Reef Associated Plants and Invertebrates FMP.

Alternative 1: No Action. Do not amend the current framework measures for the Corals FMP.

Alternative 2: Amend the framework procedures for the Coral FMP to provide a mechanism to expeditiously adjust the following reference points and management measures through framework action:

a. Quota Requirements.
b. Seasonal Closures.
c. Area Closures.
d. Fishing Year.
e. Trip/Bag Limit.
f. Size Limits.
g. Gear Restrictions or Prohibitions.
h. Fishery Management Units (FMUs).
i. Total Allowable Catch (TAC).
j. Annual Catch Limits (ACLs).
k. Accountability Measures (AMs).
l. Annual Catch Targets (ACTs).
m. Maximum Sustainable Yield (MSY).
n. Optimum Yield (OY).
o. Minimum Stock Size Threshold (MSST).
p. Maximum Fishing Mortality Threshold (MFMT).
q. Overfishing Limit (OFL).
r. Acceptable Biological Catch (ABC) control rules.
s. Actions To Minimize the Interaction of Fishing Gear With Endangered Species or Marine Mammals.

Alternative 3: Amend the framework procedures for the Coral FMP to provide the Council with a mechanism to expeditiously adjust a subset of management measures outlined in Alternative 2.

Written comments can be sent to the Council not later than August 15, 2011, or submitted at the Council meeting that will take place at La Concha hotel, in San Juan, Puerto Rico on August 30–31, 2011.

Special Accommodations

These meetings are physically accessible to people with disabilities. For more information or request for sign language interpretation and other auxiliary aids, please contact Mr. Miguel A. Rolón, Executive Director, Caribbean Fishery Management Council, 268 Muñoz Rivera Avenue, Suite 1108, San Juan, Puerto Rico 00918–1920, telephone (787) 766–5926, at least five days prior to the meeting date.

Dated: July 8, 2011.

Tracey L. Thompson,

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

[FR Doc. 2011–17674 Filed 7–13–11; 8:45 am]

BILLING CODE 3510–22–P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XA568

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to a Marine Geophysical Survey in the Arctic Ocean, September–October 2011

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

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

SUMMARY: NMFS has received an application from the University of Alaska Geophysics Institute (UAGI) for an Incidental Harassment Authorization (IHA) to take marine mammals, by harassment, incidental to conducting a marine geophysical seismic survey in the Arctic Ocean during September–October 2011. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an IHA to UAGI to take, by Level B harassment only, several species of marine mammals during the specified activity.

DATES: Comments and information must be received no later than August 15, 2011.

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. The mailbox address for providing e-mail comments is *ITP.Nachman@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.

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

A copy of the application 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.*

The National Science Foundation (NSF), which is providing funding to UAGI to conduct the survey, has prepared a draft ''Environmental Assessment of a Marine Geophysical Survey by the *R/V Marcus G. Langseth* in the Arctic Ocean, September–October 2011,'' prepared by LGL Ltd., Environmental Research Associates (LGL), on behalf of UAGI and NSF, which is also available at the same internet address. Documents cited in this notice may also be viewed, by appointment, during regular business hours, at the aforementioned address.

FOR FURTHER INFORMATION CONTACT: Candace Nachman, Office of Protected Resources, NMFS, (301) 427–8401.

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 small numbers 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 for incidental takings 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. 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 issue or deny the authorization.

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

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

Summary of Request

NMFS received an application on March 4, 2011, from UAGI for the taking, by harassment, of marine mammals incidental to conducting a marine geophysical seismic survey in the Arctic Ocean. NMFS reviewed UAGI's application and identified a number of issues requiring further clarification. After addressing comments from NMFS, UAGI modified its application and submitted a revised application on May 10, 2011. The May 10, 2011, application is the one available for public comment (see **ADDRESSES**) and considered by NMFS for this proposed IHA.

UAGI proposes to conduct a 2D seismic survey in the Arctic Ocean, Chukchi Sea, in both international waters and within the U.S. Exclusive Economic Zone (EEZ) in water depths ranging from 30–3,800 m (98–12,467 ft). UAGI plans to conduct the proposed seismic survey from September 5 through October 9, 2011, which includes vessel transit time from Dutch Harbor.

UAGI plans to use one source vessel, the R/V *Marcus G. Langseth* (*Langseth*) and a seismic airgun array to collect seismic reflection data across the transition from the Chukchi Shelf to the Chukchi Borderland to define the apparent change in structure between two large continental blocks. In addition to the proposed operations of the seismic airgun array, UAGI intends to operate a multibeam echosounder (MBES) and a sub-bottom profiler (SBP) continuously throughout the survey. A 75-kilohertz (kHz) acoustic Doppler current profiler (ADCP) may also be used.

Acoustic stimuli (*i.e.,* increased underwater sound) generated during the operation of the seismic airgun array may have the potential to cause a short-term behavioral disturbance for marine mammals in the proposed survey area. This is the principal means of marine mammal taking associated with these activities, and UAGI has requested an authorization to take 11 species of marine mammals by Level B harassment. These species are: Bowhead whale; gray whale; humpback whale; minke whale; fin whale; beluga whale; killer whale; bearded seal; spotted seal; ringed seal; and ribbon seal. Take is not expected to result from the use of the MBES or SBP, for reasons discussed later in this notice; nor is take expected to result from collision with the vessel because it is a single vessel moving at a relatively slow speed during seismic acquisition within the survey, for a relatively short period of time (approximately 35 days). It is likely that any marine mammal would be able to avoid the vessel.

Description of the Specified Activity

UAGI's survey is proposed to occur in the area 72.5–77° N. and 160–175° W. in international waters and within the U.S. EEZ (see Figure 1 in UAGI's application). The project is scheduled to occur from September 5–October 9, 2011. Some minor deviation from these dates is possible, depending on logistics and weather. Therefore, NMFS is proposing to make the IHA valid from September 5–October 23, 2011. The vessel will not be able to remain in the area once ice begins to form, as the *Langseth* is not an icebreaker. The *Langseth* would depart from Dutch Harbor on September 5, 2011, and sail northeast to arrive at approximately 72.5° N., 162° W., where the seismic survey will begin, more than 200 km (124 mi) from Barrow. The entire cruise would last for approximately 35 days, and it is estimated that the total seismic survey time will be approximately 25 days, depending on ice conditions. Seismic survey work is scheduled to terminate near the starting point at approximately 72.4° N., 164° W. on October 6; the vessel would then sail south to Dutch Harbor for arrival on October 9. There could be extra days of seismic shooting, if the collected data are of substandard quality.

The proposed survey will include collection of seismic reflection data across the transition from the Chukchi Shelf to the Chukchi Borderland to define the apparent change in structure between two large continental blocks. This study will test existing tectonic models and develop new constraints on the development of the Amerasian Basin and will substantially advance our understanding of the Mesozoic history of this basin. In addition, these data will enable the formulation of new tectonic models for the history of this region, which will improve our understanding of the surrounding continents.

The survey will involve one source vessel, the *Langseth,* which is operated by Lamont-Doherty Earth Observatory (L–DEO), a part of Columbia University, under a cooperative agreement with NSF. The *Langseth* will deploy an array of 10 airguns (1,830 in^3) as an energy source at a tow depth of 6 m (19.7 ft). The receiving system will consist of a 2-km (1.2-mi) long hydrophone streamer. As the airgun array is towed along the survey lines, the hydrophone streamer will receive the returning acoustic signals and transfer the data to the on-board processing system. In addition, at least 72 sonobuoys will be deployed in order to record seismic refraction data. The *Langseth* will be avoiding the ice edge, and an ice expert will be available to provide daily guidance and to predict ice movements.

The proposed program will consist of a total of approximately 5,502 km (3,419 mi) of survey lines, not including transits to and from the survey area when airguns will not be in use (see Figure 1 in UAGI's application). Water depths within the study area range from approximately 30–3,800 m (98–12,467). Just over half of the survey effort (55%) will occur in water 100–1,000 m (328–3,281 ft) deep, 32% will take place in water >1,000 m (3,281 ft) deep, and 13% will occur in water depths <100 m (328 ft). There will be additional seismic operations in the survey area associated with turns, airgun testing, and repeat coverage of any areas where initial data quality is sub-standard. In addition to the operations of the airgun array, a Kongsberg EM 122 MBES and a Knudsen 320B SBP will also be operated from the *Langseth* continuously throughout the cruise. A 75-kHz ADCP may also be used.

All planned geophysical data acquisition activities will be conducted by L–DEO with on-board assistance by the scientists who have proposed the study. The Principal Investigator is Dr. Bernard Coakley of UAGI. The vessel will be self-contained, and the crew will live aboard the vessel for the entire cruise.

Vessel Specifications

The *Langseth* will tow the 10-airgun array along predetermined lines. The vessel will also tow the hydrophone streamer and deploy the sonobuoys. When the *Langseth* is towing the airgun array, as well as the hydrophone streamer, the turning rate of the vessel while the gear is deployed is limited. Thus, the maneuverability of the vessel is limited during operations with the streamer.

The vessel has a length of 71.5 m (235 ft); a beam of 17 m (56 ft); a maximum draft of 5.9 m (19 ft); and a gross tonnage of 3,834. The *Langseth* was designed as a seismic research vessel with a propulsion system designed to be as quiet as possible to avoid interference with the seismic signals emanating from the airgun array. The ship is powered by two 3,550 horsepower (hp) Bergen BRG–6 diesel engines which drive two propellers directly. Each propeller has four blades, and the shaft typically rotates at 750 revolutions per minute. The vessel also has an 800 hp bowthruster, which is not used during seismic acquisition. The *Langseth's* operation speed during seismic acquisition is typically 7.4 to 9.3 km per hour (hr) (km/hr) (4 to 5 knots [kts]). When not towing seismic survey gear, the *Langseth* typically cruises at 18.5 km/hr (10 kts). The *Langseth* has a range of 25,000 km (15,534 mi) (the distance the vessel can travel without refueling).

The *Langseth* is not an ice-strengthened vessel and must especially consider safety-of-operations while towing a significant amount of equipment behind the vessel; it therefore cannot operate in ice conditions that would pose serious hazards to the vessel and crew. After consideration of the operational challenges, however, NSF and L–DEO concluded that the *Langseth* would be able to support the activity if it remained in ice-free waters. An ice expert would be available to help provide guidance during any operations.

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

Acoustic Source Specifications

(1) Airgun Array

During the survey, the airgun array to be used will consist of 10 airguns, with a total volume of approximately 1,830 cubic inches (in^3). The airgun array will consist of a mixture of Bolt 1500LL and Bolt 1900LLX airguns, set in a typical configuration of one of the *Langseth's* four linear arrays or ''strings'' (see Figure 2 in UAGI's application); the first and last airguns in the strings are spaced 16 m (52 ft) apart. The airgun array will be towed approximately 100 m (328 ft) behind the *Langseth.* The shot interval will be 15 seconds (s). The firing pressure of the array is 1,950 pounds per square inch. During firing, a brief (approximately 0.1 s) pulse of sound is emitted. The airguns will be silent during the intervening periods.

The tow depth of the array will be 6 m (19.7 ft). Because the actual source is a distributed sound source (10 airguns) rather than a single point source, the highest sound levels measurable at any location in the water will be less than the nominal source level. In addition, the effective source level for sound propagating in near-horizontal directions will be substantially lower than the nominal source level applicable to downward propagation because of the directional nature of the sound from the airgun array.

(2) MBES

The *Langseth* will operate a Kongsberg EM 122 MBES concurrently during airgun operations to map characteristics of the ocean floor. The hull-mounted MBES emits brief pulses of sound (also called a ping) (10.5 to 13 kHz, usually 12 kHz) in a fan-shaped beam that extends downward and to the sides of the ship. The transmitting beamwidth is 1° fore-aft and 150° athwartship, and the maximum source level is 242 dB re 1 μPa (rms).

For deep-water operations, each ping consists of eight (in water greater than 1,000 m [3,281 ft]) or four (in water less than 1,000 m [3,281 ft]) successive, fan-shaped transmissions, each ensonifying a sector that extends 1° fore-aft. Continuous-wave pulses increase from 2 to 15 milliseconds (ms) long in water depths up to 2,600 m (8,530.2 ft), and frequency-modulated chirp pulses up to 100 ms long are used in water greater than 2,600 m (8,530.2 ft). The successive transmissions span an overall cross-track angular extent of about 150°, with 2 ms gaps between the pulses for successive sectors.

(3) SBP

The *Langseth* will also operate a Knudsen 320B SBP continuously throughout the cruise simultaneously with the MBES to map and provide information about the sedimentary features and bottom topography. The beam is transmitted as a 27° cone, which is directed downward by a 3.5 kHz transducer in the hull of the *Langseth.* The maximum output is 1,000 watts (204 dB re 1 μPa), but in practice, the output varies with water depth. The pulse interval is 1 s, but a common mode of operation is to broadcast five pings at 1-s intervals followed by a 5-s pause.

(4) ADCP

The Ocean Surveyor 75 is an ADCP operating at a frequency of 75 kHz, producing a ping every 1.4 s. The system is a four-beam phased array with a beam angle of 30°. Each beam has a width of 4°, and there is no overlap. Maximum output is 1 kilowatt, with a maximum depth range of 700 m (2,296.6 ft).

Metrics Used in This Document

This section includes a brief explanation of the sound measurements frequently used in the discussions of acoustic effects in this document. Sound pressure is the sound force per unit area, and is usually measured in micropascals (μPa), where 1 pascal (Pa) is the pressure resulting from a force of one newton exerted over an area of one square meter. Sound pressure level (SPL) is expressed as the ratio of a measured sound pressure and a reference level. The commonly used reference pressure level in underwater acoustics is 1 μPa, and the units for SPLs are dB re: 1 μPa. SPL (in decibels [dB]) = 20 log (pressure/reference pressure).

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

Predicted Sound Levels

Received sound levels have been predicted by Marine Acoustics, Inc. (MAI), in relation to distance and direction from the airguns, for the 10-airgun array. The MAI model was site specific; sound velocity profiles, bathymetry, and bottom composition were used to model propagation at seven sites 120–2,727 m (328–8,947 ft) deep in the survey area that represented different physiographic provinces described by Jakobsson *et al.* (2003). The source model used was the CASS/GRAB model, and propagation was modeled using the Range-Dependent Acoustic Model (RAM) (Zingarelli and King, 2005). The detailed modeling report can be found in Appendix A1 of the draft EA (see **ADDRESSES**).

Received sound levels for a single 40-in^3 airgun were modeled by L–DEO. The tow depth has minimal effect on the maximum near-field output and the shape of the frequency spectrum for the single airgun; thus, the predicted exclusion zone radii are essentially the same at different tow depths. As the L–DEO model does not allow for bottom interactions, and thus is most directly applicable to deep water and to relatively short ranges, correction factors were used to estimate exclusion zone radii in shallow and intermediate-depth water as was done for previous L–DEO surveys from the *Langseth.* A detailed description of the L–DEO modeling effort is provided in Appendix A2 of the draft EA.

Table 1 in this document and Table 1 in UAGI's application show the distances at which three rms sound levels are expected to be received from the 10-airgun array and a single airgun. For the 10-airgun array, distances were modeled at seven sites; the distances in Table 1 are the averages from the sites in each depth range.

TABLE 1—MAXIMUM PREDICTED DISTANCES TO WHICH SOUND LEVELS ≥190, 180, AND 160 dB RE 1 μPA (RMS) COULD BE RECEIVED IN VARIOUS WATER-DEPTH CATEGORIES DURING THE PROPOSED SURVEY IN THE ARCTIC OCEAN. THE DISTANCES FOR THE 10-AIRGUN ARRAY ARE THE AVERAGES OF MODELED 95% PERCENTILE DISTANCES AT MODELING SITES IN EACH DEPTH RANGE

Source and volume	Tow depth (m)	Water depth	Predicted RMS radii (m)		
			190 dB	180 dB	160 dB
Single Bolt		Deep (>1000 m)	12	40	385
	6	Intermediate (100–1000 m)	18	60	578
		Shallow (<100)	150	296	1,050
1 string		Deep (>1000 m)	130	425	14,070
10 airguns	6	Intermediate (200–1000 m)	130	1400	13,980
1830 in³		Shallow (<200)	190	1870	14,730

* The tow depth has minimal effect on the maximum near-field output and the shape of the frequency spectrum for the single 40 in³ airgun; thus, the predicted safety radii are essentially the same at any tow depth.

NMFS expects that acoustic stimuli resulting from the proposed operation of the single airgun or the 10 airgun array has the potential to harass marine mammals, incidental to the conduct of the proposed seismic survey. NMFS expects these disturbances to be temporary and result, at worst, in a temporary modification in behavior and/or low-level physiological effects (Level B harassment) of small numbers of certain species of marine mammals. NMFS does not expect that the movement of the *Langseth,* during the conduct of the seismic survey, has the potential to harass marine mammals because of the relatively slow operation speed of the vessel (4–5 kts [7.4 to 9.3 km/hr]) during seismic data acquisition.

Description of Marine Mammals in the Area of the Specified Activity

The Chukchi Sea supports a diverse assemblage of marine mammals, including: Bowhead, gray, beluga, killer, minke, humpback, and fin whales; harbor porpoise; ringed, ribbon, spotted, and bearded seals; narwhals; polar bears; and walruses. The bowhead, humpback, and fin whales are listed as endangered, and the polar bear is listed as threatened under the U.S. Endangered Species Act of 1973 (ESA; 16 U.S.C. 1531 *et seq.*). All of these species are also considered depleted under the MMPA. On December 10, 2010, NMFS published a notification of proposed threatened status for subspecies of the ringed seal (75 FR 77476) and a notification of proposed threatened and not warranted status for subspecies and distinct population segments of the bearded seal (75 FR 77496) in the **Federal Register.** Neither species is considered depleted under the MMPA.

The bowhead and beluga whales and the ringed and bearded seals are the marine mammal species most likely to be encountered during this survey, with the ringed seal being the most likely marine mammal species to occur throughout the proposed survey area. Although humpback and minke whales are uncommon in the Arctic Ocean, sightings of both species have occurred in the Chukchi Sea in recent years (Brueggeman, 2009; Haley *et al.,* 2010; Clarke *et al.,* 2011).

There are scattered records of narwhal in Alaskan waters, where the species is considered extralimital (Reeves *et al.,* 2002). Harbor porpoises occur mainly in shelf areas where they can dive to depths of at least 220 m (722 ft) and stay submerged for more than 5 min (Harwood and Wilson, 2001). This species prefers shallower waters, making it unlikely that harbor porpoises would be encountered during the proposed seismic survey. Because of the rarity of these two species in the proposed survey area, they are not considered further in this document. The polar bear and walrus are managed by the U.S. Fish and Wildlife Service (USFWS) and are not considered further in this proposed IHA notice.

Refer to Sections III and IV of UAGI's application for detailed information regarding the abundance and distribution, seasonal distribution, population status, and life history and behavior of these species and their occurrence in the proposed project area. When reviewing the application, NMFS determined that the species descriptions provided by UAGI correctly characterized the abundance and distribution, seasonal distribution, population status, and life history and behavior of each species. Additional information can also be found in the NMFS Stock Assessment Reports (SAR). The 2010 Alaska Marine Mammal SAR is available on the Internet at: *http://www.nmfs.noaa.gov/pr/pdfs/sars/ak2010.pdf.*

The application also presents how UAGI calculated the estimated densities for the marine mammals in the proposed survey area. NMFS has reviewed these data and determined them to be the best available scientific information for the purposes of the proposed IHA. UAGI's methodology for estimating take is described further in the ''Estimated Take by Incidental Harassment'' section found later in this document.

Brief Background on Marine Mammal Hearing

When considering the influence of various kinds of sound on the marine environment, it is necessary to understand that different kinds of marine life are sensitive to different frequencies of sound. Based on available behavioral data, audiograms have been derived using auditory evoked potentials, anatomical modeling, and other data, Southall *et al.* (2007) designate ''functional hearing groups'' for marine mammals and estimate the lower and upper frequencies of functional hearing of the groups. The functional groups and the associated frequencies are indicated below (though animals are less sensitive to sounds at the outer edge of their functional range and most sensitive to sounds of frequencies within a smaller range somewhere in the middle of their functional hearing range):

• Low frequency cetaceans (13 species of mysticetes): Functional hearing is estimated to occur between approximately 7 Hz and 22 kHz (however, a study by Au *et al.* (2006) of humpback whale songs indicate that the range may extend to at least 24 kHz);

• Mid-frequency cetaceans (32 species of dolphins, six species of larger toothed whales, and 19 species of beaked and bottlenose whales): Functional hearing is estimated to occur between approximately 150 Hz and 160 kHz;

• High frequency cetaceans (eight species of true porpoises, six species of river dolphins, Kogia, the franciscana, and four species of cephalorhynchids): functional hearing is estimated to occur between approximately 200 Hz and 180 kHz; and

• Pinnipeds in Water: functional hearing is estimated to occur between approximately 75 Hz and 75 kHz, with the greatest sensitivity between approximately 700 Hz and 20 kHz.

As mentioned previously in this document, 11 marine mammal species (seven cetacean and four pinniped species) are likely to occur in the proposed survey area. Of the seven cetacean species likely to occur in UAGI's propose survey area, five are classified as low frequency cetaceans (*i.e.,* bowhead, gray, humpback, minke, and fin whales) and two are classified as mid-frequency cetaceans (*i.e.,* beluga and killer whales) (Southall *et al.,* 2007).

Potential Effects of the Specified Activity on Marine Mammals

Acoustic stimuli generated by the operation of the airguns, which introduce sound into the marine environment, may have the potential to cause Level B harassment of marine mammals in the proposed survey area. The effects of sounds from airgun operations might include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, temporary or permanent hearing impairment, or non-auditory physical or physiological effects (Richardson *et al.*, 1995; Gordon *et al.*, 2004; Nowacek *et al.*, 2007; Southall *et al.*, 2007). Takes by serious injury or mortality are not anticipated to occur as a result of the proposed activities.

Tolerance

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

Numerous studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers. Malme *et al.*, (1985) studied the responses of humpback whales on their summer feeding grounds in southeast Alaska to seismic pulses from an airgun with a total volume of 100 in^3. They noted that the whales did not exhibit persistent avoidance when exposed to the airgun and concluded that there was no clear evidence of avoidance, despite the possibility of subtle effects, at received levels up to 172 dB re 1 μPa.

Weir (2008) observed marine mammal responses to seismic pulses from a 24 airgun array firing a total volume of either 5,085 in^3 or 3,147 in^3 in Angolan waters between August 2004 and May 2005. Weir recorded a total of 207 sightings of humpback whales (n = 66), sperm whales (n = 124), and Atlantic spotted dolphins (n = 17) and reported that there were no significant differences in encounter rates (sightings/hr) for humpback and sperm whales according to the airgun array's operational status (*i.e.*, active versus silent).

Masking

The term masking refers to the inability of a subject to recognize the occurrence of an acoustic stimulus as a result of the interference of another acoustic stimulus (Clark *et al.*, 2009). Marine mammals are highly dependent on sound, and their ability to recognize sound signals amid other noise is important in communication, predator and prey detection, and, in the case of toothed whales, echolocation. Introduced underwater sound may, through masking, reduce the effective communication distance of a marine mammal species if the frequency of the source is close to that used as a signal by the marine mammal, and if the anthropogenic sound is present for a significant fraction of the time (Richardson *et al.*, 1995). Even in the absence of manmade sounds, the sea is usually noisy. Background ambient noise often interferes with or masks the ability of an animal to detect a sound signal even when that signal is above its absolute hearing threshold. Natural ambient noise includes contributions from wind, waves, precipitation, other animals, and (at frequencies above 30 kHz) thermal noise resulting from molecular agitation (Richardson *et al.*, 1995). Background noise also can include sounds from human activities. Masking of natural sounds can result when human activities produce high levels of background noise. Conversely, if the background level of underwater noise is high (*e.g.*, on a day with strong wind and high waves), an anthropogenic noise source will not be detectable as far away as would be possible under quieter conditions and will itself be masked.

Masking effects of pulsed sounds (even from large arrays of airguns) on marine mammal calls and other natural sounds are expected to be limited. Because of the intermittent nature and low duty cycle of seismic airgun pulses, animals can emit and receive sounds in the relatively quiet intervals between pulses. However, in some situations, reverberation occurs for much or the entire interval between pulses (*e.g.*, Simard *et al.*, 2005; Clark and Gagnon, 2006), which could mask calls. Some baleen and toothed whales are known to continue calling in the presence of seismic pulses, and their calls can usually be heard between the seismic pulses (*e.g.*, Richardson *et al.*, 1986; McDonald *et al.*, 1995; Greene *et al.*, 1999; Nieukirk *et al.*, 2004; Smultea *et al.*, 2004; Holst *et al.*, 2005a,b, 2006; and Dunn and Hernandez, 2009). However, Clark and Gagnon (2006) reported that fin whales in the northeast Pacific Ocean went silent for an extended period starting soon after the onset of a seismic survey in the area. Similarly, there has been one report that sperm whales ceased calling when exposed to pulses from a very distant seismic ship (Bowles *et al.*, 1994). However, more recent studies found that they continued calling in the presence of seismic pulses (Madsen *et al.*, 2002; Tyack *et al.*, 2003; Smultea *et al.*, 2004; Holst *et al.,* 2006; and Jochens *et al.,* 2008). Dolphins and porpoises commonly are heard calling while airguns are operating (e.g., Gordon *et al.*, 2004; Smultea *et al.*, 2004; Holst *et al.*, 2005a,b; and Potter *et al.*, 2007). The sounds important to small odontocetes are predominantly at much higher frequencies than are the dominant components of airgun sounds, thus limiting the potential for masking.

Although some degree of masking is inevitable when high levels of manmade broadband sounds are introduced into the sea, marine mammals have evolved systems and behavior that function to reduce the impacts of masking. Structured signals, such as the echolocation click sequences of small toothed whales, may be readily detected even in the presence of strong background noise because their frequency content and temporal features usually differ strongly from those of the background noise (Au and Moore, 1988, 1990). The components of background noise that are similar in frequency to the sound signal in question primarily determine the degree of masking of that signal.

There is evidence of other marine mammal species continuing to call in the presence of industrial activity. For example, bowhead whale calls are frequently detected in the presence of seismic pulses, although the number of calls detected may sometimes be reduced (Richardson *et al.*, 1986; Greene *et al.*, 1999; Blackwell *et al.*, 2009). Additionally, annual acoustical monitoring near BP's Northstar production facility during the fall bowhead migration westward through the Beaufort Sea has recorded thousands of calls each year (for examples, see Richardson *et al.*, 2007; Aerts and Richardson, 2008). Construction, maintenance, and operational activities have been occurring from this facility for more than 10 years. To compensate and reduce masking, some mysticetes may alter the frequencies of their communication sounds (Richardson *et al.*, 1995a; Parks *et al.*, 2007). Masking processes in baleen whales are not amenable to laboratory study, and no direct measurements on hearing sensitivity are available for these species. It is not currently possible to determine with precision the potential consequences of temporary or local background noise levels. However, Parks *et al.* (2007) found that right whales altered their vocalizations, possibly in response to background noise levels. For species that can hear over a relatively broad frequency range, as is presumed to be the case for mysticetes, a narrow band source may only cause partial masking. Richardson *et al.* (1995a) note that a bowhead whale 20 km (12.4 mi) from a human sound source, such as that produced during oil and gas industry activities, might hear strong calls from other whales within approximately 20 km (12.4 mi), and a whale 5 km (3.1 mi) from the source might hear strong calls from whales within approximately 5 km (3.1 mi). Additionally, masking is more likely to occur closer to a sound source, and distant anthropogenic sound is less likely to mask short-distance acoustic communication (Richardson *et al.*, 1995a).

Redundancy and context can also facilitate detection of weak signals. These phenomena may help marine mammals detect weak sounds in the presence of natural or manmade noise. Most masking studies in marine mammals present the test signal and the masking noise from the same direction. The sound localization abilities of marine mammals suggest that, if signal and noise come from different directions, masking would not be as severe as the usual types of masking studies might suggest (Richardson *et al.*, 1995). The dominant background noise may be highly directional if it comes from a particular anthropogenic source such as a ship or industrial site. Directional hearing may significantly reduce the masking effects of these noises by improving the effective signal-to-noise ratio. In the cases of high-frequency hearing by the bottlenose dolphin, beluga whale, and killer whale, empirical evidence confirms that masking depends strongly on the relative directions of arrival of sound signals and the masking noise (Penner *et al.*, 1986; Dubrovskiy, 1990; Bain *et al.*, 1993; Bain and Dahlheim, 1994). Toothed whales, and probably other marine mammals as well, have additional capabilities besides directional hearing that can facilitate detection of sounds in the presence of background noise. There is evidence that some toothed whales can shift the dominant frequencies of their echolocation signals from a frequency range with a lot of ambient noise toward frequencies with less noise (Au *et al.*, 1974, 1985; Moore and Pawloski, 1990; Thomas and Turl, 1990; Romanenko and Kitain, 1992; Lesage *et al.*, 1999). A few marine mammal species are known to increase the source levels or alter the frequency of their calls in the presence of elevated sound levels (Dahlheim, 1987; Au, 1993; Lesage *et al.*, 1993, 1999; Terhune, 1999; Foote *et al.*, 2004; Parks *et al.*, 2007, 2009; Di Iorio and Clark, 2009; Holt *et al.*, 2009).

These data demonstrating adaptations for reduced masking pertain mainly to the very high frequency echolocation signals of toothed whales. There is less information about the existence of corresponding mechanisms at moderate or low frequencies or in other types of marine mammals. For example, Zaitseva *et al.* (1980) found that, for the bottlenose dolphin, the angular separation between a sound source and a masking noise source had little effect on the degree of masking when the sound frequency was 18 kHz, in contrast to the pronounced effect at higher frequencies. Directional hearing has been demonstrated at frequencies as low as 0.5–2 kHz in several marine mammals, including killer whales (Richardson *et al.*, 1995). This ability may be useful in reducing masking at these frequencies. In summary, high levels of noise generated by anthropogenic activities may act to mask the detection of weaker biologically important sounds by some marine mammals. This masking may be more prominent for lower frequencies. For higher frequencies, such as that used in echolocation by toothed whales, several mechanisms are available that may allow them to reduce the effects of such masking.

In general, NMFS expects the masking effects of seismic pulses to be minor, given the normally intermittent nature of seismic pulses. Refer to Appendix B (4) of the draft EA for a more detailed discussion of masking effects on marine mammals.

Behavioral Disturbance

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

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

Baleen Whales—Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable (reviewed in Richardson *et al.*, 1995). Whales are often reported to show no overt reactions to pulses from large arrays of airguns at distances beyond a few kilometers, even though the airgun pulses remain well above ambient noise levels out to much longer distances. However, as reviewed in Appendix B (5) of NSF's EA, baleen whales exposed to strong noise pulses from airguns often react by deviating from their normal migration route and/ or interrupting their feeding and moving away. In the cases of migrating gray and bowhead whales, the observed changes in behavior appeared to be of little or no biological consequence to the animals (Richardson *et al.*, 1995). They simply avoided the sound source by displacing their migration route to varying degrees but within the natural boundaries of the migration corridors.

Studies of gray, bowhead, and humpback whales have shown that seismic pulses with received levels of 160 to 170 dB re 1 μPa (rms) seem to cause obvious avoidance behavior in a substantial fraction of the animals exposed (Malme et al., 1986, 1988; Richardson *et al.*, 1995). In many areas, seismic pulses from large arrays of airguns diminish to those levels at distances ranging from 4–15 km (2.5–9.3 mi) from the source. A substantial proportion of the baleen whales within those distances may show avoidance or other strong behavioral reactions to the airgun array. Subtle behavioral changes sometimes become evident at somewhat lower received levels, and studies summarized in Appendix B (5) of NSF's EA have shown that some species of baleen whales, notably bowhead and humpback whales, at times, show strong avoidance at received levels lower than 160 to 170 dB re 1 μPa (rms).

McCauley *et al.* (1998, 2000a) studied the responses of humpback whales off western Australia to a full-scale seismic survey with a 16 airgun array (2,678 in ^{3}) and to a single airgun (20 in^3) with a source level of 227 dB re 1 μPa (p-p). In the 1998 study, they 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. In the 2000 study, McCauley *et al.* (2000a) noted localized displacement during migration of 4–5 km (2.5–3.1 mi) by traveling pods and 7–12 km (4.3–7.5 mi) by more sensitive resting pods of cow-calf pairs. Avoidance distances with respect to the single airgun were smaller but consistent with the results from the full array in terms of the received sound levels. The mean received level for initial avoidance of an approaching airgun was 140 dB re 1 μPa for humpback pods containing females, and, at the mean closest point of approach distance, the received level was 143 dB re 1 μPa. The initial avoidance response generally occurred at distances of 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.

Data collected by observers during several seismic surveys in the Northwest Atlantic showed that sighting rates of humpback whales were significantly greater during periods of no seismic compared with periods when a full array was operating (Moulton and Holst, 2010). In addition, humpback whales were more likely to swim away and less likely to swim towards a vessel during seismic vs. non-seismic periods (Moulton and Holst, 2010).

Humpback whales on their summer feeding grounds in southeast Alaska did not exhibit persistent avoidance when exposed to seismic pulses from a 100 in ^{3} airgun (Malme *et al.*, 1985). Some humpbacks seemed ''startled'' at received levels of 150 to 169 dB re 1 μPa. Malme *et al.* (1985) concluded that there was no clear evidence of avoidance, despite the possibility of subtle effects, at received levels up to 172 dB re 1 μPa (rms).

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

Studies of the bowhead whale show that their responsiveness to seismic surveys can be quite variable depending on their activity (migrating vs. feeding). Bowhead whales migrating west across the Alaskan Beaufort Sea in autumn, in particular, are unusually responsive, with substantial avoidance occurring out to distances of 20–30 km (12.4–18.6 mi) from a medium-sized airgun source at received sound levels of around 120 to 130 dB re 1 μPa (Miller *et al.*, 1999; Richardson *et al.*, 1999; see Appendix B (5) of NSF's EA). However, more recent research on bowhead whales (Miller *et al.*, 2005; Harris *et al.*, 2007) corroborates earlier evidence that, during the summer feeding season, bowheads are not as sensitive to seismic sources. Nonetheless, subtle but statistically significant changes in surfacing–respiration–dive cycles were evident upon statistical analysis (Richardson *et al.*, 1986). In the summer, bowheads typically begin to show avoidance reactions at received levels of about 152 to 178 dB re 1 μPa (Richardson *et al.*, 1986, 1995; Ljungblad *et al.*, 1988; Miller *et al.*, 2005).

Reactions of migrating and feeding (but not wintering) gray whales to seismic surveys have been studied. Malme *et al.* (1986, 1988) studied the responses of feeding eastern Pacific gray whales to pulses from a single 100 in ^{3} airgun off St. Lawrence Island in the northern Bering Sea. They estimated, based on small sample sizes, that 50% of feeding gray whales stopped feeding at an average received pressure level of 173 dB re 1 μPa on an (approximate) rms basis, and that 10% of feeding whales interrupted feeding at received levels of 163 dB re 1 μPa. Those findings were generally consistent with the results of experiments conducted on larger numbers of gray whales that were migrating along the California coast (Malme *et al.*, 1984; Malme and Miles, 1985), and western Pacific gray whales feeding off Sakhalin Island, Russia (Wursig *et al.*, 1999; Gailey *et al.*, 2007; Johnson *et al.*, 2007; Yazvenko *et al.*, 2007a, b), along with data on gray whales off British Columbia (Bain and Williams, 2006).

Various species of *Balaenoptera* (blue, sei, fin, and minke whales) have occasionally been seen in areas ensonified by airgun pulses (Stone, 2003; MacLean and Haley, 2004; Stone and Tasker, 2006), and calls from blue and fin whales have been localized in areas with airgun operations (e.g., McDonald *et al.*, 1995; Dunn and Hernandez, 2009, Castellote *et al.*, 2010). Sightings by observers on seismic vessels off the United Kingdom from

1997 to 2000 suggest that, during times of good sightability, sighting rates for mysticetes (mainly fin and sei whales) were similar when large arrays of airguns were shooting vs. silent (Stone, 2003; Stone and Tasker, 2006). However, these whales tended to exhibit localized avoidance, remaining significantly further (on average) from the airgun array during seismic operations compared with non-seismic periods (Stone and Tasker, 2006). In a study off of Nova Scotia, Moulton and Miller (2005) found little difference in sighting rates (after accounting for water depth) and initial sighting distances of balaenopterid whales when airguns were operating vs. silent. However, there were indications that these whales were more likely to be moving away when seen during airgun operations. Similarly, ship-based monitoring studies of blue, fin, sei and minke whales offshore of Newfoundland (Orphan Basin and Laurentian Sub-basin) found no more than small differences in sighting rates and swim directions during seismic versus non-seismic periods (Moulton *et al.*, 2005, 2006a,b). Castellote *et al.* (2010) reported that singing fin whales in the Mediterranean moved away from an operating airgun array.

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

Data on short-term reactions by cetaceans to impulsive noises are not necessarily indicative of long-term or biologically significant effects. It is not known whether impulsive sounds affect reproductive rate or distribution and habitat use in subsequent days or years. However, gray whales have continued to migrate annually along the west coast of North America with substantial increases in the population over recent years, despite intermittent seismic exploration (and much ship traffic) in that area for decades (Appendix A in Malme *et al.*, 1984; Richardson *et al.*, 1995; Allen and Angliss, 2010). The western Pacific gray whale population did not seem affected by a seismic survey in its feeding ground during a previous year (Johnson *et al.*, 2007). Similarly, bowhead whales have continued to travel to the eastern Beaufort Sea each summer, and their numbers have increased notably, despite seismic exploration in their summer and autumn range for many years (Richardson *et al.*, 1987; Allen and Angliss, 2010).

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

Seismic operators and marine mammal observers on seismic vessels regularly see dolphins and other small toothed whales near operating airgun arrays, but, in general, there is a tendency for most delphinids to show some avoidance of operating seismic vessels (*e.g.*, Goold, 1996a,b,c; Calambokidis and Osmek, 1998; Stone, 2003; Moulton and Miller, 2005; Holst *et al.*, 2006; Stone and Tasker, 2006; Weir, 2008; Richardson *et al.*, 2009; Barkaszi *et al.*, 2009, Moulton and Holst, 2010). Some dolphins seem to be attracted to the seismic vessel and floats, and some ride the bow wave of the seismic vessel even when large arrays of airguns are firing (*e.g.*, Moulton and Miller, 2005). Nonetheless, small toothed whales more often tend to head away, or to maintain a somewhat greater distance from the vessel, when a large array of airguns is operating than when it is silent (*e.g.*, Stone and Tasker, 2006; Weir, 2008, Barry *et al.*, 2010, Moulton and Holst, 2010). In most cases, the avoidance radii for delphinids appear to be small, on the order of 1 km (0.6 mi) or less, and some individuals show no apparent avoidance. The beluga whale is a species that (at least at times) shows long-distance avoidance of seismic vessels. Aerial surveys conducted in the southeastern Beaufort Sea during summer found that sighting rates of beluga whales were significantly lower at distances 10–20 km (6.2–12.4 mi) compared with 20–30 km (12.4–18.6 mi) from an operating airgun array, and observers on seismic boats in that area rarely saw belugas (Miller *et al.*, 2005; Harris *et al.*, 2007).

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

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

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

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

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

Pinnipeds—Pinnipeds are not likely to show a strong avoidance reaction to the airgun array. Pinnipeds generally seem to be less responsive to exposure to industrial sound than most cetaceans. Responses by pinnipeds to underwater sound from some types of industrial activities such as seismic exploration appear to be temporary and localized (Harris *et al.,* 2001; Reiser *et al.,* 2009).

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

Hearing Impairment and Other Physical Effects

Temporary or permanent hearing impairment is a possibility when marine mammals are exposed to very strong sounds. Non-auditory physical effects might also occur in marine mammals exposed to strong underwater sound. Possible types of non-auditory physical effects or injuries that theoretically might occur in mammals close to a strong sound source include stress, neurological effects, bubble formation, and other types of organ or tissue damage. It is possible that some marine mammal species (*i.e.,* beaked whales) may be especially susceptible to injury and/or stranding when exposed to strong pulsed sounds. However, as discussed later in this document, there is no definitive evidence that any of these effects occur even for marine mammals in close proximity to industrial sound sources, and beaked whales do not occur in the proposed activity area.

Factors that influence the amount of threshold shift include the amplitude, duration, frequency content, temporal pattern, and energy distribution of noise exposure. The magnitude of hearing threshold shift normally decreases over time following cessation of the noise exposure. The amount of threshold shift just after exposure is called the initial threshold shift. If the threshold shift eventually returns to zero (*i.e.,* the threshold returns to the pre-exposure value), it is called temporary threshold shift (TTS) (Southall *et al.,* 2007). Researchers have studied TTS in certain captive odontocetes and pinnipeds exposed to strong sounds (reviewed in Southall *et al.,* 2007). However, there has been no specific documentation of TTS let alone permanent hearing damage, i.e., permanent threshold shift (PTS), in free-ranging marine mammals exposed to sequences of airgun pulses during realistic field conditions. The following subsections discuss in somewhat more detail the possibilities of TTS, PTS, and non-auditory physical effects.

Temporary Threshold Shift—TTS is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter, 1985). While experiencing TTS, the hearing threshold rises, and a sound must be stronger in order to be heard. At least in terrestrial mammals, TTS can last from minutes or hours to (in cases of strong TTS) days. For sound exposures at or somewhat above the TTS threshold, hearing sensitivity in both terrestrial and marine mammals recovers rapidly after exposure to the noise ends. Few data on sound levels and durations necessary to elicit mild TTS have been obtained for marine mammals, and none of the published data concern TTS elicited by exposure to multiple pulses of sound. Available data on TTS in marine mammals are summarized in Southall *et al.* (2007). Table 1 (found earlier in this document and Table 1 in UAGI's application) presents the distances from the *Langseth'*s 10-airgun array at which the received energy level (per pulse, flat-weighted) would be expected to be greater than or equal to 180 and 190 dB re 1 μPa (rms). As shown in the table, these distances vary with depth.

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

For baleen whales, there are no data, direct or indirect, on levels or properties of sound that are required to induce TTS. The frequencies to which baleen whales are most sensitive are assumed to be lower than those to which odontocetes are most sensitive, and natural background noise levels at those low frequencies tend to be higher. As a result, auditory thresholds of baleen whales within their frequency band of best hearing are believed to be higher (less sensitive) than are those of odontocetes at their best frequencies (Clark and Ellison, 2004), meaning that baleen whales require sounds to be louder (*i.e.,* higher dB levels) than odontocetes in the frequency ranges at which each group hears the best. From this, it is suspected that received levels causing TTS onset may also be higher in baleen whales (Southall *et al.,* 2007). Since current NMFS practice assumes the same thresholds for the onset of hearing impairment in both odontocetes and mysticetes, NMFS' onset of TTS threshold is likely conservative for mysticetes. For this proposed study, UAGI expects no cases of TTS given the strong likelihood that baleen whales would avoid the approaching airguns (or vessel) before being exposed to levels high enough for TTS to occur.

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

NMFS has established acoustic thresholds that identify the received sound levels above which hearing impairment or other injury could potentially occur, which are 180 and 190 dB re 1 μPa (rms) for cetaceans and pinnipeds, respectively (NMFS 1995, 2000). The established 180- and 190-dB re 1 μPa (rms) criteria are the received levels above which, in the view of a panel of bioacoustics specialists convened by NMFS before additional TTS measurements for marine mammals became available, one could not be certain that there would be no injurious effects, auditory or otherwise, to marine mammals. TTS is considered by NMFS to be a type of Level B (non-injurious) harassment. The 180- and 190-dB levels are shutdown criteria applicable to cetaceans and pinnipeds, respectively, as specified by NMFS (2000); these levels were used to establish the exclusion zones (EZs) described later in this document.

Permanent Threshold Shift—When PTS occurs, there is physical damage to the sound receptors in the ear. In severe cases, there can be total or partial deafness, whereas in other cases, the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter, 1985). There is no specific evidence that exposure to pulses of airgun sound can cause PTS in any marine mammal (see Southall *et al.,* 2007), even with large arrays of airguns. However, given the possibility that mammals close to an airgun array might incur at least mild TTS, there has been further speculation about the possibility that some individuals occurring very close to airguns might incur PTS (e.g., Richardson *et al.,* 1995, p. 372*ff;* Gedamke *et al.,* 2008). Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage, but repeated or (in some cases) single exposures to a level well above that causing TTS onset might elicit PTS.

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

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

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

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

Stranding and Mortality

Marine mammals close to underwater detonations of high explosives can be killed or severely injured, and the auditory organs are especially susceptible to injury (Ketten *et al.,* 1993; Ketten, 1995). However, explosives are no longer used for marine waters for commercial seismic surveys or (with rare exceptions) for seismic research; they have been replaced entirely by airguns or related non-explosive pulse generators. Airgun pulses are less energetic and have slower rise times, and there is no specific evidence that they can cause serious injury, death, or stranding even in the case of large airgun arrays. However, the association of strandings of beaked whales with naval exercises involving mid-frequency active sonar and, in one case, a L–DEO seismic survey (Malakoff, 2002; Cox *et al.,* 2006), has raised the possibility that beaked whales exposed to strong ''pulsed'' sounds may be especially susceptible to injury and/or behavioral reactions that can lead to stranding (*e.g.,* Hildebrand, 2005; Southall *et al.,* 2007). Appendix B (6) of NSF's EA provides additional details.

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

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

(2) A change in behavior (such as a change in diving behavior) that might contribute to tissue damage, gas bubble formation, hypoxia, cardiac arrhythmia, hypertensive hemorrhage or other forms of trauma;

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

(4) Tissue damage directly from sound exposure, such as through acoustically-mediated bubble formation and growth or acoustic resonance of tissues.

Some of these mechanisms are unlikely to apply in the case of impulse sounds. However, there are indications that gas-bubble disease (analogous to ''the bends''), induced in supersaturated tissue by a behavioral response to acoustic exposure, could be a pathologic mechanism for the strandings and mortality of some deep-diving cetaceans exposed to sonar. However, the evidence for this remains circumstantial and is associated with exposure to naval mid-frequency sonar, not seismic surveys (Cox *et al.,* 2006; Southall *et al.,* 2007).

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

There is no conclusive evidence of cetacean strandings or deaths at sea as a result of exposure to seismic surveys, but a few cases of strandings in the general area where a seismic survey was ongoing have led to speculation concerning a possible link between seismic surveys and strandings. Suggestions that there was a link between seismic surveys and strandings of humpback whales in Brazil (Engel *et al.,* 2004) were not well founded (IAGC, 2004; IWC, 2007). In September 2002, there was a stranding of two Cuvier's beaked whales in the Gulf of California, Mexico, when the L–DEO vessel R/V *Maurice Ewing* was operating a 20 airgun (8,490 in^3) array in the general area. The link between the stranding and the seismic surveys was inconclusive and not based on any physical evidence (Hogarth, 2002; Yoder, 2002). Nonetheless, the Gulf of California incident, plus the beaked whale strandings near naval exercises involving use of mid-frequency sonar, suggests a need for caution in conducting seismic surveys in areas occupied by beaked whales until more is known about effects of seismic surveys on those species (Hildebrand, 2005). No injuries of beaked whales are anticipated during the proposed study because none occur in the proposed project area.

Potential Effects on Marine Mammals of Other Acoustic Devices

(1) MBES

UAGI intends to operate the Kongsberg EM 122 MBES from the source vessel during the proposed study. Sounds from the MBES are very short pings, occurring for 2–15 ms once every 5–20 s, depending on water depth. Most of the energy in the sound pulses emitted by this MBES is at frequencies near 12 kHz, and the maximum source level is 242 dB re 1 μPa (rms). The beam is narrow (1–2°) in fore-aft extent and wide (150°) in the cross-track extent. Each ping consists of eight (in water greater than 1,000 m [3,280 ft] deep) or four (in water less than 1,000 m [3,280 ft] deep) successive fan-shaped transmissions (segments) at different cross-track angles. Any given mammal at depth near the trackline would be in the main beam for only one or two of the nine segments. Also, marine mammals that encounter the Kongsberg EM 122 are unlikely to be subjected to repeated pulses because of the narrow fore-aft width of the beam and will receive only limited amounts of pulse energy because of the short pulses. Animals close to the ship (where the beam is narrowest) are especially unlikely to be ensonified for more than one 2–15 ms pulse (or two pulses if in the overlap area). Similarly, Kremser *et al.* (2005) noted that the probability of a cetacean swimming through the area of exposure when a MBES emits a pulse is small. The animal would have to pass the transducer at close range and be swimming at speeds similar to the vessel in order to receive the multiple pulses that might result in sufficient exposure to cause TTS.

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

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

Behavioral Responses—Behavioral reactions of free-ranging marine mammals to sonars, echosounders, and other sound sources appear to vary by species and circumstance. Observed reactions have included silencing and dispersal by sperm whales (Watkins *et al.,* 1985), increased vocalizations and no dispersal by pilot whales (Rendell and Gordon, 1999), and the previously-mentioned beachings by beaked whales. During exposure to a 21–25 kHz ''whale-finding'' sonar with a source level of 215 dB re 1 μPa, gray whales reacted by orienting slightly away from the source and being deflected from their course by approximately 200 m (656 ft) (Frankel, 2005). When a 38 kHz echosounder and a 150 kHz ADCP were transmitting during studies in the Eastern Tropical Pacific, baleen whales showed no significant responses, while spotted and spinner dolphins were detected slightly more often and beaked whales less often during visual surveys (Gerrodette and Pettis, 2005).

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

Very few data are available on the reactions of pinnipeds to echosounder sounds at frequencies similar to those used during seismic operations. Hastie and Janik (2007) conducted a series of behavioral response tests on two captive gray seals to determine their reactions to underwater operation of a 375 kHz multibeam imaging echosounder that included significant signal components down to 6 kHz. Results indicated that the two seals reacted to the signal by significantly increasing their dive durations. Because of the likely brevity of exposure to the MBES sounds, pinniped reactions are expected to be limited to startle or otherwise brief responses of no lasting consequences to the animals.

Hearing Impairment and Other Physical Effects—Given recent stranding events that have been associated with the operation of naval sonar, there is concern that mid-frequency sonar sounds can cause serious impacts to marine mammals (see above). However, the MBES proposed for use during UAGI's proposed seismic survey is quite different than sonar used for Navy operations. Pulse duration of the MBES is very short relative to the naval sonar. Also, at any given location, an individual marine mammal would be in the beam of the MBES for much less time given the generally downward orientation of the beam and its narrow fore-aft beamwidth; Navy sonar often uses near-horizontally-directed sound. Those factors would all reduce the sound energy received from the MBES rather drastically relative to that from naval sonar. As noted by Burkhardt *et al.* (2008), cetaceans are very unlikely to incur PTS from operation of scientific sonars on a ship that is underway.

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

(2) SBP

UAGI also intends to operate a SBP from the source vessel during the proposed survey. Sounds from the SBP are very short pulses, occurring for 1–4 ms once every second. Most of the energy in the sound pulses emitted by the SBP is at 3.5 kHz, and the beam is directed downward. The SBP on the *Langseth* has a maximum source level of 204 dB re 1 μPa.

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

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

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

Hearing Impairment and Other Physical Effects—It is unlikely that the SBP produces pulse levels strong enough to cause hearing impairment or other physical injuries even in an animal that is (briefly) in a position near the source. The SBP is usually operated simultaneously with other higher-power acoustic sources, including airguns. Many marine mammals are anticipated to move away in response to the approaching higher-power sources or the vessel itself before the mammals would be close enough for there to be any possibility of effects from the less intense sounds from the SBP.

(3) ADCP

UAGI intends to operate an ADCP during the proposed seismic survey. Sounds from the ADCP are very short, occurring every 0.65–1.4 ms. Most of the energy in the sound emitted is at high frequencies (approximately 75 kHz). The ADCP produces sounds that are within the range of frequencies used by odontocetes that may occur in the proposed project area; however, it is outside the hearing range of mysticetes and at the extreme upper end of the hearing range for pinnipeds.

Masking—Whereas the ADCP produces sounds within the frequency range used by odontocetes that may be present in the proposed survey area, marine mammal communications are not anticipated to be masked appreciably by the signals. This is a consequence of the relatively low power output, low duty cycle, and brief period when an individual mammal is likely to be within the area of potential effects. In the case of mysticetes and pinnipeds, the pulses do not overlap with the predominant frequencies in the calls, thus avoiding significant masking impacts.

Behavioral Responses—When a 38-kHz echosounder and a 150-kHz ADCP were transmitting during studies in the Eastern Tropical Pacific, baleen whales showed no significant responses, while spotted and spinner dolphins were detected slightly more often and beaked whales less often during visual surveys (Gerrodette and Pettis, 2005). Marine mammal behavioral reactions to other sound sources are discussed above. Responses to the ADCP are likely to be similar to those for other sources if received at the same levels. The signals from the ADCP are weaker than those from the echosounders and the airguns. Therefore, behavioral responses are not expected unless marine mammals are very close to the source.

Hearing Impairment and Other Physical Effects—Source levels of the ADCP are lower than those of the airguns, which are discussed above. It is unlikely that the ADCP produces sound levels strong enough to cause TTS or (especially) PTS or other physical injuries even in marine mammals that are (briefly) in a position near the source.

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

Anticipated Effects on Habitat

The proposed seismic survey is not anticipated to have any permanent impact on habitats used by the marine mammals in the proposed survey area, including the food sources they use (*i.e.,* fish and invertebrates). Additionally, no physical damage to any habitat is anticipated as a result of conducting the proposed seismic survey. While it is anticipated that the specified activity may result in marine mammals avoiding certain areas due to temporary ensonification, this impact to habitat is temporary and reversible and was considered in further detail earlier in this document, as behavioral modification. The main impact associated with the proposed activity will be temporarily elevated noise levels and the associated direct effects on marine mammals, previously discussed in this notice. This section discusses the potential impacts of anthropogenic sound sources on common marine mammal prey in the proposed survey area (*i.e.*, fish and invertebrates).

Effects on Fish

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

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

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

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

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

Little is known about the mechanisms and characteristics of damage to fish that may be inflicted by exposure to seismic survey sounds. Few data have been presented in the peer-reviewed scientific literature. As far as UAGI and NMFS know, there are only two papers with proper experimental methods, controls, and careful pathological investigation implicating sounds produced by actual seismic survey airguns in causing adverse anatomical effects. One such study indicated anatomical damage, and the second indicated TTS in fish hearing. The anatomical case is McCauley *et al.* (2003), who found that exposure to airgun sound caused observable anatomical damage to the auditory maculae of pink snapper (*Pagrus auratus*). This damage in the ears had not been repaired in fish sacrificed and examined almost two months after exposure. On the other hand, Popper *et al.* (2005) documented only TTS (as determined by auditory brainstem response testing) in two of three fish species from the Mackenzie River Delta. This study found that broad whitefish (*Coregonus nasus*) exposed to airgun shots at a SEL of 177 dB re 1 μPa²•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 airguns [less than 400 Hz in the study by McCauley *et al.* (2003) and less than approximately 200 Hz in Popper *et al.* (2005)] likely did not propagate to the fish because the water in the study areas was very shallow (approximately 9 m [29.5 ft] in the former case and less than 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).

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

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

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

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

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

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

Anticipated Effects on Invertebrates

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

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

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

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

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

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

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

In conclusion, NMFS has preliminarily determined that UAGI's proposed marine seismic survey is not expected to have any habitat-related effects that could cause significant or long-term consequences for individual marine mammals or on the food sources that they utilize.

Proposed Mitigation

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

UAGI and L–DEO have based the proposed mitigation measures described herein, to be implemented for the proposed seismic survey, on the following:

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

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

To reduce the potential for disturbance from acoustic stimuli associated with the proposed activities, UAGI and/or its designees has proposed to implement the following mitigation measures for marine mammals:

(1) Proposed exclusion zones;
(2) Power-down procedures;
(3) Shut-down procedures; and
(4) Ramp-up procedures.

Planning Phase

Prior to submitting a final MMPA ITA request to NMFS, NSF works with the scientists that propose studies to determine when to conduct the research study. Dr. Coakley worked with L–DEO and NSF to identify potential time periods to carry out the proposed survey, taking into consideration key factors such as environmental conditions (*i.e.,* ice conditions, the seasonal presence of marine mammals and sea birds), weather conditions, and equipment. The project's proposed timeframe avoids the eastward (spring) bowhead migration but overlaps with that of the westward fall migration and the subsistence bowhead hunt along the north shore of Alaska near Barrow. To avoid disturbance, the seismic survey has been scheduled to depart from Dutch Harbor in early September and remain at least 200 km (124 mi) from Barrow during transit to and from the survey area, which is approximately 250–800 km (155–497 mi) northwest of Barrow. Also, to reduce potential effects, the size of the energy source was reduced from the *Langseth's* 36-airgun, 6600-in^3 array to a 10-airgun, 1830-in^3 array.

Proposed Exclusion Zones

Received sound levels for the 10-airgun array have been predicted by MAI in relation to distance and direction from the airguns, and received sound levels for a single 40-in^3 mitigation airgun have been predicted by L–DEO. Table 1 shows the distances at which three rms sound levels are expected to be received from the 10-airgun array and a single airgun at shallow, intermediate, and deep water depths. The 180- and 190-dB levels are shut-down criteria applicable to cetaceans and pinnipeds, respectively, as specified by NMFS (2000); these levels were used to establish the EZs. For the 10-airgun array, the 180-dB radius for each of the three water depth categories is as follows: 425 m (0.26 mi) in deep water; 1,400 m (0.87 mi) in intermediate water; and 1,870 m (1.16 mi) in shallow water. For the 10-airgun array, the 190-dB radius for each of the three water depth categories is as follows: 130 m (426.5 ft) in deep water; 130 m (426.5 ft) in intermediate water; and 190 m (623.4 ft) in shallow water. If the protected species visual observer (PSVO) detects marine mammal(s) within or about to enter the appropriate EZ, the airguns will be powered down (or shut down if necessary) immediately (described next).

Power-Down Procedures

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

If the PSVO detects a marine mammal outside the EZ, but it is likely to enter the EZ, the airguns will be powered-down before the animal is within the applicable EZ (dependent upon species). Likewise, if a marine mammal is already within the EZ when first detected, UAGI and L–DEO will power-down the airguns immediately. During a power-down of the airgun array, USGS will also operate the 40 in^3 airgun. If a marine mammal is detected within or near the smaller EZ around that single airgun (Table 1), UAGI and L–DEO will shut-down the airgun (see next section).

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

- A PSVO has visually observed the animal leave the EZ, or
- A PSVO has not sighted the animal within the EZ for 15 min for species with shorter dive durations (*i.e.,* small odontocetes or pinnipeds), or 30 min for species with longer dive durations (*i.e.,* mysticetes; no large odontocetes, such as sperm whales, or beaked whales occur in the proposed survey area).

The airgun array will be ramped up gradually after the marine mammal has cleared the EZ (see *Ramp-up Procedures*).

Shut-Down Procedures

UAGI and L–DEO will shut down the operating airgun(s) if a marine mammal is seen within or approaching the EZ for the single airgun. A shut-down shall be implemented:

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

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

UAGI and L–DEO shall not resume airgun activity until the marine mammal has cleared the EZ or until the PSVO is confident that the animal has left the vicinity of the vessel. Criteria for judging that the animal has cleared the EZ will be as described in the preceding section regarding a power-down.

Ramp-Up Procedures

UAGI and L–DEO shall follow a ramp-up procedure when the airgun array begins operating after a specified period without airgun operations or when a power-down has exceeded that period. UAGI proposes that, for the present cruise, this period would be approximately 8 min. L–DEO has used similar periods (approximately 8 to 10 min) during previous L–DEO surveys.

Ramp-up will begin with the smallest airgun in the array (40 in^3). Airguns will be added in a sequence such that the source level of the array will increase in steps not exceeding 6 dB per 5 min period over a total duration of approximately 15–20 min. During ramp-up, the PSVOs will monitor the EZ, and if marine mammals are sighted, UAGI and L–DEO will implement a power-down or shut-down as though the full airgun array were operational.

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

Mitigation Conclusions

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

- The manner in which, and the degree to which, the successful implementation of the measure is expected to minimize adverse impacts to marine mammals;
- The proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and
- The practicability of the measure for applicant implementation.

Based on our evaluation of the applicant's proposed measures, NMFS has preliminarily determined that the mitigation measures proposed above provide the means of effecting the least practicable impact on marine mammal species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance. Proposed measures to ensure availability of such species or stock for taking for certain subsistence uses is discussed later in this document (see ''Impact on Availability of Affected Species or Stock for Taking for Subsistence Uses'' section).

Proposed Monitoring and Reporting

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

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

Vessel-Based Visual Monitoring

PSVOs will be based aboard the seismic source vessel and will watch for marine mammals near the vessel during daytime airgun operations and during any ramp-ups at night. PSVOs will also watch for marine mammals near the seismic vessel for at least 30 min prior to the start of airgun operations after an extended shut-down (as described in the ''Proposed Mitigation'' section earlier in this document). PSVOs will conduct observations during daytime periods when the seismic system is not operating for comparison of sighting rates and behavior with and without airgun operations and between acquisition periods. Based on PSVO observations, the airguns will be powered-down or shut-down when marine mammals are observed within or about to enter a designated EZ.

During seismic operations in the Arctic Ocean, at least five PSOs will be based aboard the *Langseth*. L–DEO will appoint the PSOs with NMFS' concurrence. Observations will take place during ongoing daytime operations and nighttime ramp-ups of the airguns. During the majority of seismic operations, two PSVOs will be on duty from the observation tower to monitor marine mammals near the seismic vessel. Use of two simultaneous PSVOs will increase the effectiveness of detecting animals near the source vessel. However, during meal times and bathroom breaks, it is sometimes difficult to have two PSVOs on effort, but at least one PSVO will be on duty. PSVO(s) will be on duty in shifts of duration no longer than 4 hr.

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

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

When marine mammals are detected within or about to enter the designated EZ, the airguns will immediately be powered-down or shut-down if necessary. The PSO(s) will continue to maintain watch to determine when the animal(s) are outside the EZ by visual confirmation. Airgun operations will not resume until the animal is confirmed to have left the EZ, or if not observed after 15 min for species with shorter dive durations (small odontocetes and pinnipeds) or 30 min for species with longer dive durations (mysticetes).

Passive Acoustic Monitoring (PAM)

PAM will complement the visual monitoring program, when practicable. Visual monitoring typically is not effective during periods of poor visibility or at night, and even with good visibility, is unable to detect marine mammals when they are below the surface or beyond visual range.

Besides the three PSVOs, an additional Protected Species Acoustic Observer (PSAO) with primary responsibility for PAM will also be aboard the vessel. UAGI and L–DEO can use acoustic monitoring in addition to visual observations to improve detection, identification, and localization of marine mammals. The acoustic monitoring will serve to alert visual observers (if on duty) when vocalizing marine mammals are detected. It is only useful when marine mammals call, but it can be effective either by day or by night and does not depend on good visibility. It will be monitored in real time so that the PSVOs can be advised when animals are detected acoustically. When bearings (primary and mirror-image) to calling animal(s) are determined, the bearings will be relayed to the visual observer to help him/her sight the calling animal(s).

The PAM system consists of hardware (*i.e.,* hydrophones) and software. The ''wet end'' of the system consists of a towed hydrophone array that is connected to the vessel by a tow cable. The array will be deployed from a winch located on the back deck. A deck cable will connect from the winch to the main computer laboratory where the acoustic station and signal conditioning and processing system will be located. The digitized signal and PAM system is monitored by PSAOs at a station in the main laboratory. The hydrophone array is typically towed at depths of less than 20 m (66 ft).

Ideally, the PSAO will monitor the towed hydrophones 24 hr per day at the seismic survey area during airgun operations and during most periods when the *Langseth* is underway while the airguns are not operating. However, PAM may not be possible if damage occurs to both the primary and back-up hydrophone arrays during operations. The primary PAM streamer on the *Langseth* is a digital hydrophone streamer. Should the digital streamer fail, back-up systems should include an analog spare streamer and a hull-mounted hydrophone. Every effort would be made to have a working PAM system during the cruise. In the unlikely event that all three of these systems were to fail, UAGI would continue science acquisition with the visual-based observer program. The PAM system is a supplementary enhancement to the visual monitoring program. If weather conditions were to prevent the use of PAM, then conditions would also likely prevent the use of the airgun array.

One PSAO will monitor the acoustic detection system at any one time, by listening to the signals from two channels via headphones and/or speakers and watching the real-time spectrographic display for frequency ranges produced by marine mammals. PSAOs monitoring the acoustical data will be on shift for 1–6 hours at a time. Besides the PSVO, an additional PSAO with primary responsibility for PAM will also be aboard the source vessel. All PSVOs are expected to rotate through the PAM position, although the most experienced with acoustics will be on PAM duty more frequently.

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

PSVO Data and Documentation

PSVOs will record data to estimate the numbers of marine mammals exposed to various received sound levels and to document apparent disturbance reactions or lack thereof. Data will be used to estimate numbers of animals potentially 'taken' by harassment (as defined in the MMPA). They will also provide information needed to order a power-down or shut-down of the airguns when a marine mammal is within or near the EZ. Observations will also be made during daytime periods when the *Langseth* is underway without seismic operations.

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

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

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

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

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

Results from the vessel-based observations will provide:

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

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

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

4. Information to compare the distance and distribution of marine mammals relative to the source vessel at times with and without seismic activity.

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

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

In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by the IHA (if issued), such as an injury (Level A harassment), serious injury or mortality (*e.g.,* ship-strike, gear interaction, and/or entanglement), UAGI and L–DEO will immediately cease the specified activities and immediately report the incident to the Chief of the Permits, Conservation, and Education Division, Office of Protected Resources, NMFS, and the Alaska Regional Stranding Coordinators. The report must include the following information:

- Time, date, and location (latitude/longitude) of the incident;
- Name and type of vessel involved;

- Vessel's speed during and leading up to the incident;
- Description of the incident;
- Status of all sound source use in the 24 hours preceding the incident;
- Water depth;
- Environmental conditions (*e.g.,* wind speed and direction, Beaufort sea state, cloud cover, and visibility);
- Description of all marine mammal observations in the 24 hours preceding the incident;
- Species identification or description of the animal(s) involved;
- Fate of the animal(s); and
- Photographs or video footage of the animal(s) (if equipment is available).

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

In the event that UAGI discovers an injured or dead marine mammal, and the lead PSO determines that the cause of the injury or death is unknown and the death is relatively recent (*i.e.,* in less than a moderate state of decomposition as described in the next paragraph), UAGI will immediately report the incident to the Chief of the Permits, Conservation, and Education Division, Office of Protected Resources, NMFS, and the NMFS Alaska Stranding Hotline and/or by e-mail to the Alaska Regional Stranding Coordinators. The report must include the same information identified in the paragraph above. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with UAGI to determine whether modifications in the activities are appropriate.

In the event that UAGI discovers an injured or dead marine mammal, and the lead PSO determines that the injury or death is not associated with or related to the activities authorized in the IHA (*e.g.,* previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), UAGI will report the incident to the Chief of the Permits, Conservation, and Education Division, Office of Protected Resources, NMFS, and the NMFS Alaska Stranding Hotline and/or by e-mail to the Alaska Regional Stranding Coordinators, within 24 hours of the discovery. UAGI will provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS and the Marine Mammal Stranding Network.

Estimated Take by Incidental Harassment

Except with respect to certain activities not pertinent here, the MMPA defines ''harassment'' as: ''any act of pursuit, torment, or annoyance which (i) Has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment].'' Only take by Level B harassment is anticipated and proposed to be authorized as a result of the proposed marine seismic survey in the Arctic Ocean. Acoustic stimuli (*i.e.,* increased underwater sound) generated during the operation of the seismic airgun array may have the potential to cause marine mammals in the survey area to be exposed to sounds at or greater than 160 dB or cause temporary, short-term changes in behavior. NMFS also assumes that marine mammals exposed to levels exceeding 160 dB re 1 μPa (rms) may experience Level B harassment. The use of the ADCP is not anticipated to result in the take of low-frequency cetaceans or pinnipeds, as the frequency for this device is outside of or at the extreme upper end of the hearing ranges of these species. There is no evidence that the planned activities could result in injury, serious injury, or mortality within the specified geographic area for which UAGI seeks the IHA. The proposed mitigation and monitoring measures will minimize any potential risk for injury, serious injury, or mortality.

The following sections describe UAGI's methods to estimate take by incidental harassment and present the applicant's estimates of the numbers of marine mammals that could be affected during the proposed seismic program. The estimates are based on a consideration of the number of marine mammals that could be disturbed appreciably by operations with the 10-airgun array to be used during approximately 5,500 km (3,417.5 mi) of survey lines in the Arctic Ocean.

The anticipated radii of influence of the MBES, SBP, and ADCP are less than those for the airgun array. UAGI assumes that, during simultaneous operations of the airgun array and the other sources, any marine mammals close enough to be affected by the MBES, SBP, and ADCP would already be affected by the airguns. However, whether or not the airguns are operating simultaneously with the other sources, marine mammals are expected to exhibit no more than short-term and inconsequential responses to the MBES, SBP, and ADCP given their characteristics (*e.g.,* narrow, downward-directed beam) and other considerations described previously. Therefore, UAGI provides no additional allowance for animals that could be affected by sound sources other than airguns.

UAGI calculated densities using data from the Chukchi Sea for the fall in depth strata 35–50 m (115–164 ft), 51–200 m (167–656 ft), and greater than 200 m (656 ft), mean group sizes from the Beaufort Whale Aerial Survey Project (BWASP) database, and values for trackline detection probability bias and availability bias, *f*(0) and *g*(0), from Harwood *et al.* (1996) for belugas, Thomas *et al.* (2002) for bowhead whales, and Forney and Barlow (1998) for gray whales. Based on the lack of any beluga whale sightings and very low densities of bowheads (0.0003–0.0044/km^2) and gray whales (0.0026–0.0042/km^2) during non-seismic periods of industry vessel operations in the Chukchi Sea in September–October 2006–2008 (Haley *et al.* 2010), and the lack of beluga, bowhead, or gray whale sightings during arctic cruises by the Healy in August–September 2005 or July–August 2006 (Haley 2006; Haley and Ireland 2006), the calculated densities are possibly overestimates. Accordingly, they were reduced by an order of magnitude. Densities were calculated for depths greater than 200 m (656 ft) and less than 200 m (656 ft); in the latter case, the densities were effort-weighted averages of the 35–50 m (115–164 ft) and 51–200 m (167–656 ft) densities.

There is evidence of the occasional occurrence of humpback, minke, fin, and killer whales in the northern Chukchi Sea, but because they occur so infrequently in the Chukchi Sea, little to no data are available for the calculation of densities. Minimal densities have therefore been assigned to these species to allow for chance encounters.

Four species of pinnipeds under NMFS jurisdiction could be encountered in the proposed seismic survey area: ringed seal, bearded seal, ribbon seal, and spotted seal. Bengtson *et al.* (2005) reported ringed and bearded seal densities in nearshore fast ice and pack ice and offshore pack ice based on aerial surveys in May–June 1999 and May 2000; ringed seal but not bearded seal densities were corrected for haulout behavior. UAGI used densities from the offshore stratum (12P). Bearded seal densities were used for water depths less than 200 m (656 ft) and were assumed to be zero in water depths greater than 200 m (656 ft) because they are predominantly benthic feeders. The fall densities of ringed seals in the open water of the offshore survey area have been estimated as 1/10 of the spring pack ice densities because ringed seals are strongly associated with sea ice and begin to reoccupy nearshore fast ice areas as it forms in the fall. The resulting densities (.081/km^2 in 1999 and .023/km^2 in 2000) are similar to ringed seal density estimates (0.016/km^2 to 0.069/km^2) from industry vessel operations during summer 2006–2008 (Haley *et al.*, 2010).

Little information is available on spotted seal or ribbon seal densities in offshore areas of the Chukchi Sea. Spotted seal density in the summer was estimated by multiplying the ringed seal density by 0.02. This calculation was based on the ratio of the estimated Chukchi populations of the two species: 8% of the Alaskan population of spotted seals is present in the Chukchi Sea during the summer and fall (Rugh *et al.,* 1997); the Alaskan population of spotted seals is 59,214 (Allen and Angliss, 2010); and the population of ringed seals in the Alaskan Chukchi Sea is greater than 208,000 (Bengtson *et al.,* 2005). The ribbon seal density used is based on two ribbon seal sightings reported during industry vessel operations in the Chukchi Sea in 2006–2008 (Haley *et al.,* 2010).

Table 2 in this document (and Table 3 in UAGI's application) provides the estimated densities of marine mammals expected to occur in the proposed survey area. As noted previously, there is some uncertainty about the representativeness of the data and assumptions used in the calculations. Because few data were available for the survey area, UAGI calculated densities based on densities observed in adjacent areas of the northern Chukchi Sea, adjusted downward by various assumed factors (see above and UAGI's application). For species seen only rarely in the northern Chukchi Sea, UAGI assigned low densities. It is not known how closely the densities that were used reflect the actual densities that will be encountered; however, the approach used here is believed to be the best available at this time. The estimated numbers of individuals potentially exposed are presented below based on the 160-dB re 1 μParms criterion for all marine mammals.

TABLE 2—EXPECTED DENSITIES OF MARINE MAMMALS IN THE OFFSHORE SURVEY AREA OF THE ARCTIC OCEAN NORTH OF THE CHUKCHI SEA IN SEPTEMBER–OCTOBER 2011. CETACEAN DENSITIES ARE CORRECTED FOR F(0) AND G(0) BIASES. SPECIES LISTED AS ENDANGERED ARE IN ITALICS

Species	Density (#/1000 km^2) in depths <200 m	Density (#/1000 km^2) in depths >200 m
Mysticetes:		
Bowhead Whale	1.87	0
Gray Whale	1.48	0
Fin Whale	0.01	0.01
Humpback Whale	0.01	0.01
Minke Whale	0.01	0.01
Odontocetes:		
Beluga	1.65	6.78
Killer whale	0.01	0.01
Pinnipeds:		
Bearded Seal	14.18	0
Spotted Seal	0.98	0.98
Ringed Seal	48.92	48.92
Ribbon Seal	0.27	0.27

UAGI's estimates of exposures to various sound levels assume that the proposed survey will be fully completed; in fact, the ensonified areas calculated using the planned number of line-kilometers have been increased by 25% to accommodate turns, lines that may need to be repeated, equipment testing, etc. As is typical during offshore ship surveys, inclement weather and equipment malfunctions are likely to cause delays and may limit the number of useful line-kilometers of seismic operations that can be undertaken. The *Langseth* is not ice-strengthened and will completely avoid ice, so it is very likely that the survey will not be completed because ice likely will be present. Furthermore, any marine mammal sightings within or near the designated EZ 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 (rms) sounds are precautionary, and probably overestimate the actual numbers of marine mammals that might be involved. These estimates assume that there will be no ice, weather, equipment, or mitigation delays, which is highly unlikely.

UAGI estimated the number of different individuals that may be exposed to airgun sounds with received levels greater than or equal to 160 dB re 1 μPa (rms) on one or more occasions by considering the total marine area that would be within the 160 dB radius around the operating airgun array on at least one occasion and the expected density of marine mammals. The number of possible exposures (including repeated exposures of the same individuals) can be estimated by considering the total marine area that would be within the 160 dB radius around the operating airguns, including areas of overlap. In the proposed survey, the seismic lines are widely spaced in the survey area, so few individual marine mammals would be exposed more than once during the survey. The area including overlap is only 1.3 times the area excluding overlap. Moreover, it is unlikely that a particular animal would stay in the area during the entire survey. The number of different individuals potentially exposed to received levels greater than or equal to 160 re 1 μPa (rms) was calculated by multiplying:

(1) The expected species density, times.

(2) The anticipated area to be ensonified to that level during airgun operations in each depth stratum, excluding overlap.

The area expected to be ensonified was determined by entering the planned survey lines into a MapInfo GIS, using the GIS to identify the relevant areas by ''drawing'' the applicable 160 dB buffer (see Table 1 in this document and in the IHA application) around each seismic line, and then calculating the total area within the buffers. Areas of overlap (because of lines being closer together than the 160 dB radius) were limited and included only once when estimating the number of individuals exposed. Before calculating numbers of individuals exposed, the areas were increased by 25% as a precautionary measure.

For species whose densities were the same regardless of water depth, UAGI used ensonified areas for all water depths to calculate numbers exposed. For species whose densities were different in water depths less than 200 m (656 ft) and greater than 200 m (656 ft; see Table 2 in this document and Table 3 in UAGI's application), UAGI used ensonified areas for tracklines in water depths less than 200 m (656 ft) and the sum of the ensonified areas in water depths 200–1,000 m (656–3,280 ft) and greater than 1,000 m (3,280 ft) and applied them to the different densities.

Table 4 in UAGI's application shows the estimates of the number of different individual marine mammals that potentially could be exposed to sounds greater than or equal to 160 dB re 1 μPa (rms) during the proposed seismic survey if no animals moved away from the survey vessel. Table 3 in this document presents the abundance of the different species or stocks, proposed take authorization, and the percentage of the regional population or stock. Table 4 in UAGI's application includes species beyond those presented in Table 3 in this document for which take is requested. Walrus and polar bears are not included in this document because those species are under the jurisdiction of the USFWS. Although presented in Table 4 in UAGI's application, no take has been requested and none is proposed to be authorized for narwhal or harbor porpoise. Because the harbor porpoise is mainly a shallow-water species, it is not expected to occur in the survey area. Narwhals are considered extralimital in Alaska, and any vagrants likely would be associated with sea ice. The *Langseth* is not ice-strengthened and will completely avoid ice, so encounters with narwhals are not expected.

Applying the approach described above, approximately 122,530 km^2 (47,309 mi^2; approximately 153,163 km^2 [59,137 mi^2] including the 25% contingency) would be within the 160-dB isopleth on one or more occasions during the survey. For less than 200 m (656 ft) and greater than 200 m (656 ft) depth ranges, the areas are 38,188 km^2 (14,744 mi^2; 47,736 km^2 [18,431 mi^2] including the 25% contingency) and 84,342 km^2 (32,565 mi^2; 105,427 km^2 [40,706 mi^2] including the 25% contingency), respectively. Because this approach does not allow for turnover in the mammal populations in the study area during the course of the survey, the actual number of individuals exposed could be underestimated in some cases. However, the approach assumes that no marine mammals will move away from or toward the trackline as the *Langseth* approaches in response to increasing sound levels prior to the time the levels reach 160 dB, which will result in overestimates for those species known to avoid seismic vessels. The take estimates presented in this section of the document do not take into consideration the mitigation and monitoring measures that are proposed for inclusion in the IHA (if issued).

TABLE 3—POPULATION ABUNDANCE ESTIMATES, TOTAL PROPOSED TAKE, AND THE PERCENTAGE OF THE POPULATION OR STOCK THAT MAY BE EXPOSED TO SOUNDS ≥160 DB RE 1 μPA (RMS) DURING THE PROPOSED SEISMIC SURVEY IN THE ARCTIC OCEAN, SEPTEMBER–OCTOBER 2011

Species	Abundance [1]	Proposed take authorization	Percentage of population or stock
Bowhead Whale	[2] 14,731	89	0.6
Gray Whale	19,126	71	0.4
Humpback Whale	[3] 20,800	2	0.01
Minke Whale	810	2	0.2
Fin Whale	5,700	2	0.04
Beluga Whale	[4] 42,968	794	1.8
Killer Whale	[5] 768	2	0.3
Bearded Seal	250,000–300,000	677	0.2–0.3
Spotted Seal	59,214	150	0.3
Ringed Seal	249,000	7,492	3
Ribbon Seal	49,000	42	0.09

[1] Unless stated otherwise, abundance estimates are from Allen and Angliss (2011).
[2] Based on estimate of 10,545 individuals in 2001 with a 3.4% annual growth rate (George *et al.*, 2004 and revised by Zeh and Punt, 2005).
[3] North Pacific Ocean (Barlow *et al.*, 2009).
[4] Based on estimates for the eastern Chukchi Sea and Beaufort Sea stocks (Allen and Angliss, 2011).
[5] Based on estimates for the Northern resident and transient stocks (Allen and Angliss, 2011).

Encouraging and Coordinating Research

UAGI and NSF will coordinate the planned marine mammal monitoring program associated with the seismic survey in the Arctic Ocean with other parties that may have interest in the area and/or be conducting marine mammal studies in the same region during the proposed seismic survey. No other marine mammal studies are expected to occur in the study area at the proposed time. However, other industry-funded seismic surveys may be occurring in the northeast Chukchi and/or western Beaufort Sea closer to shore, and those projects are likely to involve marine mammal monitoring. UAGI and NSF have coordinated, and will continue to coordinate, with other applicable Federal, State, and Borough agencies, and will comply with their requirements.

Negligible Impact and Small Numbers Analysis and Preliminary Determination

NMFS has defined ''negligible impact'' in 50 CFR 216.103 as ''* * * an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.'' In making a negligible impact determination, NMFS considers a variety of factors, including but not limited to: (1) The number of anticipated mortalities; (2) the number and nature of anticipated injuries; (3) the number, nature, intensity, and duration of Level B harassment; and (4) the context in which the takes occur.

For reasons stated previously in this document, no injuries or mortalities are anticipated to occur as a result of UAGI's proposed seismic survey, and none are proposed to be authorized by NMFS. Additionally, for reasons presented earlier in this document, temporary hearing impairment (and especially permanent hearing impairment) is not anticipated to occur during the proposed specified activity. Impacts to marine mammals are anticipated to be in the form of Level B behavioral harassment only, due to the brief duration and sporadic nature of the survey. Certain species may have a behavioral reaction (*e.g.,* increased swim speed, avoidance of the area, *etc.*) to the sound emitted during the proposed marine seismic survey. Table 3 in this document outlines the number of Level B harassment takes that are anticipated as a result of the proposed activities. No mortality or injury is expected to occur, and due to the nature, degree, and context of behavioral harassment anticipated, the activity is not expected to impact rates of recruitment or survival. The proposed survey would not occur in any areas designated as critical habitat for ESA-listed species. Additionally, as mentioned previously in this document, the proposed seismic survey will not destroy marine mammal habitat.

While some of the species could potentially occur in the proposed survey area year-round, some species only occur at certain times of the year. In the fall, bowhead whales begin their westward migration through the Beaufort Sea in late August/early September. The whales usually reach Barrow around mid-September. It is likely that most bowhead whales will not enter the proposed survey area until about the second half of the proposed survey time period. Additionally, humpback and fin whales have only started to be sighted in the Chukchi Sea in the last 5–6 years. As the extent of Arctic sea ice begins to change, these species may be expanding their normal range further north. However, this is still considered the extreme northern edge of the range of these species, so it is unlikely that they will be present throughout the entire proposed survey time period.

Of the 11 marine mammal species likely to occur in the proposed survey area, three are listed as endangered under the ESA: Bowhead, humpback, and fin whale. All of these species are also considered depleted under the MMPA. As stated previously in this document, the affected bowhead whale stock has been increasing at a rate of 3.4% per year since 2001. On December 10, 2010, NMFS published a notification of proposed threatened status for subspecies of the ringed seal (75 FR 77476) and a notification of proposed threatened and not warranted status for subspecies and distinct population segments of the bearded seal (75 FR 77496) in the **Federal Register**. Neither species is considered depleted under the MMPA. The listing for these species is not anticipated to be completed prior to the end of this proposed seismic survey. Certain stocks of beluga whale and spotted seal are listed or proposed for listing under the ESA. However, those stocks do not occur in the proposed project area.

As has been noted previously in this document, many cetacean species, especially mysticetes, may display avoidance reactions and not enter into areas close to the active airgun array. However, alternate areas are available to these species. The location of the survey is not a known feeding ground for these species. It is not used for breeding or nursing. Although ice seals breed and nurse in the Chukchi Sea, the survey occurs outside of the time for ice seal breeding or nursing in the Chukchi Sea.

The population estimates for the species that may potentially be taken as a result of UAGI's proposed seismic survey were presented earlier in this document. For reasons described earlier in this document, the maximum calculated number of individual marine mammals for each species that could potentially be taken by harassment is small relative to the overall population sizes (3% for ringed seals, 1.8% for beluga whales, and less than 1% of each of the other 9 marine mammal populations or stocks).

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the mitigation and monitoring measures, NMFS preliminarily finds that the proposed seismic survey will result in the incidental take of small numbers of marine mammals and that the total taking from UAGI's proposed activities will have a negligible impact on the affected species or stocks. Impact on

Availability of Affected Species or Stock for Taking for Subsistence Uses

Relevant Subsistence Uses

Subsistence remains the basis for Alaska Native culture and community. Marine mammals are legally hunted in Alaskan waters by coastal Alaska Natives. In rural Alaska, subsistence activities are often central to many aspects of human existence, including patterns of family life, artistic expression, and community religious and celebratory activities. Additionally, the animals taken for subsistence provide a significant portion of the food that will last the community throughout the year. The main species that are hunted include bowhead and beluga whales, ringed, spotted, and bearded seals, walruses, and polar bears. (As mentioned previously in this document, both the walrus and the polar bear are under the USFWS' jurisdiction.) The importance of each of these species varies among the communities and is largely based on availability.

Barrow and Wainwright, which is in the Chukchi Sea, are the two villages that are closest to the proposed survey area, which will be initiated more than 200 km (124 mi) offshore. Marine mammals are also hunted in the Beaufort Sea villages of Kaktovik and Nuiqsut (mostly from Cross Island). Other villages in the Chukchi Sea that hunt for marine mammals include Point Lay, Point Hope, Kivalina, and Kotzebue. The villages of Kivalina and Kotzebue are many hundreds of miles south of the proposed project area.

(1) Bowhead Whale

Bowhead whale hunting is the key activity in the subsistence economies of Barrow and two smaller communities to the east, Nuiqsut and Kaktovik. Bowhead whales are also hunted by communities along the Chukchi Sea. The community of Barrow hunts bowhead whales in both the spring and fall during the whales' seasonal migrations along the coast. The communities of Nuiqsut and Kaktovik participate only in the fall bowhead harvest. The spring hunt at Barrow occurs after leads open because of the deterioration of pack ice; the spring hunt typically occurs from early April until the first week of June. The fall migration of bowhead whales that summer in the eastern Beaufort Sea typically begins in late August or September. The location of the fall subsistence hunt depends on ice conditions and (in some years) industrial activities that influence the bowheads movements as they move west (Brower, 1996). In the fall, subsistence hunters use aluminum or fiberglass boats with outboards. Hunters prefer to take bowheads close to shore to avoid a long tow during which the meat can spoil, but Braund and Moorehead (1995) report that crews may (rarely) pursue whales as far as 80 km (50 mi) offshore. The autumn hunt at Barrow usually begins in mid-September, and mainly occurs in the waters east and northeast of Point Barrow. The whales have usually left the Beaufort Sea by late October (Treacy, 2002a,b). Along the Chukchi Sea coast, bowhead whales have recently primarily been hunted during the spring, between March and June. However, with changing ice patterns, there is a possibility that Chukchi Sea villages could begin participating in fall bowhead whale hunts. Table 4 in this document (Table 5 in UAGI's application) presents harvest data for the years 1993–2008 for bowhead whale hunts in five North Slope communities.

The proposed survey will not have any impacts on the spring bowhead whale hunt by communities along the Chukchi Sea and Barrow, as those hunts are completed many months prior to the beginning of this proposed survey. The villages of Kaktovik and Nuiqsut are several hundred miles to the east of the proposed survey location. Therefore, no impacts are anticipated on the fall hunts at Kaktovik or Nuiqsut (Cross Island). The closest tracklines to Barrow are more than 200 km (124 mi) and in most cases between 250 and 800 km (155–497 mi) to the northwest of Barrow. The whales will reach Barrow before they enter into the proposed survey area.

Table 4. Number of bowhead whales landed, by year, at Point Hope, Wainwright, Barrow, Cross Island (Nuiqsut), and Kaktovik, 1993-2008. Barrow numbers include the total number of whales landed for the year followed by the numbers landed during the fall hunt in parenthesis.

Year	Point Hope	Wainwright	Barrow	Cross Island	Kaktovik
1993	2	5	23 (7)	3	3
1994	5	4	16 (1)	0	3
1995	1	5	19 (11)	4	4
1996	3	3	24 (19)	2	1
1997	4	3	30 (21)	3	4
1998	3	3	25 (16)	4	3
1999	2	5	24 (6)	3	3
2000	3	5	18 (13)	4	3
2001	4	6	27 (7)	3	4
2002	0	1	22 (17)	4	3
2003	4	5	16 (6)	4	3
2004	3	4	21 (14)	3	3
2005	7	4	29 (13)	1	3
2006	0	2	22 (19)	4	3
2007	3	4	20 (7)	3	3
2008	2	2	21(12)	4	3

Sources:USDI/BLM and references therein; Burns et al. (1993); Koski et al. (2005); Suydam et al. 2004, 2005, 2006, 2007, 2008, 2009.

(2) Beluga Whale

Beluga whales are available to subsistence hunters at Barrow in the spring when pack-ice conditions deteriorate and leads open up. Belugas may remain in the area through June and sometimes into July and August in ice-free waters. Hunters usually wait until after the spring bowhead whale hunt is finished before turning their attention to hunting belugas. Few, if any, belugas are taken by Kaktovik and Nuiqsut hunters and only during the fall whale harvest. Along the Chukchi Sea, belugas are hunted during the spring and in the summer (between July and August) by residents of Wainwright and Point Hope. Near Point Lay, belugas are taken in June and July. During 2002–2006, Alaska Native subsistence hunters took a mean annual number of 25.4 beluga whales from the Beaufort Sea stock and 59 from the eastern Chukchi Sea stock. The average annual harvest of beluga whales taken by Barrow for 1962–1982 was five (MMS, 1996). The Alaska Beluga Whale Committee recorded that 23 beluga whales had been harvested by Barrow hunters from 1987 to 2002, ranging from 0 in 1987, 1988, and 1995 to the high of 8 in 1997 (Fuller and George, 1999; Alaska Beluga Whale Committee, 2002 cited in USDI/BLM, 2005).

UAGI's proposed seismic survey is not anticipated to impact beluga hunts conducted by villages of the North Slope. The timing of the proposed survey is after the spring and summer beluga harvests in the Chukchi Sea. Although hunting of beluga from Point Hope may extend into September, off Point Hope, the vessel will remain approximately 80 km (50 mi) from the coast, in transit northward to the study area.

(3) Ice Seals

Ringed seals are hunted by villagers along the Beaufort Sea coast mainly from October through June. Hunting for these smaller mammals is concentrated during winter because bowhead whales, bearded seals, and caribou are available through other seasons. Winter leads in the area off Point Barrow and along the barrier islands of Elson Lagoon to the east are used for hunting ringed seals. The average annual ringed seal harvest by the community of Barrow from the 1960s through much of the 1980s has been estimated as 394. Along the Chukchi Sea coast, ringed seals are mainly taken between May and September near Wainwright, and throughout the year by Point Lay and Point Hope hunters. As the seismic survey will occur far offshore, the survey will not affect ringed seals in the nearshore areas where they are hunted. It is unlikely that accessibility to ringed seals during the subsistence hunt could be impaired during the *Langseth's* transit to and from the study area when the airguns are not operating. Although some hunting in the Chukchi Sea does occur as far as 32 km (20 mi) from shore, the area affected during transit would be in close proximity to the ship, which will be transiting approximately 80 km (50 mi) offshore.

The spotted seal subsistence hunt on the Beaufort Sea coast peaks in July and August, at least in 1987–1990, but involves few animals. Spotted seals typically migrate south by October to overwinter in the Bering Sea. Admiralty Bay, less than 60 km (37 mi) to the east of Barrow (and more than 260 km [162 mi] from the proposed survey area), is a location where spotted seals are harvested. Spotted seals are also occasionally hunted in the area off Point Barrow and along the barrier islands of Elson Lagoon to the east (USDI/BLM, 2005). The average annual spotted seal harvest by the community of Barrow from 1987–1990 was one (Braund *et al.,* 1993). Along the Chukchi Sea coast, seals are mainly taken between May and September near Wainwright, and throughout the year by Point Lay and Point Hope hunters.

The proposed seismic survey will take place at least 200 km offshore from the preferred nearshore harvest area of these seals. It is unlikely that accessibility to spotted seals during the subsistence hunt could be impaired during the *Langseth's* transit to and from the study area when the airguns are not operating. Although some hunting in the Chukchi Sea does occur as far as 40 km (25 mi) from shore, the area affected during transit would be in close proximity to the ship.

Bearded seals, although not favored for their meat, are important to subsistence activities in Barrow because of their skins. Six to nine bearded seal hides are used by whalers to cover each of the skin-covered boats traditionally used for spring whaling. Because of their valuable hides and large size, bearded seals are specifically sought. Bearded seals are harvested during the summer months in the Beaufort Sea (USDI/BLM, 2005). The summer hunt typically occurs near Thetis Island in July through August (prior to initiation of UAGI's proposed survey). The animals inhabit the environment around the ice floes in the drifting ice pack, so hunting usually occurs from boats in the drift ice. Braund *et al.* (1993) estimated that 174 bearded seals were harvested annually at Barrow from 1987 to 1990. The majority of bearded seal harvest sites from 1987 to 1990 was within approximately 24 km (15 mi) of Point Barrow (Braund *et al.,* 1993), well inshore of the proposed survey. Along the Chukchi Sea coast, bearded seals are mainly taken between May and September near Wainwright, during the spring and summer by Point Hope hunters, and throughout the year by Point Lay hunters. These hunts occur closer into shore than the proposed survey area or the proposed transit route.

Potential Impacts to Subsistence Uses

NMFS has defined ''unmitigable adverse impact'' in 50 CFR 216.103 as:

* * * an impact resulting from the specified activity: (1) That is likely to reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs by: (i) Causing the marine mammals to abandon or avoid hunting areas; (ii) Directly displacing subsistence users; or (iii) Placing physical barriers between the marine mammals and the subsistence hunters; and (2) That cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met.

Noise emitted during the proposed seismic survey from the acoustic sources has the potential to impact marine mammals hunted by Native Alaskans. In the case of cetaceans, the most common reaction to anthropogenic sounds (as noted previously in this document) is avoidance of the ensonified area. In the case of bowhead whales, this often means that the animals divert from their normal migratory path by several kilometers. However, because the proposed survey occurs so far from any of the traditional hunting grounds and to the west of the fall bowhead hunting areas (meaning the whales would reach the hunting grounds before entering the survey area), it is not anticipated that there will be impacts to subsistence uses.

Plan of Cooperation (POC)

Regulations at 50 CFR 216.104(a)(12) require MMPA authorization applicants for activities that take place in Arctic waters to provide a POC or information that identifies what measures have been taken and/or will be taken to minimize adverse effects on the availability of marine mammals for subsistence purposes. UAGI has worked with the people of the North Slope Borough (NSB) to identify and avoid areas of potential conflict. The project's principal investigator (PI) contacted Dr. Glenn Sheehan of the Barrow Arctic Science Consortium and NSB biologist, Dr. Robert Suydam, on January 7, 2010, to inform them of the proposed study and the elements intended to minimize potential subsistence conflict. The PI presented the proposed UAGI survey at a meeting of the Alaska Eskimo Whaling Commission (AEWC) in Barrow on February 11, 2010. He explained the survey plans to the local residents, including NSB Department of Wildlife Management biologists, consulted with stakeholders about their concerns, and discussed the aspects of the survey designed to mitigate impacts. No major concerns were expressed. The PI also attended the 2011 AEWC meeting on February 17–18; representatives from all NSB communities attended. The only concern expressed was that AEWC would like a good communication link with the *Langseth* during the survey. As requested by AEWC, communication lines between the NSB and the *Langseth* during the survey will be kept open in order to minimize potential conflicts. The study was also presented to government agencies, affected stakeholders, and the general public at the annual Arctic Open-water Meeting in Anchorage, Alaska, on March 7–8, 2011.

As part of its MMPA IHA application, UAGI submitted a POC to NMFS. As noted in the POC, a Barrow resident knowledgeable about the mammals and fish of the area is expected to be included as a PSO aboard the *Langseth.* Although the primary duty of this individual will be as a member of the PSO team responsible for implementing the monitoring and mitigation requirements, this person will also be able to act as a liaison with hunters if they are encountered at sea. However, the proposed activity has been timed so as to avoid overlap with the main harvests of marine mammals (especially bowhead whales). Meetings with whaling captains, other community representatives, the AEWC, NSB, and any other parties to the POC have been and will continue to be held, as necessary, to negotiate the terms of the POC and to coordinate the planned seismic survey operations with subsistence activity.

Unmitigable Adverse Impact Analysis and Preliminary Determination

NMFS has preliminarily determined that UAGI's proposed marine seismic survey in the Arctic Ocean will not have an unmitigable adverse impact on the availability of marine mammal species or stocks for taking for subsistence uses.

This preliminary determination is supported by the fact that UAGI and NSF have worked closely with the AEWC and NSB to ensure that the proposed activities are not co-located with annual subsistence activities. Additionally, the proposed seismic survey will occur more than 200 km (124 mi) offshore of the North Slope and to the west of the communities that conduct fall bowhead whale subsistence hunts. This means that the whales will reach the communities prior to entering into the proposed survey area. The Chukchi Sea beluga hunts are typically completed prior to the time the *Langseth* would be transiting through the Chukchi Sea to the survey site. Should late summer or early fall hunts of certain species be occurring at the time of transit of the vessel, the hunts occur closer into shore than the proposed transit route of the *Langseth.*

Based on the measures described in UAGI's POC, the proposed mitigation and monitoring measures (described earlier in this document), and the project design itself, NMFS has determined preliminarily that there will not be an unmitigable adverse impact on subsistence uses from UAGI's marine seismic survey.

Endangered Species Act (ESA)

Three of the marine mammal species that could occur in the proposed seismic survey area are listed under the ESA: Bowhead whale; humpback whale; and fin whale. Under Section 7 of the ESA, NSF has initiated formal consultation with the NMFS, Office of Protected Resources, Endangered Species Division, on this proposed seismic survey. NMFS's Office of Protected Resources, Permits, Conservation and Education Division, has also initiated formal consultation under section 7 of the ESA with NMFS' Office of Protected Resources, Endangered Species Division, to obtain a Biological Opinion evaluating the effects of issuing the IHA on ESA-listed marine mammals and, if appropriate, authorizing incidental take. NMFS will conclude formal section 7 consultation prior to making a determination on whether or not to issue the IHA. If the IHA is issued, UAGI, in addition to the mitigation and monitoring requirements included in the IHA, will be required to comply with the Terms and Conditions of the Incidental Take Statement corresponding to NMFS's Biological Opinion issued to both NSF and NMFS's Office of Protected Resources. Although the ringed seal and bearded seal have been proposed for listing under the ESA, neither of the listings will be finalized prior to conclusion of the proposed seismic survey. Therefore, consultation pursuant to section 7 of the ESA is not needed for these species.

National Environmental Policy Act (NEPA)

With its complete application, UAGI and NSF provided NMFS an EA analyzing the direct, indirect, and cumulative environmental impacts of the proposed specified activities on marine mammals including those listed as threatened or endangered under the ESA. The EA, prepared by LGL on behalf of NSF is entitled ''Environmental Assessment of a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Arctic Ocean, September–October 2011.'' Prior to making a final decision on the IHA application, NMFS will either prepare an independent EA, or, after review and evaluation of the NSF EA for consistency with the regulations published by the Council on Environmental Quality and NOAA Administrative Order 216–6, Environmental Review Procedures for Implementing the National Environmental Policy Act, adopt the NSF EA and make a decision of whether or not to issue a Finding of No Significant Impact.

Proposed Authorization

As a result of these preliminary determinations, NMFS proposes to authorize the take of marine mammals incidental to UAGI's proposed marine seismic survey in the Arctic Ocean, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated.

Dated: July 11, 2011.

James H. Lecky,

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

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BILLING CODE 3510–22–P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

[RIN 0648–XA562]

Taking and Importing Marine Mammals; Taking Marine Mammals Incidental to Operation and Maintenance of the Neptune Liquefied Natural Gas Facility off Massachusetts

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

ACTION: Notice of issuance of a Letter of Authorization.

SUMMARY: In accordance with the Marine Mammal Protection Act (MMPA), as amended, and implementing regulations, notification is hereby given that a Letter of Authorization (LOA) has been issued to Neptune LNG LLC (Neptune) to take marine mammals, by harassment, incidental to port commissioning and operations, including maintenance and repair activities, at the Neptune Deepwater Port (the Port) in Massachusetts Bay.

DATES: Effective from July 12, 2011, through July 10, 2016.

ADDRESSES: The LOA and supporting documentation may be obtained by writing to Michael Payne, Chief, Permits, Conservation and Education Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910, calling the contact listed under **FOR FURTHER INFORMATION CONTACT,** or visiting the Internet at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm.* Documents cited in this notice may also be viewed, by appointment, during regular business hours at the above address.

The Final Environmental Impact Statement (Final EIS) on the Neptune Deepwater Port License Application authored by the Maritime Administration (MARAD) and U.S. Coast Guard (USCG) is available for viewing at *http://www.regulations.gov* by entering the search words ''Neptune LNG.''

FOR FURTHER INFORMATION CONTACT: Candace Nachman, Office of Protected Resources, NMFS, (301) 427–8401.

SUPPLEMENTARY INFORMATION:

Background

Section 101(a)(5)(A) of the MMPA (16 U.S.C. 1361 *et seq.*) directs the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of small numbers 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 regulations are issued. Under the MMPA, the term ''take'' means to harass, hunt, capture, or kill or to attempt to harass, hunt, capture, or kill any marine mammal.

Authorization for incidental takings may be granted for periods up to 5 years, after notification and opportunity for public comment, 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