch per unit effort of fish when airgun pulses were emitted, particularly in the immediate vicinity of the seismic survey (Pickett *et al.*, 1994; La Bella *et al.*, 1996). For some species, reductions in catch may have resulted from a change in behavior of the fish (e.g., a change in vertical or horizontal distribution) as reported in Slotte *et al.* (2004).

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.

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Effects on Invertebrates

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

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

The following sections provide a synopsis of available information on the effects of exposure to seismic survey sound on species of decapod crustaceans and cephalopods, the two taxonomic groups of invertebrates on which most such studies have been conducted. The available information is from studies with variable degrees of scientific soundness and from anecdotal information.

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

Some studies have suggested that seismic survey sound has a limited pathological impact on early developmental stage of crustaceans (Pearson *et al.*, 1994; Christian *et al.*, 2003; DFO, 2004). However, the impacts appear to be either temporary or insignificant compared to what occurs under natural conditions. Controlled field experiments on adult crustaceans (Christian *et al.*, 2003, 2004; DFO 2004) and adult cephalopods (McCauley *et al.*, 2000a,b) exposed to seismic survey sound have not resulted in any significant pathological impacts on animals. It has been suggested that exposure to commercial seismic survey activities has injured giant squid (Guerra *et al.*, 2003), but there is no evidence to support such claims.

Physiological Effects – Physiological effects refer mainly to biochemical responses by marine invertebrates to acoustic stress. Such stress potentially cold affect invertebrate populations by increasing mortality or reducing reproductive success. Any primary and secondary stress responses (i.e. changes in haemolymph levels of enzymes, proteins, etc.) of crustaceans after exposure seismic survey sounds appear to be temporary (hours to days) in studies done to date (Payne *et al.*, 2007). The periods necessary for these biochemical changes to return to normal are variable and depend on numerous aspects of the biology of the species and of the sound stimulus.

Behavioral Effects – There is increasing interest in assessing the possible direct and indirect effects of seismic and other sounds on invertebrate behavior, particularly in relation to the consequences for fisheries. Changes in behavior could potentially affect such aspects as reproductive success, distribution, susceptibility to predation, and catchability by fisheries. Studies investigating the possible behavioral effects of exposure to seismic survey sound on crustaceans and cephalopods have been conducted on both uncaged and caged animals. In some cases, invertebrates exhibited startle responses (e.g., squid in McCauley *et al.*, 2000a,b). In other cases, no behavioral impacts were noted (e.g., crustaceans in Christian *et al.*, 2003, 2004; DFO, 2004). Ther have been anecdotal reports of reduced catch rates of shrimp shortly after exposure to seismic survey; however, other studies have not observed any significant changes in shrimp catch rate (Andriguetto-Filho *et al.*, 2005). 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).

During the proposed study, only a small fraction of the available habitat would be ensonified at any given time, and fish and invertebrate 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 duration (total of approximately 150 hours) and 975 km (606 mi) extent.

Because of the reasons noted above and the nature of the proposed activities (small airgun and limited duration), 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.

The effects of the proposed activity on marine mammal habitats and food resources are expected to be negligible, as described above. A small minority of the marine mammals that are present near the proposed activity may be temporarily displaced as much as a few kilometers by the planned activity. During the proposed survey, marine mammals will be distributed according to their habitat preferences, in shelf, slope, and pelagic waters.

Concentrations of marine mammals and/or marine mammal prey species are not expected to occur in or near the proposed study area, and that area does not appear to constitute an area of localized or critical feeding, breeding, or migration for any marine mammal species. The proposed activity is not expected to have any habitat-related effects that could cause significant or long-term consequences for individual marine mammals or their populations, because operations at the various sites will be limited in duration.

Proposed Monitoring

Vessel-based marine mammal visual observers (MMVOs) will be aboard the seismic source vessel and will watch for marine mammals near the vessel during all daytime GI gun operations and during start-ups of the gun at night. MMVOs will also watch for marine mammals near the seismic vessel for at least 30 minutes prior to the start of GI gun operations after an extended shut down. When feasible, MMVOs will also make observations during daytime periods when the seismic system is not operating for comparison of sighting rates and behavior with vs. without GI guns operations. Based on MMVO observations, the GI guns will be shut down when marine mammals are observed within or about to enter a designated exclusion zone (EZ; safety radius). The EZ is a region in which a possibility exists of adverse effects on animal hearing or other physical effects.

MMVOs will be appointed by the academic institution conducting the research cruise, with NMFS Office of Protected Resources concurrence. A total of three MMVOs are planned to be aboard the source vessel. At least one MMVO will monitor the EZ during daytime GI guns operations and any night-time startups. MMVOs will normally work in daytime shifts of 4 hours duration or less. The vessel crew will also be instructed to assist in detecting marine mammals.

The *Thompson* will serve as the platform from which MMVOs will watch for marine mammals before and during the GI guns operations. Two locations are likely as observation stations onboard the *Thompson*. At one station on the bridge, the eye level will be approximately 13.8 m (45.3 ft) above sea level and the location will offer a good view around the vessel (approximately 310 degrees for one observer and a full 360 degrees when two observers are stationed at different vantage points). A second observation station is the 03 deck where the observer's eye level will be approximately 10.8 m (35.4 ft) above sea level. The 03 deck offers a view of 330° for two observers.

Standard equipment for MMVOs will be 7 x 50 reticle binoculars and optical range finders. At night, night-vision devices (NVDs) will be available. Vessel lights and/or NVDs are useful in sighting some marine mammals at the surface within a short distance from the ship (within the EZ for the two GI guns). The observers will be in wireless communication with ship's officers on the bridge and scientists in the vessel's operations laboratory, so they can advise promptly of the need for avoidance maneuvers or GI guns shut down.

MMVOs will record data to estimate the numbers of marine mammals exposed to various received sound levels and to document any apparent disturbance reactions. Data will be used to estimate the numbers of mammals potentially ''taken'' by harassment (as defined in the MMPA). They will also provide the information needed to order a shutdown of the two GI guns when a marine mammal is within or near the EZ. When a mammal sighting is made, the following information about the sighting will be recorded:

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

(2) Time, location, heading, speed, activity of the vessel (shooting or not), sea state, visibility, and sun glare.

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

All marine mammal observations and information regarding airgun operations 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 shutting down the GI guns.

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

(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.

Mitigation

Mitigation and monitoring measures proposed to be implemented for the proposed seismic survey have been developed and refined during previous SIO and L-DEO seismic studies and associated EAs, IHA applications, and IHAs. The mitigation and monitoring measures described herein represent a combination of the procedures required by past IHAs for other SIO and L-DEO projects. The measures are described in detail below.

Mitigation measures that are proposed to be implemented include (1) vessel speed or course alteration, provided that doing so will not compromise operational safety requirements, (2) GI guns ramp up and shut down, and (3) minimizing approach to slopes and submarine canyons, if possible, because of sensitivity of beaked whales. Two other standard mitigation measures airgun array power down are not possible because only two, low-volume GI guns will be used for the surveys.

Speed or Course Alteration – If a marine mammal is detected outside the EZ but is likely to enter it based on relative movement of the vessel and the animal, then if safety requirements allow, the vessel speed and/or direct course will be adjusted to minimize the likelihood of the animal entering the EZ. Major course and speed adjustments are often impractical when towing long seismic streamers and large source arrays, but are possible in this case because only two GI guns and a short P-Cable system with streamers will be used. If the animal appears likely to enter the EZ, further mitigative actions will be taken, i.e. either further course alterations or shut down of the airgun.

Ramp-up Procedures – A ''ramp-up'' procedure will be followed when the airguns begin operating after a period without airgun operations. The two GI guns will be added in sequence 5 minutes apart. During ramp-up procedures, the safety radius for the two GI guns will be maintained.

Shut-down Procedures – If a marine mammal is within or about to enter the EZ for the two GI guns, it will be shut down immediately. Following a shut down, the GI guns 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; (2) has not been seen within the EZ for 10 minutes in the case of small odontocetes and pinnipeds; or (3) has not been seen within the EZ for 15 minutes in the case of mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, and beaked whales.

The 10– and 15–min periods specified in (2) and (3), above, are shorter than would be used in a large-source project given the small 180 and 190 dB (rms) radii for the two GI guns. GI gun operations will be able to resume following a shut-down during either the day or night, as the relatively small exclusion zone(s) will normally be visible even at night (see section VIII of UTIG's application).

Minimize Approach to Slopes and Submarine Canyons – Although sensitivity of beaked whales to airguns is not specifically known, they appear to be sensitive to other sound sources (e.g., mid-frequency sonar; see section IV of UTIG's application). Beaked whales tend to concentrate in continental slope areas, and in areas where there are submarine canyons. Avoidance of airgun operations over or near submarine canyons where practicable has become a standard mitigation measure, but there are no submarine canyons within or near the study area. Also, airgun operations are not planned over slope sites during the proposed survey.

Reporting

A report will be submitted to NMFS within 90 days after the end of the cruise. The report will describe the operations that were conducted and sightings of the marine mammals that were detected near the operations. The report will be submitted to NMFS, providing full documentation of methods, results, and interpretation pertaining to all monitoring. The 90–day report will summarize the dates and locations of seismic operations, all marine mammal and turtle 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.

ESA

Under section 7 of the ESA, the NSF has begun informal consultation on this proposed seismic survey. NMFS will also consult informally 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 Planned Low-Energy Marine Seismic Survey by the Scripps Institution of Oceanography in the Northeast Pacific Ocean, September 2007. NMFS adopted NSF's 2007 EA and will conducted a separate NEPA analysis and prepare a Supplemental EA, prior to making a determination on the issuance of the IHA.

Preliminary Determinations

NMFS has preliminarily determined that the impact of conducting the seismic survey in the northeast Pacific Ocean may result, at worst, in a temporary modification in behavior (Level B Harassment) of small numbers of ten species of marine mammals. Further, this activity is expected to result in a negligible impact on the affected species or stocks. The provision requiring that the activity not have an unmitigable adverse impact on the availability of the affected species or stock for subsistence uses does not apply to this proposed action as there are no subsistence users within the geographic area of the proposed project.

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 marine mammals would have to be closer than either 104 m (341.1 ft) in intermediate depths or 69 m (226.3 ft) in deep water from the vessel to be exposed to levels of sound (180 dB) believed to have even a minimal chance of causing TTS; and (3) the likelihood that marine mammal detection ability by trained observers is high at that short distance from the vessel. As a result, no take by injury or death is anticipated and the potential for temporary or permanent hearing impairment is very low and will be avoided through the incorporation of the proposed mitigation measures.

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

Proposed Authorization

As a result of these preliminary determinations, NMFS proposes to issue an IHA to UTIG for conducting a low-energy seismic survey in the northeastern Pacific Ocean during June-July, 2008, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated.

Dated: May 16, 2008.

James H. Lecky,

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

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COMMODITY FUTURES TRADING COMMISSION

Energy Markets Advisory Committee Meeting

This is to give notice that the Commodity Futures Trading Commission's Energy Markets Advisory Committee will conduct a public meeting on Tuesday, June 10, 2008. The meeting will take place in the first floor hearing room of the Commission's Washington, DC headquarters, Three Lafayette Centre, 1155 21st Street, NW., Washington, DC 20581 from 1 p.m. to 4:30 p.m. The purpose of the meeting is to discuss energy market issues. The meeting will be chaired by Walter L. Lukken, who is Acting Chairman of the Commission and Chairman of the Energy Markets Advisory Committee.

The agenda will consist of the following:

(1) Call to Order and Introduction;
(2) Current Market and Regulatory Developments;
(3) Market Transparency;
(4) Energy Market Best Practices;
(5) Discussion of Future Meetings and Topics;
(6) Adjournment.

The meeting is open to the public. Any member of the public who wishes to file a written statement with the committee should mail a copy of the statement to the attention of: Energy Markets Advisory Committee, c/o Acting Chairman Walter L. Lukken, Commodity Futures Trading Commission, Three Lafayette Centre, 1155 21st Street, NW., Washington, DC 20581, before the meeting. Members of the public who wish to make oral statements should inform Acting Chairman Lukken in writing at the foregoing address at least three business days before the meeting. Reasonable provision will be made, if time permits, for oral presentations of no more than five minutes each in duration.