NOAA's National Marine Fisheries Service
Endangered Species Act Section 7 Consultation

Biological Opinion

Agencies:	United States Geological Survey And The Permits, Conservation, and Education Division of the Office of Protected Resources, NOAA's National Marine Fisheries Service
Activities Considered:	Geophysical Survey by the United States Geological Survey in the Central-Western Bering Sea and Issuance of an Incidental Harassment Authorization Pursuant to Section 101(a)(5)(D) of the Marine Mammal Protection Act
Consultation Conducted by:	Endangered Species Division of the Office of Protected Resources, NOAA's National Marine Fisheries Service
Approved by:	
Date:	AUG 5 2011

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA) (16 U.S.C. 1531 *et seq.*) requires each federal agency to insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When a federal agency's action "may affect" listed species or designated critical habitat, that agency is required to consult formally with either NOAA's National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS), depending upon the listed resources that may be affected. Federal agencies are exempt from this requirement if they have concluded that an action "may affect", but is "unlikely to adversely affect" listed species or designated critical habitat, and NMFS and/or USFWS concur with that conclusion (50 CFR 402.14[b]).

This document represents NMFS' Biological Opinion (Opinion) on the effects of two separate but related federal actions on threatened and endangered species and designated critical habitat. The first action is the United States Geological Survey's (USGS') proposed marine geophysical survey in the central-western Bering Sea. Since these surveys would result in "takes" of marine mammals incidental to this survey, this Opinion also considers NMFS' Office of Protected Resources—Permits, Conservation, and Education Division's (Permits Division's) proposed issuance of an Incidental Harassment Authorization (IHA) pursuant to the Marine Mammal Protection Act (MMPA), 16 U.S.C. §1371 (a)(5)(D) for the aforementioned surveys. Therefore, the action agencies for this consultation are USGS and the Permits Division. The consulting agency is NMFS' Office of Protected Resources—Endangered Species Division (Endangered Species Division).

This Opinion is based on information provided in the IHA application, draft IHA, environmental assessment, monitoring reports from similar activities, published and unpublished scientific information on endangered and threatened species, scientific and commercial information such as reports from government agencies and the peer-reviewed literature, biological opinions on similar activities, and other relevant sources of information.

CONSULTATION HISTORY

On April 8, 2011, the Endangered Species Division received a request for formal consultation from USGS on their proposed geophysical survey to be conducted in the Central-Western Bering Sea from August 7 through September 1, 2011. This request was accompanied by an environmental assessment as well as a copy of the IHA application that was submitted to the Permits Division for harassment of marine mammals incidental to the proposed survey. The Endangered Species Division deemed the initiation package sufficient and initiated consultation on the USGS' proposed action.

On June 3, 2011, the Endangered Species Division received a request for formal consultation from the Permits Division regarding the proposed issuance of an IHA for harassment of marine mammals incidental to the proposed survey. The issuance of the IHA represented a related but separate federal action and was treated as such by the Endangered Species Division. The initiation package contained similar materials than what was included in the USGS' initiation package along with a copy of the Federal Register notice soliciting public comment on their intent to issue an IHA. The Endangered Species Division deemed the initiation package sufficient and initiated consultation on the Permits Division's proposed action. While the Endangered Species Division initiated consultation on the Permit's Division proposed action at a later time than the USGS proposed action, the Endangered Species Division consulted on these two actions concurrently.

On July 20, 2010, the Endangered Species Division contacted the Permits Division regarding the status of the draft IHA. The Permits Division provided information on the status of the IHA as well as information that the methods for the proposed action as well as the mitigation measures to be required did not change from those that had been provided in the USGS' original application that was provided to the Endangered Species Division on June 3, 2011.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTIONS

The proposed action for this consultation involves two separate but related actions. First, the USGS proposes to conduct a marine geophysical survey in the central-western Bering Sea from approximately August 7th through September 1st, 2011. The survey will take place within the Exclusive Economic Zone (EEZ) of the U.S. and adjacent international waters approximately 350 kilometers from the coast. The survey will be conducted on the *R/V Langseth* which is owned by the National Science Foundation (NSF) and operated through a Cooperative

Agreement by Colombia University's Lamont-Doherty Earth Observatory (LDEO). As owners of the *R/V Langseth*, NSF will participate as a Cooperating Agency with USGS. As this survey is expected to incidentally harass marine mammals, the Permits Division proposes to issue an IHA pursuant to Section 101(a)(5)(D) of the MMPA to USGS based on their request. The IHA would be valid from August 7-October 1, 2011, and would authorize the incidental harassment of fin whales, humpback whales, sei whales, sperm whales and steller sea lions as well as other non-ESA listed whales and pinnipeds. The Permits Division estimated that the proposed action would incidentally harass 61 fin whales, 6 humpback whales, 1 sei whale, 1 sperm whale, and 42 Steller sea lions. Listed leatherback sea turtles are also expected to be harassed during the conduct of the seismic activities. While issuance of the IHA represents a separate federal action from the USGS' marine geophysical survey, the Endangered Species Division is analyzing both actions concurrently for this consultation. Below is a summary of the two proposed actions. More details can be found in the USGS' IHA application and draft Environmental Assessment document.

Overview of the Marine Geophysical Survey

The purpose of the proposed survey is to collected seismic reflection and refraction profiles to be used to delineate the U.S. extended continental shelf (ECS) in the central-western Bering Sea between 350-800 kilometers offshore in water depths over 3,000 meters. The seismic profiles are designed to identify the stratigraphic "basement" and to map the thickness of the overlying sediments. All acoustic sources will be deployed from the *R/V Langseth*, which has a length of 71.5 meters, a beam of 17 meters, and a maximum draft of 5.9 meters. The ship is powered by two Bergen BRG-6 diesel engines, each producing 3,550 horsepower which drive the two propellers directly. The ship typically cruises at 18.5 kilometers per hour during transit to and from the survey site while the operation speed during seismic acquisition is typically 7.4-9.3 kilometers per hour. The ship's propulsion system is designed to be as quiet as possible to avoid interference with the seismic signals.

The *R/V Langseth* is scheduled to depart Dutch Harbor on or around August 7, 2011 and spend about 1.5 days in transit to the study area. The program will start with the multichannel seismic (MCS) survey to be conducted for 10 days along 14 transect lines. Following the MCS survey, 18 ocean bottom seismometers (OBSs) will be deployed and a refraction survey will take place along three of the 14 transect lines. OBS deployment will take about a day while the refraction survey will take approximately four days to complete. An additional two days will be needed to retrieve the OBSs. In addition to the operations of the airgun array, a multibean echosounder (MBES), a sub-bottom profiler (SBP), and a hull-mounted acoustic Doppler current profiler (ADCP) will be operated from the *R/V Langseth* continuously throughout the survey cruise. Additional seismic operations associated with equipment testing, startup, and possible line changes or repeat coverage of any areas where initial data quality is substandard will also be conducted. If time permits, an additional 525 kilometers of MCS survey lines will be conducted as well. Upon completion of seismic operations, the vessel will return to Dutch Harbor on or around September 1, 2011.

Description of the Airgun Array

The *R/V Langseth* will deploy an array of 36 airguns with a total volume of approximately 6,600 cubic inches (in^3). The receiving system will consist of one, eight kilometer (4.3 nautical mile)

long hydrophone streamer and/or five OBSs. As the airgun is towed along the survey lines, the hydrophone streamer will receive the returning acoustic signals and transfer the data to the on-board processing system. The OBSs record the returning acoustic signals internally for later analysis. When the *R/V Langseth* is towing the airgun array and the hydrophone streamer, the turning rate of the vessel is limited to five degrees per minute. Thus, the maneuverability of the vessel is limited during operations with the streamer.

The airgun array will consist of a mixture of Bolt 1500LL and Bolt 1900LLX airguns ranging in size from 40 to 360 in^3, with a firing pressure of 1,900 pounds per square inch. The airguns will be configured as four identical linear arrays or ''strings.'' Each string will have ten airguns and the first and last airguns in the strings are spaced 16 meters apart. Of the ten airguns, nine will be fired simultaneously, whereas the tenth is kept in reserve as a spare, to be turned on in case of failure of another airgun. The four airgun strings will be distributed across an area of approximately 24 x 16 meters behind the ship and will be towed approximately 100 meters behind the vessel. The shot interval will be 50 meters or approximately 22 seconds for the MCS survey and 150 meters or approximately 66 seconds for the OBS refraction survey. The firing pressure of the array is 1,900 pounds per square inch. During firing, a brief (approximately 0.1 second) pulse sound is emitted. The airguns will be silent during the intervening periods. The dominant frequency components range from 2-188 Hertz (Hz). The array will be powered-down to one 40 cubic inch (in^3) airgun during turns. The tow depth of the array will be nine meters (29.5 feet) during operation.

Predicted Sound Pressure Levels

Airguns function by venting high pressure air into the water which creates an air bubble. The pressure signature of an individual airgun consists of a sharp rise and then fall in pressure, followed by several positive and negative pressure excursions caused by the oscillation of the resulting air bubble. The oscillation of the air bubble transmits sounds downward through the seafloor and the amount of sound transmitted in the near horizontal directions is reduced. However, the airgun array also emits sounds that travel horizontally toward non-target areas.

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 decibels (dB) re: 1 μPa. 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 Opinion refer to the root mean square unless otherwise noted. For example, when discussing the established exclusion zone for cetaceans, we refer to received sound levels that are expected to approach 180 dB re: 1 μPa_{rms}. More details can be found in Appendix A of the USGS' IHA application and Appendix B of USGS' Environmental Assessment. The nominal source levels of the airgun arrays used by USGS on the *R/V Langseth* are 236 to 265 decibels (dB) re: 1 micropascal (μPa) [peak-to-peak (p-p)] and the root mean square (rms value) for a given airgun pulse is typically 16 dB re: 1 μPa lower than the p-p value. Since the actual source is a distributed sound source (36 airguns) rather than a

single point source, the highest sound measurable at any location in the water will be less than the nominal source level.

Tolstoy et al., (2009) reported results for propagation measurements of pulses from the *R/V Langseth*'s 36 airgun, 6,600 in^3 array in shallow-water (approximately 50 meters) and deepwater depths (approximately 1,600 meters) in the Gulf of Mexico in 2007 and 2008. LDEO has used these reported empirical values to determine exclusion zones (EZs) for the 36 airgun array and the single airgun, to designate mitigation zones, and to estimate take for marine mammals. Results of the Gulf of Mexico calibration study (Tolstoy et al., 2009) showed that radii around the airguns for various received levels varied with water depth. The empirical data for deep water (greater than 1,000 meters; 3,280 feet) indicated that the LDEO model (as applied to the *R/V Langseth*'s 36 airgun array) overestimated the received sound levels at a given distance.

Using the corrected measurements (array) or model (single airgun), **Table 1** (below) shows the distances at which three rms sound levels are expected to be received from the 36 airgun array well as received from a single airgun. The 180 and 190 dB re: 1 μPa_{rms} distances are the safety criteria as specified by NMFS and are applicable to cetaceans and pinnipeds, respectively. The 180 dB distance would also be used as the exclusion zone (EZ) for sea turtles, as required by the NMFS during most other recent LDEO seismic projects (Smultea et al., 2004; Holst et al., 2005a; Holst and Beland, 2008; Holst and Smultea, 2008; Holt, 2008).

Table 1. Distances to which sound levels ≥ 190, 180, 170, and 160 dB re 1 μPa_{rms} could be received from the single airgun and the airgun array.

Source and Volume	Tow Depth (meters)	Water Depth	Estimated RMS Radii (m)			
			190 dB	180 dB	170 dB	160 dB
Single Bolt airgun (40 in^3)	9	Deep (over 1,000 meters)	12	40	120	385
4 strings 36 airguns (6600 in^3)	9	Deep (over 1,000 meters)	400	940	2200	3850

NMFS refers the reviewers to the application and Environmental Assessment documents for additional information pertaining to LDEO's modeling for marine seismic source arrays.

Ocean Bottom Seismometer Deployment and Retrieval

USGS proposes to conduct refraction surveys using OBSs. Following the MCS survey, 18 OBSs will be deployed and a refraction survey will take place along three of the 14 transect lines utilized during the MCS survey. Scripps Institution of Oceanography LC4x4 OBSs will be utilized that have a total volume of around one cubic meter (m^3) and are anchored by a large piece of steel grating. Once an OBS is ready to be retrieved, an acoustic release transponder interrogates the OBS at a frequency of 9–11 kilohertz (kHz), and a response is received at a frequency of 9–13 kHz. The burn wire release assembly is then activated, and the instrument is

released from the anchor to float to the surface. All OBSs will be retrieved near the end of the study.

Multi-beam Bathymetric Echosounder, Sub-Bottom Profiler, and Acoustic Doppler Current Profiler

Along with airgun operations, two additional acoustical data acquisition systems will be operated during the survey cruise. The ocean floor will be mapped with a Kongsberg EM 122 multi-beam bathymetric echosounder (MBES) and a Knudsen Chirp 3260 sub-bottom profiler (SBP). These sound sources would be operated from the *R/V Langseth* simultaneously with the airgun array throughout the survey cruise.

The hull-mounted MBES emits brief pulses of sound (also called a ping) at 10.5 to 13 kHz (more frequently at 12 kHz) in a fan-shaped beam that extends downward and to the sides of the ship. The transmitting beamwidth is 1° or 2° fore-aft and 150° athwartship and the maximum source level is 242 dB re: 1 μPa. For deep-water operations, each ping consists of eight (in waters greater than 1,000 meters) or four (in waters less than 1,000 meters) 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 meters, and frequency-modulated chirp pulses up to 100 ms long are used in water greater than 2,600 meters. The successive transmissions span an overall crosstrack angular extent of about 150°, with 2 ms gaps between the pulses for successive sectors.

The *R/V 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 up to 10,000 meters down. The beam is transmitted as a 27° cone, which is directed downward by a 3.5 kHz transducer in the hull of the ship. 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 one second, but a common mode of operation is to broadcast five pulses at one second intervals followed by a five second pause.

A Teledyne RDI hull-mounted acoustic Doppler current profiler (ADCP) will also be used continuously during the survey to measure ocean currents to depths of approximately 400 meters beneath the vessel. The ADCP pings at a maximum rate of 1 second, and has a beam angle of 30° directed vertically beneath the ship.

<u>Mitigation Measures</u>

USGS plans to include various mitigation measures in order to minimize incidental harassment of listed and non-listed marine mammals and sea turtles during survey activities. These measures include (1) vessel based monitoring and reporting, (2) passive acoustic monitoring, (3) use of exclusion zones, and (4) special ramp up and power down procedures. The sections below describe these mitigation measures in greater detail.

Vessel Based Monitoring and Reporting

Vessel-based Protected Species Visual Observers (PSVOs) will be used onboard the *R/V Langseth* to monitor for the presence of marine mammals and sea turtles near seismic sources during all daytime airgun operations, as well as during any night-time start-ups of the array.

PSVOs would also watch for marine mammals and turtles near the vessel for at least 30 minutes prior to the planned start of seismic operations after an extended shut-down of the airguns, during OBS retrieval, and during transit to and from the survey site. When marine mammals or sea turtles are observed within, or are about to enter, designated exclusion zones [See *Exclusion Zones* (EZ) section below], airgun operations would immediately be powered-down (or shut-down if necessary). Airgun operations would not resume until the animal(s) leaves the EZ, as determined by the PSVOs.

Three PSVOs are typically on watch during normal operations with two on the observation tower and the third monitoring the passive acoustic monitoring equipment [see *Passive Acoustic Monitoring* (PAM) section below]. During daytime, the PSVOs would systematically scan the area around the vessel with reticle binoculars (e.g., 7×50 Fujinon), Big-eye binoculars (25×150), and the naked eye. Laser rangefinding binoculars (Leica LRF 1200 laser rangefinder or equivalent) would be available to assist with distance estimation. At night, the PSVOs would use night vision devices when required. Laser rangefinding binoculars will be available to assist with visual distance estimation.

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.

All data will be entered into an electronic database and the accuracy of the data entry will be verified by computerized data validity checks. 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.

A report will be submitted to NMFS within 90 days after the end of the cruise. The report will provide full documentation of methods, results, and interpretations of monitoring efforts and will summarize the dates and locations of seismic operations as well as all marine mammal and turtle sightings (dates, times, locations, activities, associated seismic survey activities). The report will also include estimates of the amount and nature of any potential “take” of marine mammals and sea turtles as a result of the survey activities.

Passive Acoustic Monitoring

Passive acoustic monitoring (PAM) will complement the visual monitoring program during surveys to monitor for the presence of cetaceans. Visual monitoring typically is not effective during periods of poor visibility (e.g. during night hours) and is not useful at detecting marine mammals when they are below the surface or beyond visual range. PAM will be utilized to enhance observation efforts by monitoring for vocalizing cetaceans that would otherwise not be spotted by the onboard observers.

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 tow cable is 250 meters long, and the hydrophones are fitted in the last 10 meters of cable. A depth gauge is attached to the free end of the cable, and the cable is typically towed at depths less than 20 meters. The acoustic signals received by the hydrophones are amplified, digitized, and then processed by the Pamguard software. The system can detect marine mammal vocalizations at frequencies up to 250 kHz. The towed hydrophones will ideally be monitored 24 hours per day while at the seismic survey area during airgun operations, and during most periods when the *R/V Langseth* is underway while the airguns are not operating. One PSVO will monitor the acoustic detection system by listening to the signals from two channels via headphones and/or speakers and watching the real-time spectrographic display for frequency ranges produced by cetaceans. 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, a power down or shut down procedure will be initiated, if required, and the information will be entered into a database. The data to be entered includes 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, etc.), 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.

Proposed Exclusion Zones

The 180 and 190 dB re: 1 μPa_{rms} isopleth (also referred to as the 180 and 190 dB isopleths) are to be used as Exclusion Zones (EZ) for cetaceans and pinnipeds, respectively, based on safety criteria as specified by NMFS (2000) (see **Table 1** above). The 180 dB isopleth would also be used as the EZ for sea turtles, as required by the NMFS during most other recent LDEO seismic projects. Correction factors have been applied to the distances reported by Tolstoy et al. (2009) as part of their Gulf of Mexico study. Although the LDEO model does not account for site-specific environmental conditions encountered during this study in the central-western Bering Sea, the calibration study of the LDEO model predicted that using site-specific information may actually provide less conservative EZ radii at greater distances. Therefore, the researchers will use the EZs as predicted by the LDEO model. Estimated propagation distances to the 180 dB isopleth range from 40 meters (0.02 nautical miles) to 940 meters (0.51 nautical miles) depending on seismic source and volume while estimated propagation distances to the 190 dB isopleth range from 12 meters (0.01 nautical miles) to 400 meters (0.22 nautical miles), respectively. If marine mammals or sea turtles are detected within or are about to enter the appropriate EZ, the airguns will be powered-down (or shut-down) immediately (see procedures below).

Power Down and Ramp Up Procedures

Power-down procedures involve reducing the number of operating airguns, typically to a single airgun (e.g., 40 in^3), to minimize the EZ so that marine mammals or turtles are no longer in or about to enter the 180 dB isopleth. If a marine mammal or turtle is detected outside the 180 dB

isopleth but is likely to enter it, USGS would power-down the airgun array before the animal is within the EZ. If a marine mammal or turtle is already within the EZ when first detected, the airguns would be powered-down immediately. A power-down may also occur when the vessel is moving from one track line to another (i.e., during a turn). The continued operation of at least one airgun during a power-down is intended to alert marine mammals and turtles to the presence of the seismic vessel in that area. Complete shut down of all airguns would occur if, during operation of the single airgun (as in during power down), a marine mammal or turtle is detected within the EZ, or if during seismic activity an ESA-listed species is detected for which no take has been exempted (e.g. blue whale or North Pacific right whale, etc.) Concentrations of humpback and/or fin whales would also be avoided if possible.

Following a power down or complete shut down, airgun activity would not resume until the marine mammal or turtle cleared the respective EZ, or until the PSVO is confident the animal has left the vicinity of the vessel. The animal will be considered to have cleared the safety zone if the following has occurred:

- It is visually observed to have left the exclusion zone, or
- It has not been seen within the zone for 15 minutes in the case of small odontocetes (or pinnipeds), or
- It has not been seen within the zone for 30 minutes in the case of mysticetes and large odontocetes, or
- The vessel has moved outside the exclusion zone for turtles, e.g., if a turtle is sighted close to the vessel and the ship speed is 7.4 kilometers per hour, it would take the vessel about eight minutes to leave the turtle behind.

USGS will implement special ramp-up procedures for the array after an eight minute waiting period between the time the power down or shut down occurred. This eight minute period has been used on prior surveys and is based on the time it would take the ship to move outside the 180 dB isopleth for marine mammals and sea turtles. Ramp up would begin with the smallest airgun in the array (40 in^3). Airguns would be added in a sequence such that the increase in source level would not exceed 6 dB per five minute period over a total duration of about 35 minutes. Ramp up from a reduced power state, such as during maintenance of an airgun string while the remaining strings keep firing, would include the start-up of the returned string. During ramp-up, the PSVOs would monitor the EZ for the full airgun array for marine mammals and sea turtles. If any are spotted, appropriate power down or shut down procedures would commence followed by a new eight minute waiting period after the animal has cleared the safety zone.

Initiation of ramp-up procedures from a shut-down requires that the full EZ be visible by the PSVOs, whether the ramp-up is conducted in daytime or nighttime. Thus, the airgun array would likely not be ramped-up from a complete shut-down at night or in thick fog, because the outer part of the EZ for the array may not be visible during those conditions. Ramp-up of airguns would be allowed under reduced visibility conditions only if at least one airgun (e.g., 40 in^3 or similar) has operated continuously, on the assumption that marine mammals and turtles

would be alerted to the approaching seismic vessel by sounds from the single airgun and could adequately clear the safety area. Ramp up of the airguns would not be initiated if a sea turtle or marine mammal is sighted within or near the applicable EZ during the day or near the vessel at night.

Marine Mammal Protection Act Incidental Harassment Authorization

The Permits Division is proposing to issue an IHA authorizing non-lethal "takes" by harassment of marine mammals incidental to the planned seismic survey, pursuant to section 101 (a)(5)(D) of the MMPA. The IHA would be valid from August 7-October 1, 2011, and would authorize the incidental harassment of the following marine mammals listed under the ESA (in addition to non-listed species): fin whales, humpback whales, sei whales, sperm whales, and Steller sea lions. The proposed IHA includes the requirements USGS must comply with as part of its authorization. Many of these requirements are already included in the USGS' proposed mitigation activities included in their application for the proposed survey (described in the previous section) but are included here again to make the reviewer aware of requirements specific to the proposed IHA and required by the Permits Division. The following are specific sections of the IHA that are relevant to ESA-listed species:

1. *Mitigation and Monitoring Requirements*

USGS is required to implement the following mitigation and monitoring requirements when conducting this survey to achieve the least practicable adverse impact on affected marine mammal species or stocks:

(a) Utilize two, NMFS-qualified, vessel-based Protected Species Visual Observers (PSVOs) (except during meal times and restroom breaks, when at least one PSVO shall be on watch) to visually watch for and monitor marine mammals near the seismic source vessel during daytime airgun operations (from nautical twilight-dawn to nautical twilight-dusk) and before and during start-ups of airguns day or night. The *R/V Langseth*'s vessel crew shall also assist in detecting marine mammals, when practicable. PSVOs shall have access to reticle binoculars (7x50 Fujinon), big-eye binoculars (25x150), and night vision devices. PSVO shifts shall last no longer than 4 hours at a time. PSVOs shall also make observations during daytime periods when the seismic system is not operating for comparison of animal abundance and behavior, when feasible.

(b) PSVOs shall conduct monitoring while the airgun array and streamer(s) are being deployed or recovered from the water.

(c) Researchers must record the following information when a marine mammal is sighted:

(i) 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 including responses to ramp-up), and behavioral pace; and

(ii) time, location, heading, speed, activity of the vessel (including number of airguns operating and whether in state of ramp-up or power-down), Beaufort sea state and wind force, visibility, and sun glare; and

(iii) the data listed under Condition (ii) shall 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.

(d) Utilize the PAM system, to the maximum extent practicable, to detect and allow some localization of marine mammals around the *R/V Langseth* during all airgun operations and during most periods when airguns are not operating. One NMFS-qualified Protected Species Observer (PSO) and/or expert bioacoustician (i.e., Protected Species Acoustic Observer [PSAO]) shall monitor the PAM at all times in shifts no longer than 6 hours. An expert bioacoustician shall design and set up the PAM system and be present to operate or oversee PAM, and be available when technical issues occur during the survey.

(e) Do and record the following when an animal is detected by the PAM:

(i) notify the on-duty PSVO(s) immediately of a vocalizing marine mammal so a power-down or shut-down can be initiated, if required;

(ii) enter the information regarding the vocalization into a database. The data to be entered include an acoustic encounter identification number, whether it was linked with a visual sighting, date, time when first and last heard and whenever any additional information was recorded, position, and water depth when first detected, bearing if determinable, species or species group (e.g., unidentified dolphin, sperm whale), types and nature of sounds heard (e.g., clicks, continuous, sporadic, whistles, creaks, burst pulses, strength of signal, etc.), and any other notable information.

(f) Visually observe the entire extent of the EZ (180 dB re 1 μPa_{rms} for cetaceans and 190 dB re 1 μPa_{rms} for pinnipeds using NMFS-qualified PSVOs, for at least 30 minutes prior to starting the airgun array (day or night). If the PSVO finds a marine mammal within the EZ, USGS must delay the seismic survey until the marine mammal(s) has left the area. If the PSVO sees a marine mammal that surfaces, then dives below the surface, the PSVO shall wait 30 minutes. If the PSVO sees no marine mammals during that time, they should assume that the animal has moved beyond the EZ. If for any reason the entire radius cannot be seen for the entire 30 minutes (i.e., rough seas, fog, darkness), or if marine mammals are near, approaching, or in the EZ, the airguns may not be ramped-up. If one airgun is already running at a source level of at least 180 dB re 1 μPa_{rms}, USGS may start the second airgun without observing the entire EZ for 30 minutes prior, provided no marine mammals are known to be near the EZ (in accordance with Condition [h] below).

(g) Establish a 180 dB re 1 μPa_{rms} and 190 dB re 1 μPa_{rms} EZ for marine mammals before the airgun array (6,600 in^3) is in operation; and a 180 dB re 1 μPa_{rms} and 190 dB re 1 μPa_{rms} EZ before a single airgun (40 in^3) is in operation, respectively.

(h) Implement a "ramp-up" procedure when starting up at the beginning of seismic operations or anytime after the entire array has been shutdown for more than 8 minutes, which means start the smallest gun first and add airguns in a sequence such that the source level of the array shall increase in steps not exceeding approximately 6 dB per 5-minute period. During ramp-up, the PSVOs shall monitor the EZ, and if marine mammals are sighted, a power-down, or shut-down shall be implemented as though the full array were operational. Therefore, initiation of ramp-up procedures from shut-down requires that the PSVOs be able to view the full EZ as described in Condition (f) (above).

(i) Alter speed or course during seismic operations if a marine mammal, based on its position and relative motion, appears likely to enter the relevant EZ. If speed or course alteration is not safe or practicable, or if after alteration the marine mammal still appears likely to enter the EZ, further mitigation measures, such as a power-down or shut-down, shall be taken.

(j) Power-down or shut-down the airgun(s) if a marine mammal is detected within, approaches, or enters the relevant EZ. A shut-down means all operating airguns are shut-down (i.e., turned off). A power-down means reducing the number of operating airguns to a single operating 40 in^3 airgun, which reduces the EZ to the degree that the animal(s) is no longer in or about to enter it.

(k) Following a power-down, if the marine mammal approaches the smaller designated EZ, the airguns must then be completely shut-down. Airgun activity shall not resume until the PSVO has visually observed the marine mammal(s) exiting the EZ and is not likely to return, or has not been seen within the EZ for 15 minutes for species with shorter dive durations (small odontocetes and pinnipeds) or 30 minutes for species with longer dive durations (mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, killer, and beaked whales).

(l) Following a power-down or shut-down and subsequent animal departure, airgun operations may resume following ramp-up procedures described in Condition (h).

(m) Marine geophysical surveys may continue into night and low-light hours if such segment(s) of the survey is initiated when the entire relevant EZs are visible and can be effectively monitored.

(n) No initiation of airgun array operations is permitted from a shut-down position at night or during low-light hours (such as in dense fog or heavy rain) when the entire relevant EZ cannot be effectively monitored by the PSVO(s) on duty.

(o) If a North Pacific right, blue, and/or beluga whale is visually sighted, the airgun array shall be shut-down regardless of the distance of the animal(s) to the sound source. The

array shall not resume firing until 30 minutes after the last documented whale visual sighting.

(p) Concentrations of humpback, fin, and/or killer whales shall be avoided, if possible, and the array shall be powered-down if necessary. A concentration or group of whales shall consist of when three or more individuals are visually sighted and do not appear to be traveling (e.g., feeding, socializing, etc.).

(q) To the maximum extent practicable, schedule seismic operations (i.e., shooting airguns) during daylight hours and OBS operations (i.e., deploy/retrieve) to nighttime hours.

2. *Reporting Requirements*

USGS is required to:

(a) Submit a draft report on all activities and monitoring results to the Office of Protected Resources, NMFS, within 90 days of the completion of the *R/V Langseth*'s central-western Bering Sea cruise. This report must contain and summarize the following information:

(i) Dates, times, locations, heading, speed, weather, sea conditions (including Beaufort sea state and wind force), and associated activities during all seismic operations and marine mammal sightings;

(ii) Species, number, location, distance from the vessel, and behavior of any marine mammals, as well as associated seismic activity (number of power-downs and shut-downs), observed throughout all monitoring activities.

(iii) An estimate of the number (by species) of marine mammals that: (A) are known to have been exposed to the seismic activity (based on visual observation) at received levels greater than or equal to 160 dB re 1 μPa_{rms} and/or 180 dB re 1 μPa_{rms} for cetaceans and 190 dB re 1 μPa_{rms} for pinnipeds with a discussion of any specific behaviors those individuals exhibited; and (B) may have been exposed (based on reported and corrected empirical values for the 36 airgun array and modeling measurements for the single airgun) to the seismic activity at received levels greater than or equal to 160 dB re 1 μPa_{rms} and/or 180 dB re 1 μPa_{rms} for cetaceans and 190 dB re 1 μPa_{rms} for pinnipeds with a discussion of the nature of the probable consequences of that exposure on the individuals that have been exposed.

(iv) A description of the implementation and effectiveness of the: (A) terms and conditions of the Biological Opinion's Incidental Take Statement (ITS) (attached); and (B) mitigation measures of the Incidental Harassment Authorization. For the Biological Opinion, the report shall confirm the implementation of each Term and Condition, as well as any conservation

recommendations, and describe their effectiveness, for minimizing the adverse effects of the action on Endangered Species Act-listed marine mammals.

(b) Submit a final report to the Chief, Permits, Conservation, and Education Division, Office of Protected Resources, NMFS, within 30 days after receiving comments from NMFS on the draft report. If NMFS decides that the draft report needs no comments, the draft report shall be considered to be the final report.

3. In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by this Authorization, such as an injury (Level A harassment), serious injury or mortality (e.g., ship-strike, gear interaction, and/or entanglement), USGS shall 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:

   (a) time, date, and location (latitude/longitude) of the incident; the name and type of vessel involved; the 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 marine mammal observations in the 24 hours preceding the incident; species identification or description of the animal(s) involved; the fate of the animal(s); and photographs or video footage of the animal (if equipment is available). Activities shall not resume until NMFS is able to review the circumstances of the prohibited take. NMFS shall work with USGS to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. USGS may not resume their activities until notified by NMFS via letter or email, or telephone.

4. In the event that USGS 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), USGS will immediately report the incident to the Chief of the Permits Conservation, and Education Division, Office of Protected Resources, NMFS, at 301-713-2289, and the NMFS Alaska Stranding Hotline (1-877-925-7773) and/or by email to the Alaska Regional Stranding Coordinators. The report must include the same information identified in the paragraph 3(a) above. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with USGS to determine whether modifications in the activities are appropriate.

5. In the event that USGS 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 survey activities authorized in this IHA, USGS shall report the incident to the Chief of the Permits, Conservation, and Education Division, Office of Protected Resources, NMFS, at 301-713-2289, and the NMFS Alaska Stranding Hotline (1-877-925-7773) and/or by email to the Alaska Regional Stranding Coordinators within 24 hours of the discovery. USGS

shall provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS and the Marine Mammal Stranding Network.

APPROACH TO THE ASSESSMENT

NMFS approaches its section 7 analyses of agency actions through a series of steps. The first step identifies those aspects of proposed actions that are likely to have direct and indirect physical, chemical, and biotic effects on listed species or on the physical, chemical, and biotic environment of an action area. As part of this step, we identify the spatial extent of these direct and indirect effects, including changes in that spatial extent over time. The result of this step includes defining the *Action Area* for the consultation. The second step of our analyses identifies the listed resources that are likely to co-occur with these effects in space and time and the nature of that co-occurrence (these represent our *Exposure Analyses*). In this step of our analyses, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to an action's effects and the populations or subpopulations those individuals represent. Once we identify which listed resources are likely to be exposed to an action's effects and the nature of that exposure, we examine the scientific and commercial data available to determine whether and how those listed resources are likely to respond given their exposure (these represent our *Response Analyses*).

The final step of our analyses establishes the risks those responses pose to listed resources (these represent our *Risk Analyses*). Our jeopardy determinations must be based on an action's effects on the continued existence of threatened or endangered species as those "species" have been listed, which can include true biological species, subspecies, or Distinct Population Segments (DPSs) of species. The continued existence of these "species" depends on the fate of the populations that comprise them. Similarly, the continued existence of populations are determined by the fate of the individuals that comprise them – populations grow or decline as the individuals that comprise the population live, die, grow, mature, migrate, and reproduce (or fail to do so).

Our risk analyses reflect these relationships between listed species, the populations that comprise that species, and the individuals that comprise those populations. Our risk analyses begin by identifying the probable risks actions pose to listed individuals that are likely to be exposed to an action's effects. Our analyses then integrate those individual risks to identify consequences to the populations those individuals represent. Our analyses conclude by determining the consequences of those population-level risks to the species those populations comprise.

We measure risks to listed individuals using the individuals' "fitness," or the individual's growth, survival, annual reproductive success, and lifetime reproductive success. In particular, we examine the scientific and commercial data available to determine if an individual's probable lethal, sub-lethal, or behavioral responses to an action's effect on the environment (which we identify during our *Response Analyses*) are likely to have consequences for the individual's fitness.

When individual listed plants or animals are expected to experience reductions in fitness in response to an action, those fitness reductions are likely to reduce the abundance, reproduction,

or growth rates (or increase the variance in these measures) of the populations those individuals represent (see Stearns, 1992). Reductions in at least one of these variables (or one of the variables we derive from them) is a necessary condition for reductions in a population's viability, which is itself a necessary condition for reductions in a species' viability. As a result, when listed plants or animals exposed to an action's effects are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (e.g., Brandon, 1978; Mills and Beatty, 1979; Stearns, 1992; Anderson, 2000). As a result, if we conclude that listed plants or animals are not likely to experience reductions in their fitness, we would conclude our assessment.

Although reductions in fitness of individuals is a *necessary* condition for reductions in a population's viability, reducing the fitness of individuals in a population is not always *sufficient* to reduce the viability of the population(s) those individuals represent. Therefore, if we conclude that listed plants or animals are likely to experience reductions in their fitness, we determine whether those fitness reductions are likely to reduce the viability of the populations the individuals represent (measured using changes in the populations' abundance, reproduction, spatial structure and connectivity, growth rates, variance in these measures, or measures of extinction risk). In this step of our analyses, we use the population's base condition (established in the *Environmental Baseline* and *Status of the Species* sections) as our point of reference. If we conclude that reductions in the fitness of individuals are not likely to reduce the viability of the populations those individuals represent, we would conclude our assessment.

Reducing the viability of a population is not always *sufficient* to reduce the viability of the species those populations comprise. Therefore, in the final step of our analyses, we determine if reductions in a population's viability are likely to reduce the viability of the species those populations comprise using changes in a species' reproduction, numbers, distribution, estimates of extinction risk, or probability of being conserved. In this step of our analyses, we use the species' status (established in the *Status of the Species* section) as our point of reference. Our final jeopardy determinations are based on whether threatened or endangered species are likely to experience reductions in their viability and whether such reductions are likely to be appreciable.

Destruction or adverse modification[1] determinations must be based on an action's effects on the conservation value of habitat that has been designated as critical to threatened or endangered species. If an area encompassed in a critical habitat designation is likely to be exposed to the direct or indirect consequences of the proposed action on the natural environment, we ask if primary or secondary constituent elements included in the designation (if there are any) or physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species are likely to respond to that exposure. If primary or secondary constituent elements of designated critical habitat (or physical, chemical, or biotic phenomena that give the

1 We are aware that several courts have ruled that the definition of destruction or adverse modification that appears in the section 7 regulations at 50 CFR 402.02 is invalid and do not rely on that definition for the determinations we make in this Opinion. Instead, as we explain in the text, we use the "conservation value" of critical habitat for our determinations which focuses on the designated area's ability to contribute to the conservation or the species for which the area was designated.

designated area value for the conservation of listed species) are likely to respond given exposure to the direct or indirect consequences of the proposed action on the natural environment, we ask if those responses are likely to be sufficient to reduce the quantity, quality, or availability of those constituent elements or physical, chemical, or biotic phenomena.

If the quantity, quality, or availability of the primary or secondary constituent elements of the area of designated critical habitat (or physical, chemical, or biotic phenomena) are reduced, we ask if those reductions are likely to be sufficient to reduce the conservation value of the designated critical habitat for listed species in the action area. In this step of our assessment, we combine information about the contribution of constituent elements of critical habitat (or of the physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species, particularly for older critical habitat designations that have no constituent elements) to the conservation value of those areas of critical habitat that occur in the action area, given the physical, chemical, biotic, and ecological processes that produce and maintain those constituent elements in the action area.

If the conservation value of designated critical habitat in an action area is reduced, the final step of our analyses asks if those reductions are likely to be sufficient to reduce the conservation value of the entire critical habitat designation. In this step of our assessment, we combine information about the constituent elements of critical habitat (or of the physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species) that are likely to experience changes in quantity, quality, and availability given exposure to an action with information on the physical, chemical, biotic, and ecological processes that produce and maintain those constituent elements in the action area. We use the conservation value of the entire designated critical habitat as our point of reference for this comparison. For example, if the designated critical habitat has limited current value or potential value for the conservation of listed species that limited value is our point of reference for our assessment.

To conduct these analyses, we rely on all of the evidence available to us. This evidence might consist of monitoring reports submitted by past and present permit holders, reports from NMFS Science Centers, reports prepared by State or Tribal natural resource agencies, reports from non-governmental organizations involved in marine conservation issues, the information provided by the Permits, Conservation and Education Division when it initiates formal consultation, and the general scientific literature. We supplement this evidence with reports and other documents – environmental assessments, environmental impact statements, and monitoring reports – prepared by other federal and state agencies like the Minerals Management Service, U.S. Coast Guard and U.S. Navy whose operations extend into the marine environment.

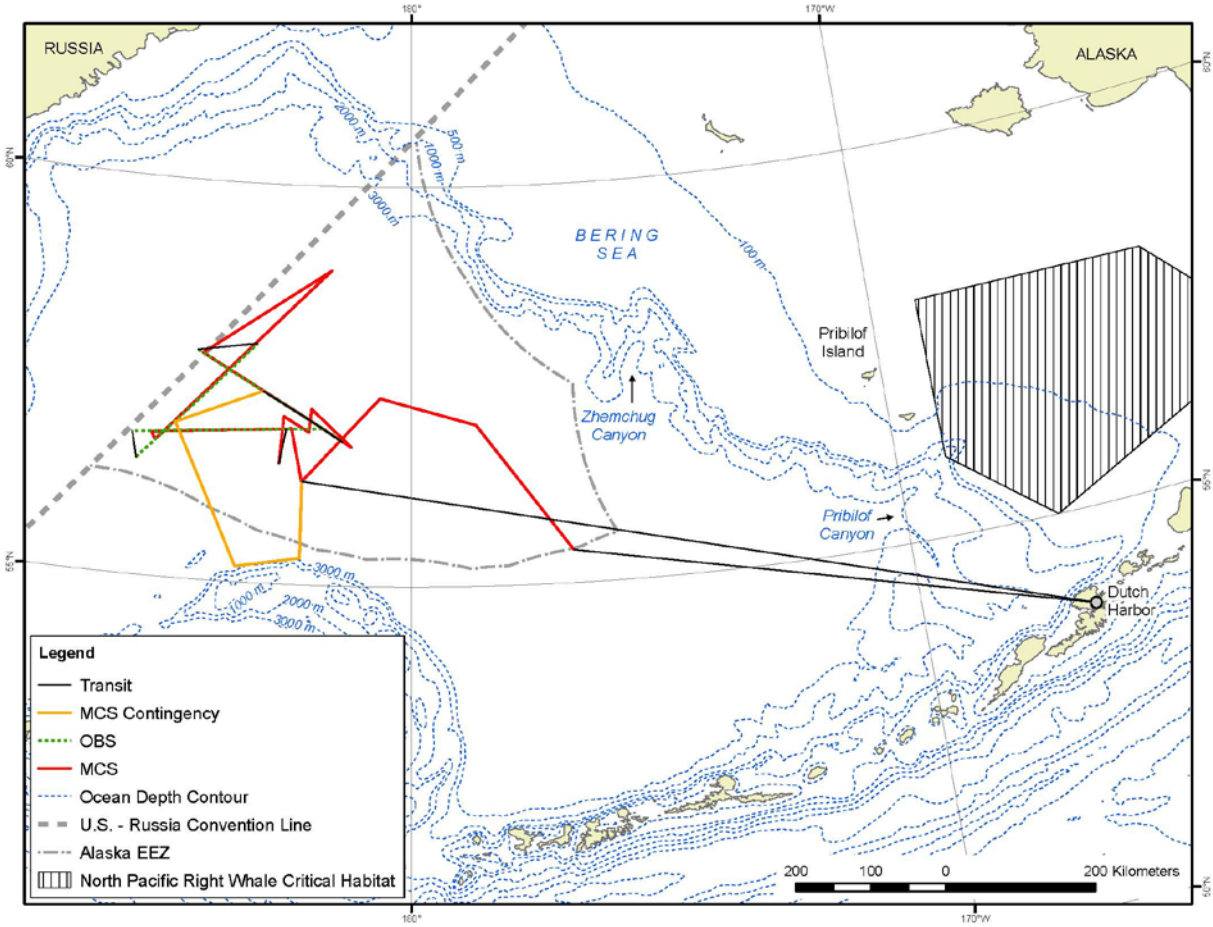
During each consultation, we conduct electronic searches of the general scientific literature using *American Fisheries Society*, *Google Scholar*, *ScienceDirect*, *BioOne*, *Conference Papers Index*, *JSTOR*, and *Aquatic Sciences and Fisheries Abstracts* search engines. We supplement these searches with electronic searches of doctoral dissertations and master's theses. These searches specifically try to identify data or other information that supports a particular conclusion as well as data that does not support that conclusion.

We rank the results of these searches based on the quality of their study design, sample sizes, level of scrutiny prior to and during publication, and study results. Carefully designed field experiments (for example, experiments that control potentially confounding variables) are rated higher than field experiments that are not designed to control those variables. Carefully designed field experiments are generally ranked higher than computer simulations. Studies that produce large sample sizes with small variances are generally ranked higher than studies with small sample sizes or large variances. Finally, in keeping with the direction from the U.S. Congress to provide the "benefit of the doubt" to threatened and endangered species [House of Representatives Conference Report No. 697, 96th Congress, Second Session, 12 (1979)], when data are equivocal, or in the face of substantial uncertainty, our decisions are designed to avoid the risks associated with incorrectly concluding an action has no adverse effect on a listed species when, in fact, such adverse effects are likely (i.e. avoiding Type II error).

ACTION AREA

The action area is defined in 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal Action and not merely the immediate area involved in the action." The action area for this consultation will encompass the survey area delineated by 55° to 59°N, and 174° to 176° W in the central-western Bering Sea where the proposed surveys are to take place (see **Figure 1** below). USGS will survey approximately 2,420 kilometers (1,306.7 nautical miles) of transect lines in water depths over 3,000 meters. Responses to seismic sound sources by listed species are expected to occur within the 160 dB isopleth or greater; therefore, the action area is expanded beyond the length of the survey track lines (2,420 kilometers) to include a total ensonified region of 15,465 square kilometers (km^2) as estimated by USGS as part of their application. NMFS also includes the transit area from Dutch Harbor to the survey site as part of the action area for this consultation due to the threat of ship strikes during transit (an additional 350 kilometers west of Dutch Harbor, Alaska).

Figure 1. Map of the Action Area Showing the Survey Track (taken from the Draft EA)



STATUS OF THE SPECIES

The Endangered Species Division has determined that the following listed and proposed species and designated critical habitat provided protection under the ESA occur within the action area and may be affected by proposed action:

LISTED RESOURCE (BY TAXON)	SCIENTIFIC NAME	LISTING STATUS
Cetaceans		
Blue whale	*Balaenoptera musculus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
North Pacific Right whale	*Eubalaena japonica*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Bowhead whale	*Balaena mysticetus*	Endangered

Pinnipeds

Steller Sea Lion Eastern DPS[2]	*Eumetopias jubatus*	Threatened
Steller Sea Lion Western DPS	*Eumetopias jubatus*	Endangered
Ringed Seal	*Phoca hispida*	Proposed Threatened

Sea Turtles

Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Green sea turtle	*Chelonia mydas*	Threatened
Olive ridley sea turtle	*Olivacea kempii*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Threatened
Loggerhead sea turtle North Pacific DPS	*Caretta caretta*	Proposed Endangered

Anadromous Fish

Chinook Salmon (Lower Columbia River)	*Oncorhynchus tshawytscha*	Threatened
Chinook Salmon (Upper Colombia River Spring-Run)	*Oncorhynchus tshawytscha*	Endangered
Chinook Salmon (Puget Sound)	*Oncorhynchus tshawytscha*	Threatened
Chinook Salmon (Snake River Fall-Run)	*Oncorhynchus tshawytscha*	Threatened
Chinook Salmon (Snake River Spring-Summer Run)	*Oncorhynchus tshawytscha*	Threatened
Chinook Salmon (Upper Willamette River)	*Oncorhynchus tshawytscha*	Threatened
Coho Salmon (Lower Columbia River)	*Oncorhynchus kisutch*	Threatened
Coho Salmon (Oregon Coast)	*Oncorhynchus kisutch*	Threatened
Chum salmon (Columbia River)	*Oncorhynchus keta*	Threatened
Chum salmon (Hood Canal Summer-Run)	*Oncorhynchus keta*	Threatened
Sockeye salmon (Ozette Lake)	*Oncorhynchus nerka*	Threatened
Sockeye salmon (Snake River)	*Oncorhynchus nerka*	Endangered
Steelhead Trout (Central California Coast)	*Oncorhynchus mykiss*	Threatened
Steelhead Trout (Lower Columbia River)	*Oncorhynchus mykiss*	Threatened
Steelhead Trout (Middle Columbia River)	*Oncorhynchus mykiss*	Threatened
Steelhead Trout (Northern California)	*Oncorhynchus mykiss*	Threatened
Steelhead Trout (Puget Sound)	*Oncorhynchus mykiss*	Threatened
Steelhead Trout (Snake River)	*Oncorhynchus mykiss*	Threatened
Steelhead Trout (California Central Valley)	*Oncorhynchus mykiss*	Threatened
Steelhead Trout (Upper Columbia River)	*Oncorhynchus mykiss*	Threatened
Steelhead Trout (Upper Willamette River)	*Oncorhynchus mykiss*	Threatened

Critical Habitat

North Pacific Right whale Critical Habitat	Designated
Steller sea lion Critical Habitat (both DPSs)	Designated

2 A distinct population segment, is a vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. The ESA provides for listing species, subspecies, or distinct population segments of vertebrate species.

Listed Resources Not Likely to be Adversely Affected

Cetaceans

Blue whales have a cosmopolitan distribution and tend to be pelagic, only coming nearshore to feed and possibly to breed (Jefferson et al., 2008). Call types from both northeastern and northwestern Pacific blue whales were recorded from July through December in the Gulf of Alaska region suggesting that blue whales utilize the surrounding area (Stafford 2003; Stafford et al. 2007); however, no blue whales were sighted during vessel-based surveys of the southeastern Bering shelf and slope during the years 1999, 2000, 2002, 2008, and 2010 (Moore et al., 2002a; Tynam, 2004; Friday et al., 2009; Friday et al., 2011). Given the present rarity of these whales in the action area and the shut down procedures USGS will employ if a blue whale is observed regardless of distance from the *R/V Langseth*, we conclude that the potential for this species to be exposed to the proposed survey is extremely unlikely and the risks posed by the proposed action are discountable. Therefore, blue whales are not likely to be adversely affected by the proposed action and this species will not be considered further in this Opinion.

Historically, North Pacific right whales ranged across the entire North Pacific north of 35ºN and occasionally occurred as far south as 20ºN. However, recent population estimates for the eastern North Pacific population based on genotyping and photo-identification provide estimates of well under 100 individuals (Wade et al., 2011). Right whales have been detected in the southeastern Bering sea around the localized area of the designated critical habitat; however, right whales have not been sighted or acoustically detected outside this localized area during recent summer surveys (Moore et al., 2000; Moore et al., 2002a; Friday et al., 2009; Friday et al., 2011; Zerbini et al., 2006; Zerbini et al., 2009; Zerbini et al., 2010; Clapham et al., 2009; Rone et al., 2010). In addition, only three sightings occurred west of 168ºW during surveys conducted during the period 1983-2003, with the closest sighting occurring over 500 kilometers from the proposed survey track lines (Shelden et al., 2005). Given the extremely low population size of the eastern North Pacific population, the present rarity of the whales in the action area, and the shut down procedures USGS will employ if a North Pacific right whale is observed regardless of distance from the *R/V Langseth*, we conclude that the potential for this species to be exposed to the proposed survey is extremely unlikely and the risks posed by the proposed action are discountable. Therefore, North Pacific right whales are not likely to be adversely affected by the proposed action and this species will not be considered further in this Opinion.

Bowhead whales are known to winter in the northern Bering sea and summers in the Canadian Beaufort Sea and Amundsen Gulf (Moore and Reeves, 1993). Spring migration through the western Beaufort sea occurs generally from mid April to mid June while fall migration back to Alaskan waters typically occurs in September and October (Braham et al., 1984; Moore and Reeves, 1993). The wintering region frequented by Bowheads is generally north of 60°N and south of 75°N in the western Arctic Basin (Braham, 1984; Moore and Reeves, 1993) which is north of the action area. Given the migratory patterns of bowhead whales, as well as the fact that whales are expected to occur well north of the action area, and the shut down procedures USGS will employ if a bowhead whale is observed regardless of distance from the *R/V Langseth*, we conclude that the potential for this species to be exposed to the proposed survey is extremely unlikely and the risks posed by the proposed action are discountable. Therefore, bowhead whales are not likely to be adversely affected by the proposed action and this species will not be considered further in this Opinion.

Pinnipeds
NMFS proposed to list Ringed seals as threatened under the ESA on December 10, 2010. Ringed seals have a circumpolar distribution from approximately 35ºN to the North Pole, occurring in all seas of the Arctic Ocean. In the North Pacific, they are found in the Bering Sea and range as far south as the Seas of Okhotsk and Japan. Throughout their range, ringed seals have an affinity for ice-covered waters and are known to retreat north during the spring and summer months as ice retreats (Allen and Angliss, 2010). Given the northern movements expected for ringed seals during the time when survey activities are occurring (early August to early September), the fact that ringed seals occurring south of 35ºN are considered rare, we conclude that the potential for this species to be exposed to the proposed survey is extremely unlikely and the risks posed by the proposed action are discountable. Therefore, ringed seals are not likely to be adversely affected by the proposed action and this species will not be considered further in this Opinion.

Sea Turtles
Four species of sea turtles can possibly be encountered in Alaskan waters: the leatherback, green, olive ridley, and loggerhead (including members of the proposed North Atlantic Ocean DPS) (ADF&G, 2011). However, the Bering Sea is considered to be outside the normal range for every one of these species except for leatherbacks which are known to tolerate a much larger temperature range than other species (NMFS and USFWS, 1992). Thus we feel that the presence of green, olive ridley, and loggerhead sea turtles in the action area is considered to be extremely rare. We conclude that the potential for these species to be exposed to the proposed survey is extremely unlikely and the risks posed by the proposed action are discountable. Therefore, green sea turtles, olive ridley sea turtles, loggerhead sea turtles as currently listed as well as the proposed North Pacific Ocean DPS of loggerhead sea turtles are not likely to be adversely affected by the proposed action and these listed and proposed species will not be considered further in this Opinion. Leatherbacks may be encountered and will be addressed further in this Opinion.

Anadromous Fish
Several listed DPSs/Evolutionary Signficant Units (ESUs) of Chinook, coho, chum, and sockeye salmon as well as steelhead trout may occur within the Alaska's coastal and marine waters as these salmonids migrate from the west coast of the United States to forage before returning to their natal streams to spawn. However, anadromous fish occurrence in Alaskan waters is generally fairly close to the Alaskan shoreline and around areas of pronounced coastal upwelling (Emmett et al., 1991; Salo, 1991; Stolz and Schnell, 1991; PFMC, 2000). The proposed survey, on the other hand, is located at least 350 kilometers from shore where the occurrence of listed salmon and steelhead trout species are considered to be rare. Given the distances of the proposed survey from the areas where listed anadromous fish species are expected to occur we conclude that the potential for this species to be exposed to the proposed survey is extremely unlikely and the risks posed by the proposed action are discountable. Therefore, all listed DPSs/ESUs of Chinook salmon, coho salmon, chum salmon, sockeye salmon, and steelhead trout that may occur in Alaskan waters are not likely to be adversely affected by the proposed action and these species will not be considered further in this Opinion

Critical Habitat
Critical habitat for the North Pacific right whale was designated in the eastern Bering Sea and in the Gulf of Alaska on April 8, 2008 (73 FR 19000). The primary constituent elements deemed necessary for the conservation of North Pacific right whales include the presence of specific copepods (*Calanus marshallae*, *Neocalanus cristatus*, and *N. plumchris*), and euphausiids (*Thysanoessa Raschii*) that act as primary prey items for the species. The critical habitat in the Gulf of Alaska would not be exposed to acoustic signals generated by the proposed survey activities as the Aleutian Islands should form an effective barrier to these signals. The critical habitat in the eastern Bering Sea is located approximately 300 kilometers east of the proposed track lines; however, none of the proposed transect lines enter the critical habitat and the survey will occur far enough away from the critical habitat area that received sound levels within the habitat will not exceed 160 dB re 1 μPa_{rms} (estimated to be approximately 3.85 kilometers from the sound source, see **Table 1** above). In addition, the *R/V Langseth* will not enter the designated critical habitat during transit to and from Dutch Harbor, Alaska (see **Figure 1** above). Therefore, critical habitat designated for North Pacific right whales is not expected to be affected by the proposed action and this listed resource will not be considered further in this Opinion.

Critical habitat was designated for the Eastern and Western DPSs of Steller sea lions on August 27, 1993 (58 FR 45269). Critical habitat occurs along the Alaskan coastline and extends out 3,000 feet (0.91 kilometers) seaward in state and federally managed waters from the baseline or basepoint of each major rookery for the Eastern DPS and extends out 20 nautical miles (37 kilometers) seaward in state and federally managed waters for the Western DPS. Essential features of Steller sea lion critical habitat include the physical and biological habitat features that support reproduction, foraging, rest, and refuge, and include terrestrial, air and aquatic areas. Specific terrestrial areas include rookeries and haul-outs where breeding, pupping, refuge and resting occurs. More than 100 major haulouts are documented. The principal, essential aquatic areas are the nearshore waters around rookeries and haulouts, their forage resources and habitats, and traditional rafting sites. Air zones around terrestrial and aquatic habitats are also designated as critical habitat to reduce disturbance in these essential areas.

None of the proposed transect lines enter steller sea lion critical habitat as the proposed survey will occur approximately 350 kilometers from the Alaskan shoreline as well as associated islands where critical habitat for Steller sea lions is currently designated. The survey will occur far enough away from the critical habitat area that received sound levels are not expected to reach levels where Steller sea lions or their prey are expected to respond [i.e.,160 dB re 1 μPa_{rms} (estimated to be approximately 3.85 kilometers from the sound source, see **Table 1** above)] Therefore, critical habitat designated for the Eastern and Western DPSs of Steller sea lions is not expected to be affected by the proposed action and these listed resources will not be considered further in this Opinion.

<u>Listed Resources Likely to be Adversely Affected</u>
The sections below provide information on the status of listed resources likely to be adversely affected by the proposed action. The biology and ecology of these species as well as their global status and trends are described below, and inform the effects analysis for this Opinion.

Fin Whale

Species Description, Distribution, and Population Structure

Fin whales are the second largest baleen whale by length, and are long-bodied and slender, with a prominent dorsal fin set about two-thirds of the way back on the body. They are dark gray dorsally and white ventrally, but the pigmentation pattern is often complex. Distinctive features of pigmentation, along with dorsal fin shapes and body scars, are useful for photo-identification (Agler et al., 1993).

Fin whales are widely distributed throughout the world's oceans; however, they tend to avoid tropical and pack ice waters with the high-latitude limit of their range set by ice and the lower-latitude limit by warmer tropical waters approximately 15° C (Sergeant, 1977). They also are less concentrated in nearshore environments while appearing to favor deeper waters. In the North Pacific in summer, fin whales are found in the Chukchi Sea, the Sea of Okhotsk, the Bering Sea and the Gulf of Alaska south to California (Gambell, 1985). Rice (1974) suggested that Northern Pacific fin whales may winter off of southern California; however, further research is needed to confirm this (Forney et al., 2000). Fin whales have also been observed feeding in Hawaiian waters in mid-May (Shallenberger, 1981; Balcomb, 1987).

In the North Atlantic Ocean, fin whales occur in summer foraging areas from the coast of North America to the Arctic, around Greenland, Iceland, northern Norway, Jan Meyers, Spitzbergen, and the Barents Sea. In the western Atlantic, they winter from the edge of sea ice south to the Gulf of Mexico and the West Indies. In the eastern Atlantic, they winter off southern Norway, the Bay of Biscay, and Spain with some whales migrating into the Mediterranean Sea (Gambell, 1985). In the Southern Hemisphere, fin whales are distributed broadly south of latitude 50° S in the summer while in the winter, the whales migrate into the Atlantic, Indian, and Pacific Oceans along the coast of South America (as far north as Peru and Brazil), Africa, and the islands in Oceania north of Australia and New Zealand (Gambell, 1985).

In the North Pacific Ocean, the IWC recognizes two "stocks": (1) East China Sea and (2) rest of the North Pacific (Donovan, 1991). However, Mizroch et al. (1984a) concluded that there were five possible "stocks" of fin whales within the North Pacific based on histological analyses and tagging experiments: (1) East and West Pacific that intermingle around the Aleutian Islands; (2) East China Sea; (3) British Columbia; (4) Southern-Central California to Gulf of Alaska; and (5) Gulf of California. Based on genetic analyses, Bérubé et al. (1998) concluded that fin whales in the Sea of Cortez represent an isolated population that has very little genetic exchange with other populations in the North Pacific Ocean (although the geographic distribution of this population and other populations can overlap seasonally). They also concluded that fin whales in the Gulf of St. Lawrence and Gulf of Maine are distinct from fin whales found off Spain and in the Mediterranean Sea. Regardless of how different authors structure the fin whale population, mark-recapture studies have demonstrated that individual fin whales migrate between management units (Mitchell, 1974; Gunnlaugsson and Sigurjónsson, 1989), which suggests that these management units are not geographically isolated populations.

NMFS currently recognizes three fin whale management stocks in U.S. Pacific waters: Alaska (Northeast Pacific), California/Oregon/Washington, and Hawaii (NMFS, 2010). We assume that

individuals from the Alaska (Northeast Pacific) stock of fin whales are the whales that would be exposed to the activities considered in this Opinion.

Life History Information
The life expectancy of fin whales is thought to be between 70 and 80 years (Kjeld et al., 2006 Wynek). Fin whales become sexually mature between 5 and 15 years of age (Gambell, 1985; COSEWIC, 2005) and have a calving interval of 2-3 years (Agler et al., 1993). Gestation lasts about 12 months and nursing occurs for 6-11 months (Perry et al., 1999). Calving and mating activities occur in late fall and winter (Mackintosh and Wheeler, 1929; Nishiwaki, 1952; Tomilin, 1957).

Fin whales feed on euphausiids and large copepods in addition to schooling fish (Nemoto, 1970; Kawamura, 1982; Watkins et al., 1984) although their diet varies seasonally and geographically (Watkins et al., 1984; Shirihai, 2002). They feed by filtering large volumes of water for the associated prey. The movements and distribution of fin whales may be based on prey availability, as Payne et al. (1990) concluded that fin whales are less stressed by fluctuations in prey availability than other species such as humpback whales due to their greater ability to exploit patchy prey aggregations.

The fin whales making up the Alaska stock are known to feed during summer months in the Bering Sea (Jefferson et al., 2008) although they are found in and around the action area in most months of the year. For example, the fin whale was the most commonly sighted whale during recent surveys conducted within the southeast Bering shelf and slope (Moore et al., 2002a; Tynan, 2004; Friday et al., 2009; Friday et al., 2011). Most fin whales in the northern hemisphere migrate seasonally from the Arctic in summer to lower latitudes in the winter to breed. However, the locations of these breeding grounds are not known and their migration patterns are less predictable than for other species (Perry et al., 1999).

Diving, Social Behavior, and Vocalization
The percentage of time fin whales spend at the surface varies. Some authors have reported that fin whales make 5-20 shallow dives with each of these dives lasting 13-20 seconds followed by a deep dive lasting between 1.5 and 15 minutes (Gambell, 1985). Other authors have reported that the fin whale's most common dives last between two and six minutes, with two to eight blows between dives (Watkins, 1981; Hain et al., 1992).

Fin whales can be found singly or in pairs, but can also form larger groupings of more than three individuals, particularly while feeding. Balcomb (1987) noted that fin whales commonly travel in herds, often widely dispersed, ranging from six to more than 100 individuals. They have also been reported grouped with other balaenopterid whale species at times (e.g. blue whales) (Corkeron et al., 1999; Shirihai, 2002).

Fin whales produce a variety of low-frequency sounds in the 10-200 Hz band range (Watkins, 1981; Watkins et al., 1987; Edds, 1988; Thompson et al., 1992). The most typical signals are long, patterned sequences of short duration (0.5-2 second) infrasonic pulses in the 18-35 Hz range (Patterson and Hamilton, 1964). Estimated source levels are as high as 190 dB in some cases (Patterson and Hamilton, 1964; Watkins et al., 1987a; Thompson et al., 1992; McDonald et

al., 1995). In temperate waters, intense bouts of long patterned sounds are very common from fall through spring, but also occur to a lesser extent during the summer in high latitude feeding areas (Clark and Charif, 1998).

Listing Status

Fin whales were originally listed as endangered 1970, and this status remained since the inception of the ESA in 1973. They are also listed as endangered on the IUCN Red List and are protected by the Convention on International Trade in Endangered Species of wild flora and fauna (CITES) as well as the MMPA. Critical habitat has not been designated for the species.

Abundance and Trends

Historically, fin whale populations worldwide were severly affected by commercial whaling in the 20th century in the North Atlantic, North Pacific, and Southern oceans (Cherfas, 1989 *as cited in* Perry et al., 1999). Braham (1991) compiled available regional estimates and estimated the global population of fin whales in 1991 to be about 119,000 individuals, which represented about a quarter of his estimated pre-exploitation abundance of 464,000 individuals.

Sergeant (1977) estimated that prior to commercial exploitation, there may have been as many as 30,000 to 50,000 fin whale individuals in the North Atlantic. Currently, no reliable population estimates exist for the entire North Atlantic; however, estimates do exist for portions of the North Atlantic. For the year's 1996-2001, the IWC's best estimate for the population of fin whales in the central and northeastern Atlantic was 30,000 individuals. Braham (1991) estimated the western North Atlantic to contain between 3,590 and 6,300 individuals while Hain et al. (1992) estimated that there were approximately 5,000 fin whales in the western North Atlantic Ocean based on a 1978-1982 survey. The most recent abundance estimate for the western North Atlantic stock was 3,985 total individuals (CV=0.24) (Waring et al., 2009).

In the North Pacific, there may have been as many as 42,000-45,000 fin whales prior to commercial exploitation; however, it is estimated that this population was reduced to between 13,620 and 18,630 by the early 1970's (Ohsumi and Wada, 1974). Moore et al. (2000) conducted surveys for whales in the central Bering Sea in 1999 and estimated the fin whale population to be approximately 4,951 individuals. Results from ship surveys performed off the coasts of Washington, Oregon, and California in the years 1996 and 2001 estimated the fin whale population at 3,279 individuals (Barlow and Taylor, 2001) while results of a 2005 ship survey in the same region estimated the fin whale population at 3,281 individuals (Forney, 2007). Based on the available information, it is feasible that the North Pacific population as a whole has failed to increase significantly over the past 30 years.

In the Southern Hemisphere, there may have been as many as 400,000 fin whales prior to exploitation by whaling vessels; however it is estimated this population may have been reduced to 85,200 fin whales by the late 1970's (IWC, 1979). A joint Conservation of Antarctic Marine Living Resources/IWC survey in the Scotia Sea and Antarctic Peninsula during the austral summer of 2000 (January-February) resulted in a more recent abundance estimate of 4,672 individuals in the Southern Hemisphere (Hedley et al., 2001; Reilly et al., 2004).

Current Threats
The main stressors affecting the ability of the species to recover include ongoing effects from prior commercial whaling, interaction with fishing gear, ship strikes, and various sources of habitat degradation. Historically, whaling represented the greatest threat to every population of fin whales and was ultimately responsible for listing fin whales as an endangered species. From 1904 to 1975, the IWC estimates that 703,693 fin whales were captured and killed in Antarctic whaling operations alone (IWC, 1990). Whaling in the Southern Ocean originally targeted humpback whales, but by 1913, those whales had become so rare that whalers shifted their focus to other species including fin and blue whales (Mizroch et al., 1984a). From 1911 to 1924, it was estimated that whalers harvested between 2,000–5,000 fin whales each year. After the introduction of factory whaling ships in 1925, the number of whales killed each year increased substantially which had a major impact on global fin whale populations prior to the ban on international whaling.

As is the case with other large whale species, entanglement in commercial fishing gear and mortality from ship strikes continue to affect the species' ability to recover. There were 14 confirmed reports of fin whales being entangled in fishing gear between 2004 and 2008 off the Atlantic coast of the U.S. and Maritime Provinces of Canada, with 3 whales dying of their wounds and an additional 3 sustaining serious injuries (Glass et al., 2010). For ship strikes, there were 13 confirmed reports of fin whales being struck by vessels with 10 dying of their wounds (Glass et al., 2010).

Organochlorines, including PCB, DDT, and DDE have been identified from fin whale blubber samples with females containing lower burdens than males. This is likely due to mobilization of contaminants during pregnancy and lactation (Aguilar and Borrell, 1988; Gauthier et al., 1997). Contaminant levels increase steadily with age until sexual maturity, at which time levels begin to drop in females and continue to increase in males (Aguilar and Borrell, 1988).

Fin whales are still hunted in subsistence fisheries off West Greenland and are hunted by Japanese whalers in the Southern Ocean as part of Japan's JARPA II research program with anticipated harvests of 50 fin whales each year expected for the period 2007-2019 (Nishiwaki et al., 2006). Other current threats affecting fin whale recovery include effects of ocean noise as well as disturbance from whale watching and other scientific research activities.

Effects of current climate change trends also present potential threats to fin whales, particularly in the Mediterranean Sea, where fin whales appear to prey exclusively on northern krill. These krill species occupy the southern extent of their range and increases in water temperature could result in their decline in the Mediterranean Sea thereby potentially affecting food availability for fin whales in this region (Gambaiani et al., 2009). However, there are insufficient data to know the effects that current climate-related trends are having on fin whale populations.

Humpback Whale

Species Discription, Distribution, and Population Structure
Humpback whales are large baleen whales known for their long pectoral fins (up to 15 ft in length) and complex whale songs. Humpback whales occur throughout the world's oceans and