DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XC494

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to an Exploration Drilling Program in the Chukchi Sea, AK

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

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

SUMMARY: NMFS received an application from ConocoPhillips Company (COP) for an Incidental Harassment Authorization (IHA) to take marine mammals, by harassment, incidental to offshore exploration drilling on Outer Continental Shelf (OCS) leases in the Chukchi Sea, Alaska. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an IHA to COP to take, by Level B harassment only, 12 species of marine mammals during the specified activity.

DATES: Comments and information must be received no later than March 25, 2013.

ADDRESSES: Comments on the application should be addressed to Michael Payne, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910. The mailbox address for providing email comments is *ITP.Nachman@noaa.gov.* NMFS is not responsible for email comments sent to addresses other than the one provided here. Comments sent via email, including all attachments, must not exceed a 25-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, which contains several attachments, including COP's marine mammal mitigation and monitoring plan and Plan of Cooperation, used in this document may be obtained by writing to the address specified above, telephoning the contact listed below (see **FOR FURTHER INFORMATION CONTACT**), or visiting the Internet at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm.* Documents cited in this notice may 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 1, 2012, from COP for the taking, by harassment, of marine mammals incidental to offshore exploration drilling on OCS leases in the Chukchi Sea, Alaska. However, before NMFS had an opportunity to review and comment on the March 1, 2012, submission, COP notified NMFS that they were making changes to the request and submitted a new application on July 16, 2012. NMFS reviewed COP's application and identified a number of issues requiring further clarification. After addressing comments from NMFS, COP modified its application and submitted a final revised application on December 6, 2012. NMFS carefully evaluated COP's application, including their analyses, and determined that the application was complete. The December 6, 2012, submission (2nd application revision) is the one available for public comment (see **ADDRESSES**) and considered by NMFS for this proposed IHA.

COP plans to drill up to two exploration wells on OCS leases offshore in the Chukchi Sea, Alaska, at the Devils Paw prospect during the 2014 Arctic open-water season (July through October). Impacts to marine mammals may occur from noise produced by the drill rig and support vessels alongside the drill rig in dynamic positioning (DP) mode, vertical seismic profile (VSP) surveys, and supporting vessels (including icebreakers) and aircraft. COP has requested an authorization to take 12 marine mammal species by Level B harassment, and NMFS is proposing to authorize take incidental to COP's offshore exploration drilling in the Chukchi Sea of the following species: beluga whale (*Delphinapterus leucas*); bowhead whale (*Balaena mysticetus*); gray whale (*Eschrichtius robustus*); killer whale (*Orcinus orca*); minke whale (*Balaenoptera acutorostrata*); fin whale (*Balaenoptera physalus*); humpback whale (*Megaptera novaeangliae*); harbor porpoise (*Phocoena phocoena*); bearded seal (*Erignathus barbatus*); ringed seal (*Phoca hispida*); spotted seal (*P. largha*); and ribbon seal (*Histriophoca fasciata*).

Description of the Specified Activity and Specified Geographic Region

COP plans to conduct an offshore exploration drilling program on U.S.

Department of the Interior (DOI), Bureau of Ocean Energy Management (BOEM) Alaska OCS leases located greater than 70 mi (113 km) from the Chukchi Sea coast during the 2014 open-water season. During the 2014 drilling program, COP plans to drill up to two exploration wells at the prospect known as Devils Paw. See Figure 1 in COP's application for the lease block and drill site locations (see **ADDRESSES**). The purpose of COP's program is to test whether oil deposits are present in a commercially viable quantity and quality. COP has stated that only if a significant accumulation of hydrocarbons is discovered will the company consider proceeding with development and production of the field.

Exploration Drilling

All of the possible Chukchi Sea offshore drill sites are located approximately 120 mi (193 km) west of Wainwright, the community proposed to be used for permanent infrastructure support for the project. Approximate distances from the exploration drilling project area to other communities along the Chukchi coast are 200 mi (322 km) from Barrow, 90 mi (145 km) from Point Lay, and 175 mi (282 km) from Point Hope. Water depths at the potential drill sites range from 132–138 ft (40.2–42 m). Table 2 in COP's application provides the coordinates for the potential drill sites (see **ADDRESSES**).

(1) Drill Rig Mobilization and Positioning

COP proposes to use a jack-up rig, instead of a drillship, to conduct the proposed program. Generally, jack-up rigs consist of a buoyant steel hull with three or more legs on which the hull can be ''jacked'' up or down. The jack-up drill rig has no self-propulsion capability and therefore needs to be transported by a heavy-lift vessel (HLV) from its original location to an area in the Bering Sea where it would then be placed in a floating mode under the control of three towing vessels. After delivering the jack-up rig, the HLV would depart immediately via the Bering Strait and would not return until completion of the project. When weather and ice conditions at the Devils Paw Prospect are favorable, the support vessels will tow the rig into position over the DP–5 drill site and initiate offloading.

Offloading procedures are estimated to take from 24 to 36 hrs, dependent on weather. Initial drill rig placement and orientation would be determined by logistics, current and forecasted weather events, ice extent, ice type, underwriter requirements, and safety considerations. Actual positioning of the rig would be determined by the well design, geology, shallow hazards, and seabed conditions. The rig would then be jacked up, manned with a crew, and provisioned for commencing drilling. The horizontal dimensions of the rig will be approximately 230 × 225 ft (70 × 68 m). When operating, the hull will be about 40 ft (12 m) above seawater surface. Maximum dimension of one leg spud can, which is the part on the seafloor, is about 60 ft (18 m).

If weather and ice conditions at the Devils Paw Prospect area are initially unfavorable, the HLV would transport the jack-up rig to the alternate staging area located about 20 mi (32 km) south of Kivalina and 6 mi (9.7 km) offshore (see Figure 1 in COP's application), offload the rig, and depart the Chukchi Sea via the Bering Strait. This alternative location has been chosen based on its proximity to infrastructure and likelihood to be ice free at the time of transfer. It may take up to 3 days to reach the prospect location from the alternate staging area (approximately 190 mi away [306 km]).

If the rig is offloaded at the alternate staging area, it would be placed into standby mode, which means it would be temporarily jacked up and manned by a limited crew to wait for conditions to improve at the prospect. In addition, support helicopters would be mobilized to Red Dog Mine near Kotzebue as necessary. Once ice conditions and weather at the Devils Paw Prospect area turn favorable, the anchor handling supply tug (AHST) and other vessels standing by in the immediate vicinity of the rig would move the rig to the prospect area. The rig would then be jacked up, manned with a crew, and supplied to commence drilling. (2) Support Vessel and Aircraft Movements

Various vessels will be involved in the drilling project, as summarized in Table 1 of COP's application (see **ADDRESSES**). The vessels involved in supporting the drilling operations will remain at about 5.5 mi (9 km) distance from the drill rig when they are not actively supporting the drilling operations. Several vessels will also be available for oil spill response purposes (see Table 1 in COP's application). Most of these vessels are relatively small and will be located aboard a mother vessel, either the oil spill response barge or the landing craft. These vessels will not be deployed in the water, unless needed to respond to a spill or to conduct oil spill response exercises as directed by DOI's Bureau of Safety and Environmental Enforcement (BSEE). The oil spill response vessel (OSRV) will also be on standby at 5.5 mi (9 km) from the drill rig. In addition to the vessels required for the actual drilling operations, a science vessel will be conducting monitoring activities. Figure 3 in COP's application provides an overview of the approximate locations of the vessels relative to the rig. The vessels will be located upwind from the rig, and, as such, they could be moved to any quadrant (A, B, C, or D) denoted in the figure, depending on the prevailing wind and currents.

COP also intends to have two helicopters and one fixed-wing airplane available as part of the operations. Helicopters would be used for personnel and equipment transport between shore and the drill rig consistently during operations. The airplane would be used for personnel and equipment transport between onshore locations. Wainwright would be the principal port from which crew transfers would take place; however, it is possible that under certain circumstances these activities might need to be conducted through Barrow or another location.

(3) Drill Rig Resupply

Transport of supplies to and from the drill rig will primarily be done with the ware vessel and offshore supply vessels (OSVs), although any other project vessel with the capability of DP could be used. The supplies would be loaded in Wainwright onto the large landing craft from where they would be transferred to the supply vessels. This transfer of supplies will take place somewhere between 5.5 mi (9 km) of the drill rig and 5 mi (8 km) offshore of Wainwright. When not engaged in transfers of supplies, the ware vessel and OSVs will be located about 5.5 mi (9 km) from the drill rig. The large landing craft will be located somewhere between 5.5 mi (9 km) of the drill site and 5 mi (8 km) offshore of Wainwright.

The duration of each supply trip by the ware vessel and OSV is estimated to be up to 7 hrs, assuming the vessels depart from their standby location at about 5.5 mi (9 km) of the rig. It would take approximately 0.5 hr to travel one-way to the drill rig (cruising mode). The supply vessel would be dynamically positioned next to the rig for about 6 hrs for each transfer of fuel and less than 6 hrs for each transfer of other supplies. The transit time between the large landing craft and the supply vessels is about 3 hrs one-way.

The ware vessel is estimated to make about two to three trips per week to the rig but could make an average of almost four resupply trips per week over 14 weeks. Based on an estimated 53 trips per season and a maximum of 6 hrs for supply transfer, the ware vessel would be in DP mode up to a total of 318 hrs over the drilling season. The OSVs are estimated to make four and a half resupply trips per week over 14 weeks. Based on an estimated total of 63 trips, unloading supplies from the OSV to the rig would take up to a total of 378 hrs (in DP mode) over the course of the drilling season. Assuming that at any time only one supply vessel will be in DP alongside the drill rig, the total duration of DP is 696 hrs.

(4) Personnel Transfer and Refueling

About 300 persons are estimated to be involved in the proposed exploration drilling overall. The jack-up drill rig, support and oil spill response vessels will be self-contained, and the crew will live aboard the rig and vessels. Air support will be necessary to meet personnel and supply needs once the rig is operational. The helicopter will fly a direct route between Wainwright and the drill rig, eight to ten times per week.

Three refueling events per well are expected to be required for the drill rig, depending on the circumstances. The duration of a rig-fueling event will be approximately 6 hrs. All refueling operations will follow procedures approved by the U.S. Coast Guard.

Vertical Seismic Profile Test

COP intends to conduct two or three VSP data acquisition runs inside the wellbore to obtain high-resolution seismic images with detailed time-depth relationships and velocity profiles of the various geological layers. The VSP data can be used to help reprocess existing 2D or 3D seismic data prior to drilling a potential future appraisal well in case oil or gas is discovered during the proposed exploration drilling.

The procedure of one VSP data acquisition run can be summarized as follows (Figure 2 in COP's application provides a schematic of the layout):

- The source of energy for the VSP data acquisition, typically consisting of one or more airguns, will be lowered from the drilling platform or a vessel to a depth of approximately 10 ft (3 m) to 30 ft (10 m) below the water surface (depending on sea state). The total volume of the airgun(s) is not expected to exceed 760 in^3.
- A minimum of two geophones positioned 50 ft (15.2 m) apart will be placed at the end of a wireline cable, which will be lowered into the wellbore to total depth. Once total depth has been reached, the wireline cable will be pulled up and stopped at predefined depths (geophone stations). Data will be acquired by producing a series of sound pulses from the airgun(s) over a period of approximately 1 min. The sound waves generated by the source and reflected from various geological layers will be recorded by the two geophones.
- After each 1-minute airgun activity, the wireline cable with the geophones will be pulled up to a shallower position in the well after which the airgun(s) will again produce a series of sound pulses over a period of approximately 1 min. This process will be repeated until data have been acquired at all pre-identified geophone stations.

Two or three VSP data acquisition runs will be conducted; the first run will take place upon reaching the bottom of the 17.5-in (44.5 cm) borehole at approximately 5,220 ft (1,590 m) below sea level (bsl), the second run upon reaching the bottom of the 13.5 and 8.5 in (34.2 and 21.5 cm) borehole at approximately 9,580 ft (2,920 m) bsl, and a possible third run upon reaching the bottom of the 6.5 in (16.5 cm) borehole at approximately 11,020 ft (33,590 m) bsl. If the integrity of the 8.5 in borehole allows drilling to 11,020 ft without the need for an extra casing a third VSP run might not be needed. The number of geophone stations for each of the three VSP data acquisition runs varies depending on the length of the wellbore to be surveyed. The time required to finish a VSP data acquisition run depends on the depth of the wellbore (resulting in longer time to lower and pull up the wire cable with geophones) and the number of stations (resulting in longer data acquisition time). The period between VSP data acquisition runs is about 7–10 days, depending on the drilling progress. The total amount of time that airguns are operating for the three runs combined that might be performed in a well is about 2 hrs, not including ramp up. In case a second well is drilled, two or three additional VSP data acquisition runs might be conducted, meaning an additional 2 hrs of airgun operations over the course of the entire open-water drilling season.

Ice Management

Understanding ice systems and monitoring their movement are important aspects of COP's Chukchi Sea operations. COP has monitored Chukchi Sea ice since 2008 and would continue that monitoring through the proposed drilling season. Initial monitoring would incorporate satellite imagery to observe the early stages of sea ice retreat. Upon arrival in the project area, the ice management vessel, possibly with one other project vessel, would operate at the edge of the ice pack and monitor ice activity, updating all interested parties on ice pack coordinates to help determine scheduling for mobilization of the rig. COP has submitted an Ice Alerts Plan to BOEM for approval in connection with the Exploration Plan. The Ice Alerts Plan summarizes historic ice monitoring results which has assisted COP in estimating the timing and placement of the rig and support vessels. Under the COP Ice Alerts Plan, an ice monitoring and management center based out of Anchorage will monitor and interpret information collected from project vessels and satellite imagery during the entire drilling operation. A summary of the major components of COP's Ice Alerts Plan is provided below.

The ice edge position will be tracked in near real time using observations from satellite images, from the ice management vessel or other project vessels. The ice management and project vessels used for ice observations will remain on standby within about 5.5 mi (9 km) of the drill rig, unless deployed to investigate migrating ice-floes. When investigating ice, the vessels will likely stay within about 75 mi (121 km) of the rig. The Ice Alerts Plan includes a process for determining how close hazardous ice can approach before the well needs to be secured and the jack-up rig moved. This critical distance is a function of rig operations at that time, the speed and direction of the ice, the weather forecast, and the method of ice management.

Based on available historical and more recent ice data, there is low probability of ice entering the drilling area during the open water season. However, if hazardous ice is on a trajectory to approach the rig, the ice management vessel will be available to respond. One option for responding is to use the vessels fire monitor (water cannon) to modify the trajectory of the floe. Another option is to redirect the ice by applying pressure with the bow of the ice management vessel, slowly pushing the ice away from the direction of the drill rig. At these slow speeds, the vessel would use low power and slow propeller rotation speed, thereby reducing noise generation from propeller rotation effects in the water. Icebreaking is not planned as a way to manage ice that may be on a trajectory toward the drilling rig. In case the jack-up rig needs to be moved due to approaching ice, the support vessels will tow the rig to a secure location.

Timeframe of Activities

COP's anticipated start and end dates of the mobilization, drilling operations, and demobilization are on or about June 15, 2014, and November 16, 2014, respectively, with actual activities in the lease sale area taking place roughly from July through October. Vessels would not arrive at the prospect prior to July 1. The HLV with the jack-up drill rig is expected to originate from Southeast Asia or the North Sea. The HLV will depart the area as soon as it has offloaded the rig. The AHST, OSVs, and ware vessel will mobilize from the Gulf of Mexico in early June and will be traveling north in close proximity to the HLV and jack-up rig. The ice management vessel will be the first to mobilize to the drill site to provide information on ice conditions to the HLV and other vessels.

COP anticipates the drilling of one well will take approximately 40 days. After the first Devils Paw well is drilled, it will be plugged and abandoned. If there is enough time, as estimated by the ice monitoring system, COP intends to drill a second well, which could take another 40 days. Relocation of the rig from the first to the second well would take approximately 24–48 hrs. If a second well is drilled, it would also be plugged and abandoned.

When drilling is completed, the jack-up rig will be demobilized and excess material transferred from the rig to supply vessels. The rig will then be jacked down and taken under tow by the AHST and OSVs to the load-out site, anticipated to be located south of the Devils Paw prospect area. The rig will remain in tow by the AHST until the HLV arrives. In case the drilling season ends earlier than anticipated, the rig may be towed to the alternate staging area and jacked up until the HLV arrives. In that situation, helicopters will be mobilized to Nome or the Red Dog Mine to support the rig as necessary. Once the AHST has the jack-up rig under tow, all other support vessels would be dismissed. The AHST and OSVs would accompany the rig until it is loaded onto the HLV. Once the rig has been loaded onto the HLV, the AHST, supply vessels, and air support will be demobilized.

Exploratory Drilling Program Sound Characteristics

Potential impacts to marine mammals could occur from the noise produced by the jack-up rig and its support vessels (including the ice management vessels and during DP), aircraft, and the airgun array during VSP tests. The drill rig produces continuous noise into the marine environment. NMFS currently uses a threshold of 120 dB re 1 µPa (rms) for the onset of Level B harassment from continuous sound sources. This 120 dB threshold is also applicable for the support vessels during DP. The airgun array proposed to be used by COP for the VSP tests produces pulsed noise into the marine environment. NMFS currently uses a threshold of 160 dB re 1 µPa (rms) for the onset of Level B harassment from pulsed sound sources.

(1) Drill Rig Sounds

The main contributors to the underwater sound levels from jack-up rig drilling activities are the use of generators and drilling machinery. Few underwater noise measurements exist from operations using a drill rig. Here we summarize the results from the drilling rig *Ocean General* and its two support vessels in the Timor Sea, Northern Australia (McCauley, 1998) and the jack-up rig *Spartan 151* in Cook Inlet, Alaska (MAI, 2011). For comparison, COP also included information on drilling sound measurements from a concrete drilling island and drillship. However, the sound propagation of a jack-up rig is substantially less than that of a drillship because the components that generate sound from a jack-up rig sit above the surface of the water instead of in the water.

McCauley (1998) conducted measurements under three different conditions: (a) Drilling rig sounds without drilling; (b) actively drilling, with the support vessel on anchor; and (c) drilling with the support vessel loading the rig (McCauley, 1998). The primary noise sources from the drill rig itself were from mechanical plants, fluid discharges, pumping systems and miscellaneous banging of gear on the rig. The overall noise level was low (117 dB re 1µPa at 410 ft [125 m]) mainly because the deck of the rig was well above the waterline (which is also the case for jack-up rigs). When the rig was actively drilling, the drill rig noise dominated the drilling sounds to a distance of about 1,312 ft (400 m). Beyond that distance, the energy from the drill string tones (in the 31 and 62 Hz ⅓ octaves) became apparent and resulted in an increase in the overall received noise level. With the rig drilling, the highest noise levels encountered were on the order of 117 dB re 1µPa at 410 ft (125 m) and 115 dB re1µPa at 1,228 ft (405 m). The noise source that far exceeded the previous two was from the support vessel standing alongside the rig for loading purposes. The thrusters and main propellers were engaged to keep the vessel in position and produced high levels of cavitation sound. The sound was broadband in nature, with highest levels of 137 dB 1µPa at 1,328 ft (405 m) and levels of 120 dB re 1µPa at 1.8–2.4 mi (3–4 km) from the well head.

Acoustic measurements of the drilling rig *Spartan 151* were conducted to report on underwater sound characteristics as a function of range using two different systems (moored hydrophone and real time system). Both systems provided consistent results. Primary sources of rig-based underwater sounds were from the diesel engines, mud pump, ventilation fans (and associated exhaust), and electrical generators. The loudest source levels (from the diesel engines) were estimated at 137 dB re 1 µPa at 1 m (rms) in the 141–178 Hz ⅓ octave band. Based on this estimate, the 120 dB (rms) re 1 µPa sound pressure level would be at about 154 ft (50 m) away from where the energy enters the water (jack-up leg or drill riser).

Hall and Francine (1991) measured drilling sounds from an offshore concrete island drilling structure. Source sound pressure level was 131 dB re 1µPa at 1 m for the drilling structure at idle (no drilling), and a transmission loss rate of 2.6 dB per doubling of distance, slightly less than theoretical cylindrical spreading. At a distance of 912 ft (278 m) from the drilling island the broadband sound pressure level was 109 dB re 1µPa. Strong tonal components at 1.375–1.5 Hz were detected in the acoustic records during drilling activities. These were likely associated with the rotary turntable, which was rotating between 75 and 110 rpm (which corresponds to 1.25–1.83 Hz). The received broadband sound pressure level at 849 ft (259 m) was 124 dB re 1µPa. The sounds measured from the concrete drilling island were almost entirely (>95%) composed of energy below 20 Hz.

Sound pressure levels of drilling activities from the concrete drilling island were substantially less than those reported for drill ships (Greene, 1987a). At a range of 557 ft (170 m) the 20–1000 Hz band level was 122–125 dB for the drillship *Explorer I,* with most energy below 600 Hz (although tones up to 1850 Hz were recorded). Drilling activity from the *Explorer* was measured as 134 dB at a range of 656 ft (200 m), with all energy below 600 Hz. Underwater sound measurements from the drillship *Kulluk* at 3,215 ft (980 m) were substantially higher (143 dB re 1µPa). Underwater sound levels recorded from the drillship *Stena Forth* in Disko Bay, Greenland, corresponded to measurements from other drillships and were higher than sound levels reported for semi-submersibles and drill rigs (Kyhn et al., 2011). The broadband source levels were similar to a fast moving merchant vessel with source levels up to 184–190 dB re 1 µPa during drilling and maintenance work, respectively. At a range of 1,640 ft (500 m) from the drillship the 10–1000 Hz band level during drilling at 295 ft (90 m) ranged from approximately 100–128 dB re1 µPa, with the highest sound level at 100 and 400 Hz. Sound levels were ≤110 dB re1 µPa at 1.2 mi (2 km) distance.

Expected sound pressure levels for the proposed drilling activities have been modeled by JASCO Applied Research, Inc. for drilling sounds only and for drilling sounds in combination with the proximity of a support vessel using DP. The acoustic modeling results show that the maximum radii to received sound levels of 120 and 160 dB re 1 µPa from drilling operations alone are 689 ft (210 m) and <33 ft (10 m), respectively (O'Neill et al., 2012). More detailed results are included in Attachment A of COP's IHA application.

(2) Vessel Sounds

In addition to the drill rig, various types of vessels will be used in support of the operations including ice management vessels, anchor handlers, supply vessels and oil-spill response vessels. Like other industry-generated sound, underwater sound from vessels is generally most apparent at relatively low frequencies (20–500 Hz). The sound characteristic of each vessel is unique depending upon propulsion unit, machinery, hull size and shape. These characteristics change with load, vessel speed and weather conditions. For example, increase in vessel size, power and speed produces increasing broadband and tonal noise. The sound produced by vessels is generated by engine machinery and propeller cavitation. When a vessel increases speed, broadband sound from propeller cavitation and hull vibration becomes dominant over machinery sound. It has been estimated that propeller cavitation produces at least 90% of all ship generated ambient noise (Ross, 2005). Sound from large vessels is generally higher at low frequencies. Small high-powered (>100 horse power [HP]) propeller driven boats often exceed large vessel sound at frequencies above 1 kHz.

Ice management vessels operating in thick ice require a greater amount of power and propeller cavitation and hence produce higher sound levels than ships of similar size during normal operation in open water (Richardson et al., 1995b). Roth and Schmidt (2010) examined ice management vessel sound pressure levels during different sea ice conditions and modes of propulsion. Comparison of source spectra in open-water and while breaking moderate ice showed increases as much as 15 dB between 20 Hz and 2 kHz. For low frequencies, a sound pressure level of about 193 dB re 1µPa at 1 m was estimated to be a reasonable peak value.

Numerous measurements of underwater vessel sound have been performed since 2000 (for review see Wyatt, 2008) mostly in support of industry activity. Results of underwater vessel sounds that have been measured in the Chukchi and Beaufort Seas were reported in various 90-day and comprehensive reports since 2007 (e.g., Aerts *et al.,* 2008; Hauser *et al.,* 2008; Brueggeman *et al.,* 2009a; Ireland *et al.,* 2009). Due to the highly variable conditions under which these measurements were conducted, including equipment and methodology used, it is difficult to compare source levels (i.e., back calculated sound levels at a theoretical 1 m from the source) or even received levels between vessels. For example, source sound pressure levels of the same tug with barge varied from 173 dB to 182 dB re 1µPa at 1 m, depending on the speed and load at the time of measurement (Zykov and Hannay, 2006). Sound pressure levels of a drill rig support vessel traveling at a speed of about 11 knots (20 kph) was measured to be 136 dB re 1µPa at 1,312 ft (400 m) (McCauley, 1998). Acoustic measurements of an anchor handling support tug of similar size and horsepower traveling at 4.3 knots (8 kph) resulted in sound pressure levels of approximately 137 dB re 1µPa at 1,312 ft (400 m) and 120 dB re 1µPa at 4,855 ft (1,480 m) (Funk *et al.,* 2008).

(3) Aircraft Sounds

Helicopters are proposed to be used for personnel and equipment transport to and from the drill rig. Over calm water away from shore, the maximum transmission of rotor and engine sounds from helicopters into the water can generally be visualized as a 26° cone under the aircraft. The size of the water surface area where transmission of sound can take place is therefore generally larger with a higher flight altitude, though the sound levels will be much lower due to the larger distance from the water. In practice, the width of the area where aircraft sounds will be received is usually wider than the 26° cone and varies with sea state because waves provide suitable angles for additional transmission of the sound. In shallow water, scattering and absorption will limit lateral propagation. Dominant tones in noise spectra from helicopters are generally below 500 Hz (Greene and Moore, 1995). Harmonics of the main rotor and tail rotor usually dominate the sound from helicopters; however, many additional tones associated with the engines and other rotating parts are sometimes present. Because of Doppler shift effects, the frequencies of tones received at a stationary site diminish when an aircraft passes overhead. The apparent frequency is increased while the aircraft approaches and is reduced while it moves away. Aircraft flyovers are not heard underwater for very long, especially when compared to how long they are heard in air as the aircraft approaches an observer.

Underwater sounds were measured for a Bell 212 helicopter (Greene 1982, 1985; Richardson *et al.,* 1990). These measurements show that there are numerous prominent tones at frequencies up to about 350 Hz, with the strongest measured tone at 20–22 Hz. Received peak sound levels of a Bell 212 passing over a hydrophone at an altitude of approximately 1,000 ft (300 m), varied between 106–111 dB re 1µPa at 29 and 59 ft (9 and 18 m) water depth. Two Class 1 or Group A type helicopters will fly to and from the jack-up rig for transportation of manpower and supplies. Helicopters will be operated by a flight crew of two and capable of carrying 12 to 13 passengers.

(4) Vertical Seismic Profile Airgun Sounds

Airguns function by venting high-pressure air into the water. 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 oscillation of the resulting air bubble. Most energy emitted from airguns is at relatively low frequencies. Typical high-energy airgun arrays emit most energy at 10–120 Hz. However, the pulses contain significant energy up to 500–1000 Hz and some energy at higher frequencies (Goold and Fish, 1998; Potter *et al.,* 2007). Studies in the Gulf of Mexico have shown that the horizontally-propagating sound can contain significant energy above the frequencies that airgun arrays are designed to emit (DeRuiter *et al.,* 2006; Madsen *et al.,* 2006; Tyack *et al.,* 2006). Energy at frequencies up to 150 kHz was found in tests of single 60-in^3 and 250-in^3 airguns (Goold and Coates, 2006). Nonetheless, the predominant energy is at low frequencies.

The strengths of airgun pulses can be measured in different ways, and it is important to know which method is being used when interpreting quoted source or received levels. Geophysicists usually quote peak-to-peak (p-p) levels, in bar-meters or (less often) dB re 1 µPa.

Peak level (zero-to-peak [0-p]) for the same pulse is typically approximately 6 dB less. In the biological literature, levels of received airgun pulses are often described based on the average or rms level, where the average is calculated over the duration of the pulse. The rms value for a given airgun pulse is typically approximately 10 dB lower than the peak level and 16 dB lower than the p-p value (Greene, 1997; McCauley *et al.,* 1998, 2000). A fourth measure that is increasingly used is the Sound Exposure Level (SEL), in dB re 1 μPa2s. Because the pulses, even when stretched by propagation effects (see below), are usually <1 s in duration, the numerical value of the energy is usually lower than the rms pressure level. However, the units are different.

Because the level of a given pulse will differ substantially depending on which of these measures is being applied, it is important to be aware which measure is in use when interpreting any quoted pulse level. NMFS refers to rms levels when discussing levels of pulsed sounds that may harass marine mammals; these are the units used in this IHA notice. Specifics about the VSP airgun(s) and expected radii of various received rms sound levels are included in the acoustic modeling report of JASCO Applied Sciences (Attachment A of COP's application). The airgun array proposed for use will not exceed 760 in^3. The VSP airgun operations differ from normal marine seismic surveys in that the airguns are fixed to one location (the drill rig), and a limited number of shots will be fired (a total of about 2 hrs of airgun activity per well, not including time required for ramp ups).

Although there will be several support vessels in the drilling operations area, NMFS considers the possibility of collisions with marine mammals highly unlikely. Once on location, the majority of the support vessels will remain in the area of the drill rig throughout the 2014 drilling season and will not be making trips between the shorebase and the offshore vessels (with the exception of the resupply transits). As noted earlier in this document and in Figure 3 of COP's application, the majority of the vessels will sit on standby mode approximately 5.5 mi (9 km) upwind of the drill rig. As the crew change/resupply activities are considered part of normal vessel traffic and are not anticipated to impact marine mammals in a manner that would rise to the level of taking, those activities are not considered further in this document.

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 (*Monodon monoceros*); polar bears (*Ursus maritimus*); and walruses (*Odobenus rosmarus divergens;* see Table 3 in COP's application). The bowhead, humpback, and fin whales are listed as ''endangered'' under the Endangered Species Act (ESA) and as depleted under the MMPA. The ringed and bearded seals are listed as ''threatened'' under the ESA. Certain stocks or populations of gray, beluga, and killer whales and spotted seals are listed as endangered or are proposed for listing under the ESA; however, none of those stocks or populations occur in the proposed activity area. Additionally, the ribbon seal is considered a ''species of concern'' under the ESA. Both the walrus and the polar bear are managed by the U.S. Fish and Wildlife Service (USFWS) and are not considered further in this proposed IHA notice.

Of these species, 12 are expected to occur in the area of COP's proposed operations. These species include: the bowhead, gray, humpback, minke, fin, killer, and beluga whales; harbor porpoise; and the ringed, spotted, bearded, and ribbon seals. Beluga, bowhead, gray, and killer whales, harbor porpoise, and ringed, bearded, and spotted seals are anticipated to be encountered more than the other four marine mammal species mentioned here. The marine mammal species that is likely to be encountered most widely (in space and time) throughout the period of the proposed drilling program is the ringed seal. Encounters with bowhead and gray whales are expected to be limited to particular seasons. Where available, COP used density estimates from peer-reviewed literature in the application. In cases where density estimates were not readily available in the peer-reviewed literature, COP used other methods to derive the estimates. NMFS reviewed the density estimate descriptions and documents and determined that they were acceptable for these purposes. The explanation for those derivations and the actual density estimates are described later in this document (see the ''Estimated Take by Incidental Harassment'' section).

The narwhal occurs in Canadian waters and occasionally in the Alaskan Beaufort Sea and the Chukchi Sea, but it is considered extralimital in U.S. waters and is not expected to be encountered. There are scattered records of narwhal in Alaskan waters, including reports by subsistence hunters, where the species is considered extralimital (Reeves *et al.,* 2002). Due to the rarity of this species in the proposed project area and the remote chance it would be affected by COP's proposed Chukchi Sea drilling activities, this species is not discussed further in this proposed IHA notice.

COP's application contains information on the status, distribution, seasonal distribution, abundance, and life history of each of the species under NMFS jurisdiction mentioned in this document. When reviewing the application, NMFS determined that the species descriptions provided by COP correctly characterized the status, distribution, seasonal distribution, and abundance of each species. Please refer to the application for that information (see **ADDRESSES**). Additional information can also be found in the NMFS Stock Assessment Reports (SAR). The Alaska 2011 SAR is available at: *http://www.nmfs.noaa.gov/pr/pdfs/sars/ak2011.pdf.*

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, 12 marine mammal species (four pinniped and eight cetacean species) are likely to occur in the proposed drilling area. Of the eight cetacean species likely to occur in COP's project area, five are classified as low frequency cetaceans (i.e., bowhead, gray, humpback, minke, and fin whales), two are classified as mid-frequency cetaceans (i.e., beluga and killer whales), and one is classified as a high-frequency cetacean (i.e., harbor porpoise) (Southall *et al.,* 2007).

Underwater audiograms have been obtained using behavioral methods for four species of phocinid seals: the ringed, harbor, harp, and northern elephant seals (reviewed in Richardson *et al.,* 1995a; Kastak and Schusterman, 1998). Below 30–50 kHz, the hearing threshold of phocinids is essentially flat down to at least 1 kHz and ranges between 60 and 85 dB re 1 μPa. There are few published data on in-water hearing sensitivity of phocid seals below 1 kHz. However, measurements for one harbor seal indicated that, below 1 kHz, its thresholds deteriorated gradually to 96 dB re 1 μPa at 100 Hz from 80 dB re 1 μPa at 800 Hz and from 67 dB re 1 μPa at 1,600 Hz (Kastak and Schusterman, 1998). More recent data suggest that harbor seal hearing at low frequencies may be more sensitive than that and that earlier data were confounded by excessive background noise (Kastelein *et al.,* 2009a,b). If so, harbor seals have considerably better underwater hearing sensitivity at low frequencies than do small odontocetes like belugas (for which the threshold at 100 Hz is about 125 dB).

Pinniped call characteristics are relevant when assessing potential masking effects of man-made sounds. In addition, for those species whose hearing has not been tested, call characteristics are useful in assessing the frequency range within which hearing is likely to be most sensitive. The four species of seals present in the study area, all of which are in the phocid seal group, are all most vocal during the spring mating season and much less so during late summer. In each species, the calls are at frequencies from several hundred to several thousand hertz—above the frequency range of the dominant noise components from most of the proposed oil exploration activities.

Cetacean hearing has been studied in relatively few species and individuals. The auditory sensitivity of bowhead, gray, and other baleen whales has not been measured, but relevant anatomical and behavioral evidence is available. These whales appear to be specialized for low frequency hearing, with some directional hearing ability (reviewed in Richardson *et al.,* 1995a; Ketten, 2000). Their optimum hearing overlaps broadly with the low frequency range where exploration drilling activities, airguns, and associated vessel traffic emit most of their energy.

The beluga whale is one of the better-studied species in terms of its hearing ability. As mentioned earlier, the auditory bandwidth in mid-frequency odontocetes is believed to range from 150 Hz to 160 kHz (Southall *et al.,* 2007); however, belugas are most sensitive above 10 kHz. They have relatively poor sensitivity at the low frequencies (reviewed in Richardson *et al.,* 1995a) that dominate the sound from industrial activities and associated vessels. Nonetheless, the noise from strong low frequency sources is detectable by belugas many kilometers away (Richardson and Wursig, 1997). Also, beluga hearing at low frequencies in open-water conditions is apparently somewhat better than in the captive situations where most hearing studies were conducted (Ridgway and Carder, 1995; Au, 1997). If so, low frequency sounds emanating from drilling activities may be detectable somewhat farther away than previously estimated.

Call characteristics of cetaceans provide some limited information on their hearing abilities, although the auditory range often extends beyond the range of frequencies contained in the calls. Also, understanding the frequencies at which different marine mammal species communicate is relevant for the assessment of potential impacts from manmade sounds. A summary of the call characteristics for bowhead, gray, and beluga whales is provided next.

Most bowhead calls are tonal, frequency-modulated sounds at frequencies of 50–400 Hz. These calls overlap broadly in frequency with the underwater sounds emitted by many of the activities to be performed during COP's proposed exploration drilling program (Richardson *et al.,* 1995a). Source levels are quite variable, with the stronger calls having source levels up to about 180 dB re 1 μPa at 1 m. Gray whales make a wide variety of calls at frequencies from <100–2,000 Hz (Moore and Ljungblad, 1984; Dalheim, 1987).

Beluga calls include trills, whistles, clicks, bangs, chirps and other sounds (Schevill and Lawrence, 1949; Ouellet, 1979; Sjare and Smith, 1986a). Beluga whistles have dominant frequencies in the 2–6 kHz range (Sjare and Smith, 1986a). This is above the frequency range of most of the sound energy produced by the proposed exploratory drilling activities and associated vessels. Other beluga call types reported by Sjare and Smith (1986a,b) included sounds at mean frequencies ranging upward from 1 kHz.

The beluga also has a very well developed high frequency echolocation system, as reviewed by Au (1993). Echolocation signals have peak frequencies from 40–120 kHz and broadband source levels of up to 219 dB re 1 μPa-m (zero-peak). Echolocation calls are far above the frequency range of the sounds produced by the devices proposed for use during COP's Chukchi Sea exploratory drilling program. Therefore, those industrial sounds are not expected to interfere with echolocation.

Potential Effects of the Specified Activity on Marine Mammals

The likely or possible impacts of the proposed exploratory drilling program in the Chukchi Sea on marine mammals could involve both non-acoustic and acoustic effects. Potential non-acoustic effects could result from the physical presence of the equipment and personnel. Petroleum development and associated activities introduce sound into the marine environment. Impacts to marine mammals are expected to primarily be acoustic in nature. Potential acoustic effects on marine mammals relate to sound produced by drilling activity, supply and support vessels on DP, and aircraft, as well as the VSP airgun array. The potential effects of sound from the proposed exploratory drilling program might include one or more of the following: tolerance; masking of natural sounds; behavioral disturbance; non-auditory physical effects; and, at least in theory, temporary or permanent hearing impairment (Richardson *et al.,* 1995a). However, for reasons discussed later in this document, it is unlikely that there would be any cases of temporary, or especially permanent, hearing impairment resulting from these activities. As outlined in previous NMFS documents, the effects of noise on marine mammals are highly variable, and can be categorized as follows (based on Richardson *et al.,* 1995b):

(1) The noise may be too weak to be heard at the location of the animal (i.e., lower than the prevailing ambient noise level, the hearing threshold of the animal at relevant frequencies, or both);

(2) The noise may be audible but not strong enough to elicit any overt behavioral response;

(3) The noise may elicit reactions of variable conspicuousness and variable relevance to the wellbeing of the marine mammal; these can range from temporary alert responses to active avoidance reactions such as vacating an area at least until the noise event ceases but potentially for longer periods of time;

(4) Upon repeated exposure, a marine mammal may exhibit diminishing responsiveness (habituation), or disturbance effects may persist; the latter is most likely with sounds that are highly variable in characteristics, infrequent, and unpredictable in occurrence, and associated with situations that a marine mammal perceives as a threat;

(5) Any anthropogenic noise that is strong enough to be heard has the potential to reduce (mask) the ability of a marine mammal to hear natural sounds at similar frequencies, including calls from conspecifics, and underwater environmental sounds such as surf noise;

(6) If mammals remain in an area because it is important for feeding, breeding, or some other biologically important purpose even though there is chronic exposure to noise, it is possible that there could be noise-induced physiological stress; this might in turn have negative effects on the well-being or reproduction of the animals involved; and

(7) Very strong sounds have the potential to cause a temporary or permanent reduction in hearing sensitivity. In terrestrial mammals, and presumably marine mammals, received sound levels must far exceed the animal's hearing threshold for there to be any temporary threshold shift (TTS) in its hearing ability. For transient sounds, the sound level necessary to cause TTS is inversely related to the duration of the sound. Received sound levels must be even higher for there to be risk of permanent hearing impairment. In addition, intense acoustic or explosive events may cause trauma to tissues associated with organs vital for hearing, sound production, respiration and other functions. This trauma may include minor to severe hemorrhage.

Potential Acoustic Effects From Exploratory Drilling Activities

(1) Tolerance

Numerous studies have shown that underwater sounds from industry activities are often readily detectable by marine mammals in the water at distances of many kilometers. Numerous studies have also shown that marine mammals at distances more than a few kilometers away often show no apparent response to industry activities of various types (Miller *et al.,* 2005; Bain and Williams, 2006). This is often true even in cases when the sounds must be readily audible to the animals based on measured received levels and the hearing sensitivity of that mammal group. Although various baleen whales, toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to underwater sound such as airgun pulses or vessels under some conditions, at other times mammals of all three types have shown no overt reactions (e.g., Malme *et al.,* 1986; Richardson *et al.,* 1995; Madsen and Mohl, 2000; Croll *et al.,* 2001; Jacobs and Terhune, 2002; Madsen *et al.,* 2002; Miller *et al.,* 2005). In general, pinnipeds and small odontocetes seem to be more tolerant of exposure to some types of underwater sound than are baleen whales. Richardson *et al.* (1995b) found that vessel noise does not seem to strongly affect pinnipeds that are already in the water. Richardson *et al.* (1995b) went on to explain that seals on haul-outs sometimes respond strongly to the presence of vessels and at other times appear to show considerable tolerance of vessels, and Brueggeman *et al.* (1992, cited in Richardson *et al.,* 1995b) observed ringed seals hauled out on ice pans displaying short-term escape reactions when a ship approached within 0.25–0.5 mi (0.4–0.8 km).

(2) Masking

Masking is the obscuring of sounds of interest by other sounds, often at similar frequencies. 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. 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.,* 1995b). 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.

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.

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.,* 1995b). 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.,* 1995b). 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.

Masking effects of underwater sounds from COP's proposed activities on marine mammal calls and other natural sounds are expected to be limited. For example, beluga whales primarily use high-frequency sounds to communicate and locate prey; therefore, masking by low-frequency sounds associated with drilling activities is not expected to occur (Gales, 1982, as cited in Shell, 2009). If the distance between communicating whales does not exceed their distance from the drilling activity, the likelihood of potential impacts from masking would be low (Gales, 1982, as cited in Shell, 2009). At distances greater than 660–1,300 ft (200–400 m), recorded sounds from drilling activities did not affect behavior of beluga whales, even though the sound energy level and frequency were such that it could be heard several kilometers away (Richardson *et al.,* 1995b). This exposure resulted in whales being deflected from the sound energy and changing behavior. These minor changes are not expected to affect the beluga whale population (Richardson *et al.,* 1991; Richard *et al.,* 1998). Brewer *et al.* (1993) observed belugas within 2.3 mi (3.7 km) of the drilling unit *Kulluk* during drilling; however, the authors do not describe any behaviors that may have been exhibited by those animals.

There is evidence of other marine mammal species continuing to call in the presence of industrial activity. 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 since the late 1990s. To compensate and reduce masking, some mysticetes may alter the frequencies of their communication sounds (Richardson *et al.,* 1995b; 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 (a species closely related to the bowhead whale) 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.* (1995b) note that a bowhead whale 12.4 mi (20 km) from a human sound source, such as that produced during oil and gas industry activities, might hear strong calls from other whales within approximately 12.4 mi (20 km), and a whale 3.1 mi (5 km) from the source might hear strong calls from whales within approximately 3.1 mi (5 km). 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.,* 1995b).

Although some masking by marine mammal species in the area may occur, the extent of the masking interference will depend on the spatial relationship of the animal and COP's activity. Almost all energy in the sounds emitted by drilling and other operational activities is at low frequencies, predominantly below 250 Hz with another peak centered around 1,000 Hz. Most energy in the sounds from the vessels and aircraft to be used during this project is below 1 kHz (Moore *et al.,* 1984; Greene and Moore, 1995; Blackwell *et al.,* 2004b; Blackwell and Greene, 2006). These frequencies are mainly used by mysticetes but not by odontocetes. Therefore, masking effects would potentially be more pronounced in the bowhead and gray whales that might occur in the proposed project area. If, as described later in this document, certain species avoid the proposed drilling locations, impacts from masking are anticipated to be low. Moreover, the very small radius of the 120 dB isopleth of the drill rig (670 ft [210 m]) will reduce the possibility of masking even further. The larger 120 dB isopleth of the drill rig while a support vessel is in DP mode beside it (5 mi [8 km]) and over the VSP airguns (3 mi [5 km]) are also not anticipated to result in substantial or long-term masking effects as these activities will only occur for a short time during the entire open-water season (696 hrs and 2–4 hrs total, respectively).

(3) Behavioral Disturbance Reactions

Behavioral responses to sound are highly variable and context-specific. Many different variables can influence an animal's perception of and response to (in both nature and magnitude) an acoustic event. An animal's prior experience with a sound or sound source affects whether it is less likely (habituation) or more likely (sensitization) to respond to certain sounds in the future (animals can also be innately pre-disposed to respond to certain sounds in certain ways; Southall *et al.,* 2007). Related to the sound itself, the perceived nearness of the sound, bearing of the sound (approaching vs. retreating), similarity of a sound to biologically relevant sounds in the animal's environment (i.e., calls of predators, prey, or conspecifics), and familiarity of the sound may affect the way an animal responds to the sound (Southall *et al.,* 2007). Individuals (of different age, gender, reproductive status, etc.) among most populations will have variable hearing capabilities and differing behavioral sensitivities to sounds that will be affected by prior conditioning, experience, and current activities of those individuals. Often, specific acoustic features of the sound and contextual variables (i.e., proximity, duration, or recurrence of the sound or the current behavior that the marine mammal is engaged in or its prior experience), as well as entirely separate factors such as the physical presence of a nearby vessel, may be more relevant to the animal's response than the received level alone.

Exposure of marine mammals to sound sources can result in (but is not limited to) no response or any of the following observable responses: increased alertness; orientation or attraction to a sound source; vocal modifications; cessation of feeding; cessation of social interaction; alteration of movement or diving behavior; avoidance; habitat abandonment (temporary or permanent); and, in severe cases, panic, flight, stampede, or stranding, potentially resulting in death (Southall *et al.,* 2007). On a related note, many animals perform vital functions, such as feeding, resting, traveling, and socializing, on a diel cycle (24-hr cycle). Behavioral reactions to noise exposure (such as disruption of critical life functions, displacement, or avoidance of important habitat) are more likely to be significant if they last more than one diel cycle or recur on subsequent days (Southall *et al.,* 2007). Consequently, a behavioral response lasting less than one day and not recurring on subsequent days is not considered particularly severe unless it could directly affect reproduction or survival (Southall *et al.,* 2007).

Detailed studies regarding responses to anthropogenic sound have been conducted on humpback, gray, and bowhead whales and ringed seals. Less detailed data are available for some other species of baleen whales, sperm whales, small toothed whales, and sea otters. The following sub-sections provide examples of behavioral responses that provide an idea of the variability in behavioral responses that would be expected given the different sensitivities of marine mammal species to sound.

Baleen Whales—Richardson *et al.* (1995a) reported changes in surfacing and respiration behavior and the occurrence of turns during surfacing in bowhead whales exposed to playback of underwater sound from drilling activities. These behavioral effects were localized and occurred at distances up to 1.2–2.5 mi (2–4 km).

Some bowheads appeared to divert from their migratory path after exposure to projected icebreaker sounds. Other bowheads however, tolerated projected icebreaker sound at levels 20 dB and more above ambient sound levels. The source level of the projected sound however, was much less than that of an actual icebreaker, and reaction distances to actual icebreaking may be much greater than those reported here for projected sounds. However, icebreaking is not a component of COP's proposed operations.

Brewer *et al.* (1993) and Hall *et al.* (1994) reported numerous sightings of marine mammals including bowhead whales in the vicinity of offshore drilling operations in the Beaufort Sea. One bowhead whale sighting was reported within approximately 1,312 ft (400 m) of a drilling vessel although most other bowhead sightings were at much greater distances. Few bowheads were recorded near industrial activities by aerial observers. After controlling for spatial autocorrelation in aerial survey data from Hall *et al.* (1994) using a Mantel test, Schick and Urban (2000) found that the variable describing straight line distance between the rig and bowhead whale sightings was not significant but that a variable describing threshold distances between sightings and the rig was significant. Thus, although the aerial survey results suggested substantial avoidance of the operations by bowhead whales, observations by vessel-based observers indicate that at least some bowheads may have been closer to industrial activities than was suggested by results of aerial observations.

Richardson *et al.* (2008) reported a slight change in the distribution of bowhead whale calls in response to operational sounds on BP's Northstar Island. The southern edge of the call distribution ranged from 0.47 to 1.46 mi (0.76 to 2.35 km) farther offshore, apparently in response to industrial sound levels. This result however, was only achieved after intensive statistical analyses, and it is not clear that this represented a biologically significant effect.

Patenaude *et al.* (2002) reported fewer behavioral responses to aircraft overflights by bowhead compared to beluga whales. Behaviors classified as reactions consisted of short surfacings, immediate dives or turns, changes in behavior state, vigorous swimming, and breaching. Most bowhead reaction resulted from exposure to helicopter activity and little response to fixed-wing aircraft was observed. Most reactions occurred when the helicopter was at altitudes ≤492 ft (150 m) and lateral distances ≤820 ft (250 m; Nowacek *et al.,* 2007).

During their study, Patenaude *et al.* (2002) observed one bowhead whale cow-calf pair during four passes totaling 2.8 hours of the helicopter and two pairs during Twin Otter overflights. All of the helicopter passes were at altitudes of 49–98 ft (15–30 m). The mother dove both times she was at the surface, and the calf dove once out of the four times it was at the surface. For the cow-calf pair sightings during Twin Otter overflights, the authors did not note any behaviors specific to those pairs. Rather, the reactions of the cow-calf pairs were lumped with the reactions of other groups that did not consist of calves.

Richardson *et al.* (1995a) and Moore and Clarke (2002) reviewed a few studies that observed responses of gray whales to aircraft. Cow-calf pairs were quite sensitive to a turboprop survey flown at 1,000 ft (305 m) altitude on the Alaskan summering grounds. In that survey, adults were seen swimming over the calf, or the calf swam under the adult (Ljungblad *et al.,* 1983, cited in Richardson *et al.,* 1995b and Moore and Clarke, 2002). However, when the same aircraft circled for more than 10 minutes at 1,050 ft (320 m) altitude over a group of mating gray whales, no reactions were observed (Ljungblad *et al.,* 1987, cited in Moore and Clarke, 2002). Malme *et al.* (1984, cited in Richardson *et al.,* 1995b and Moore and Clarke, 2002) conducted playback experiments on migrating gray whales. They exposed the animals to underwater noise recorded from a Bell 212 helicopter (estimated altitude=328 ft [100 m]), at an average of three simulated passes per minute. The authors observed that whales changed their swimming course and sometimes slowed down in response to the playback sound but proceeded to migrate past the transducer. Migrating gray whales did not react overtly to a Bell 212 helicopter at greater than 1,394 ft (425 m) altitude, occasionally reacted when the helicopter was at 1,000–1,198 ft (305–365 m), and usually reacted when it was below 825 ft (250 m; Southwest Research Associates, 1988, cited in Richardson *et al.,* 1995b and Moore and Clarke, 2002). Reactions noted in that study included abrupt turns or dives or both. Green *et al.* (1992, cited in Richardson *et al.,* 1995b) observed that migrating gray whales rarely exhibited noticeable reactions to a straight-line overflight by a Twin Otter at 197 ft (60 m) altitude. Restrictions on aircraft altitude will be part of the proposed mitigation measures (described in the ''Proposed Mitigation'' section later in this document) during the proposed drilling activities, and overflights are likely to have little or no disturbance effects on baleen whales. Any disturbance that may occur would likely be temporary and localized.

Southall *et al.* (2007, Appendix C) reviewed a number of papers describing the responses of marine mammals to non-pulsed sound, such as that produced during exploratory drilling operations. In general, little or no response was observed in animals exposed at received levels from 90–120 dB re 1 µPa (rms). Probability of avoidance and other behavioral effects increased when received levels were from 120–160 dB re 1 µPa (rms). Some of the relevant reviews contained in Southall *et al.* (2007) are summarized next.

Baker *et al.* (1982) reported some avoidance by humpback whales to vessel noise when received levels were 110–120 dB (rms) and clear avoidance at 120–140 dB (sound measurements were not provided by Baker but were based on measurements of identical vessels by Miles and Malme, 1983).

Malme *et al.* (1983, 1984) used playbacks of sounds from helicopter overflight and drilling rigs and platforms to study behavioral effects on migrating gray whales. Received levels exceeding 120 dB induced avoidance reactions. Malme *et al.* (1984) calculated 10%, 50%, and 90% probabilities of gray whale avoidance reactions at received levels of 110, 120, and 130 dB, respectively. Malme *et al.* (1986) observed the behavior of feeding gray whales during four experimental playbacks of drilling sounds (50 to 315 Hz; 21- min overall duration and 10% duty cycle; source levels of 156–162 dB). In two cases for received levels of 100–110 dB, no behavioral reaction was observed. However, avoidance behavior was observed in two cases where received levels were 110–120 dB.

Richardson *et al.* (1990) performed 12 playback experiments in which bowhead whales in the Alaskan Arctic were exposed to drilling sounds. Whales generally did not respond to exposures in the 100 to 130 dB range, although there was some indication of minor behavioral changes in several instances.

McCauley *et al.* (1996) reported several cases of humpback whales responding to vessels in Hervey Bay, Australia. Results indicated clear avoidance at received levels between 118 to 124 dB in three cases for which response and received levels were observed/measured.

Palka and Hammond (2001) analyzed line transect census data in which the orientation and distance off transect line were reported for large numbers of minke whales. The authors developed a method to account for effects of animal movement in response to sighting platforms. Minor changes in locomotion speed, direction, and/or diving profile were reported at ranges from 1,847 to 2,352 ft (563 to 717 m) at received levels of 110 to 120 dB.

Biassoni *et al.* (2000) and Miller *et al.* (2000) reported behavioral observations for humpback whales exposed to a low-frequency sonar stimulus (160- to 330-Hz frequency band; 42-s tonal signal repeated every 6 min; source levels 170 to 200 dB) during playback experiments. Exposure to measured received levels ranging from 120 to 150 dB resulted in variability in humpback singing behavior. Croll *et al.* (2001) investigated responses of foraging fin and blue whales to the same low frequency active sonar stimulus off southern California. Playbacks and control intervals with no transmission were used to investigate behavior and distribution on time scales of several weeks and spatial scales of tens of kilometers. The general conclusion was that whales remained feeding within a region for which 12 to 30 percent of exposures exceeded 140 dB.

Frankel and Clark (1998) conducted playback experiments with wintering humpback whales using a single speaker producing a low-frequency ''M-sequence'' (sine wave with multiple-phase reversals) signal in the 60 to 90 Hz band with output of 172 dB at 1 m. For 11 playbacks, exposures were between 120 and 130 dB re 1 µPa (rms) and included sufficient information regarding individual responses. During eight of the trials, there were no measurable differences in tracks or bearings relative to control conditions, whereas on three occasions, whales either moved slightly away from (n = 1) or towards (n = 2) the playback speaker during exposure. The presence of the source vessel itself had a greater effect than did the M-sequence playback.

Finally, Nowacek *et al.* (2004) used controlled exposures to demonstrate behavioral reactions of northern right whales to various non-pulse sounds. Playback stimuli included ship noise, social sounds of conspecifics, and a complex, 18-min ''alert'' sound consisting of repetitions of three different artificial signals. Ten whales were tagged with calibrated instruments that measured received sound characteristics and concurrent animal movements in three dimensions. Five out of six exposed whales reacted strongly to alert signals at measured received levels between 130 and 150 dB (i.e., ceased foraging and swam rapidly to the surface). Two of these individuals were not exposed to ship noise, and the other four were exposed to both stimuli. These whales reacted mildly to conspecific signals. Seven whales, including the four exposed to the alert stimulus, had no measurable response to either ship sounds or actual vessel noise.

Toothed Whales—Most toothed whales have the greatest hearing sensitivity at frequencies much higher than that of baleen whales and may be less responsive to low-frequency sound commonly associated with oil and gas industry exploratory drilling activities. Richardson *et al.* (1995a) reported that beluga whales did not show any apparent reaction to playback of underwater drilling sounds at distances greater than 656–1,312 ft (200–400 m). Reactions included slowing down, milling, or reversal of course after which the whales continued past the projector, sometimes within 164–328 ft (50–100 m). The authors concluded (based on a small sample size) that the playback of drilling sounds had no biologically significant effects on migration routes of beluga whales migrating through pack ice and along the seaward side of the nearshore lead east of Point Barrow in spring.

At least six of 17 groups of beluga whales appeared to alter their migration path in response to underwater playbacks of icebreaker sound (Richardson *et al.,* 1995a). Received levels from the icebreaker playback were estimated at 78–84 dB in the 1/3-octave band centered at 5,000 Hz, or 8–14 dB above ambient. If beluga whales reacted to an actual icebreaker at received levels of 80 dB, reactions would be expected to occur at distances on the order of 6.2 mi (10 km). Finley *et al.* (1990) also reported beluga avoidance of icebreaker activities in the Canadian High Arctic at distances of 22–31 mi (35–50 km). In addition to avoidance, changes in dive behavior and pod integrity were also noted.

Patenaude *et al.* (2002) reported that beluga whales appeared to be more responsive to aircraft overflights than bowhead whales. Changes were observed in diving and respiration behavior, and some whales veered away when a helicopter passed at ≤820 ft (250 m) lateral distance at altitudes up to 492 ft (150 m). However, some belugas showed no reaction to the helicopter. Belugas appeared to show less response to fixed-wing aircraft than to helicopter overflights.

In reviewing responses of cetaceans with best hearing in mid-frequency ranges, which includes toothed whales, Southall *et al.* (2007) reported that combined field and laboratory data for mid-frequency cetaceans exposed to non-pulse sounds did not lead to a clear conclusion about received levels coincident with various behavioral responses. In some settings, individuals in the field showed profound (significant) behavioral responses to exposures from 90–120 dB, while others failed to exhibit such responses for exposure to received levels from 120–

150 dB. Contextual variables other than exposure received level, and probable species differences, are the likely reasons for this variability. Context, including the fact that captive subjects were often directly reinforced with food for tolerating noise exposure, may also explain why there was great disparity in results from field and laboratory conditions—exposures in captive settings generally exceeded 170 dB before inducing behavioral responses. A summary of some of the relevant material reviewed by Southall *et al.* (2007) is next.

LGL and Greeneridge (1986) and Finley *et al.* (1990) documented belugas and narwhals congregated near ice edges reacting to the approach and passage of icebreaking ships. Beluga whales responded to oncoming vessels by (1) Fleeing at speeds of up to 12.4 mi/hr (20 km/hr) from distances of 12.4–50 mi (20–80 km), (2) abandoning normal pod structure, and (3) modifying vocal behavior and/or emitting alarm calls. Narwhals, in contrast, generally demonstrated a ''freeze'' response, lying motionless or swimming slowly away (as far as 23 mi [37 km] down the ice edge), huddling in groups, and ceasing sound production. There was some evidence of habituation and reduced avoidance 2 to 3 days after onset.

The 1982 season observations by LGL and Greeneridge (1986) involved a single passage of an icebreaker with both ice-based and aerial measurements on June 28, 1982. Four groups of narwhals (n = 9 to 10, 7, 7, and 6) responded when the ship was 4 mi (6.4 km) away (received levels of approximately 100 dB in the 150- to 1,150-Hz band). At a later point, observers sighted belugas moving away from the source at more than 12.4 mi (20 km; received levels of approximately 90 dB in the 150- to 1,150-Hz band). The total number of animals observed fleeing was about 300, suggesting approximately 100 independent groups (of three individuals each). No whales were sighted the following day, but some were sighted on June 30, with ship noise audible at spectrum levels of approximately 55 dB/Hz (up to 4 kHz).

Observations during 1983 (LGL and Greeneridge, 1986) involved two icebreaking ships with aerial survey and ice-based observations during seven sampling periods. Narwhals and belugas generally reacted at received levels ranging from 101 to 121 dB in the 20- to 1,000-Hz band and at a distance of up to 40.4 mi (65 km). Large numbers (100s) of beluga whales moved out of the area at higher received levels. As noise levels from icebreaking operations diminished, a total of 45 narwhals returned to the area and engaged in diving and foraging behavior. During the final sampling period, following an 8-h quiet interval, no reactions were seen from 28 narwhals and 17 belugas (at received levels ranging up to 115 dB).

The final season (1984) reported in LGL and Greeneridge (1986) involved aerial surveys before, during, and after the passage of two icebreaking ships. During operations, no belugas and few narwhals were observed in an area approximately 16.8 mi (27 km) ahead of the vessels, and all whales sighted over 12.4–50 mi (20–80 km) from the ships were swimming strongly away. Additional observations confirmed the spatial extent of avoidance reactions to this sound source in this context.

Buckstaff (2004) reported elevated dolphin whistle rates with received levels from oncoming vessels in the 110 to 120 dB range in Sarasota Bay, Florida. These hearing thresholds were apparently lower than those reported by a researcher listening with towed hydrophones. Morisaka *et al.* (2005) compared whistles from three populations of Indo-Pacific bottlenose dolphins. One population was exposed to vessel noise with spectrum levels of approximately 85 dB/Hz in the 1- to 22-kHz band (broadband received levels approximately 128 dB) as opposed to approximately 65 dB/Hz in the same band (broadband received levels approximately 108 dB) for the other two sites. Dolphin whistles in the noisier environment had lower fundamental frequencies and less frequency modulation, suggesting a shift in sound parameters as a result of increased ambient noise.

Morton and Symonds (2002) used census data on killer whales in British Columbia to evaluate avoidance of non-pulse acoustic harassment devices (AHDs). Avoidance ranges were about 2.5 mi (4 km). Also, there was a dramatic reduction in the number of days ''resident'' killer whales were sighted during AHD-active periods compared to pre- and post-exposure periods and a nearby control site.

Monteiro-Neto *et al.* (2004) studied avoidance responses of tucuxi (*Sotalia fluviatilis*) to Dukane® Netmark acoustic deterrent devices. In a total of 30 exposure trials, approximately five groups each demonstrated significant avoidance compared to 20 pinger off and 55 no-pinger control trials over two quadrats of about 0.19 mi^2 (0.5 km^2). Estimated exposure received levels were approximately 115 dB.

Awbrey and Stewart (1983) played back semi-submersible drillship sounds (source level: 163 dB) to belugas in Alaska. They reported avoidance reactions at 984 and 4,921 ft (300 and 1,500 m) and approach by groups at a distance of 2.2 mi (3.5 km; received levels were approximately 110 to 145 dB over these ranges assuming a 15 log R transmission loss). Similarly, Richardson *et al.* (1990) played back drilling platform sounds (source level: 163 dB) to belugas in Alaska. They conducted aerial observations of eight individuals among approximately 100 spread over an area several hundred meters to several kilometers from the sound source and found no obvious reactions. Moderate changes in movement were noted for three groups swimming within 656 ft (200 m) of the sound projector.

Two studies deal with issues related to changes in marine mammal vocal behavior as a function of variable background noise levels. Foote *et al.* (2004) found increases in the duration of killer whale calls over the period 1977 to 2003, during which time vessel traffic in Puget Sound, and particularly whale-watching boats around the animals, increased dramatically. Scheifele *et al.* (2005) demonstrated that belugas in the St. Lawrence River increased the levels of their vocalizations as a function of the background noise level (the ''Lombard Effect'').

Several researchers conducting laboratory experiments on hearing and the effects of non-pulse sounds on hearing in mid-frequency cetaceans have reported concurrent behavioral responses. Nachtigall *et al.* (2003) reported that noise exposures up to 179 dB and 55-min duration affected the trained behaviors of a bottlenose dolphin participating in a TTS experiment. Finneran and Schlundt (2004) provided a detailed, comprehensive analysis of the behavioral responses of belugas and bottlenose dolphins to 1-s tones (received levels 160 to 202 dB) in the context of TTS experiments. Romano *et al.* (2004) investigated the physiological responses of a bottlenose dolphin and a beluga exposed to these tonal exposures and demonstrated a decrease in blood cortisol levels during a series of exposures between 130 and 201 dB. Collectively, the laboratory observations suggested the onset of a behavioral response at higher received levels than did field studies. The differences were likely related to the very different conditions and contextual variables between untrained, free-ranging individuals vs. laboratory subjects that were rewarded with food for tolerating noise exposure.

Pinnipeds—Pinnipeds generally seem to be less responsive to exposure to industrial sound than most cetaceans. Pinniped responses 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).

Blackwell *et al.* (2004) reported little or no reaction of ringed seals in response to pile-driving activities during construction of a man-made island in the Beaufort Sea. Ringed seals were observed swimming as close as 151 ft (46 m) from the island and may have been habituated to the sounds which were likely audible at distances <9,842 ft (3,000 m) underwater and 0.3 mi (0.5 km) in air. Moulton *et al.* (2003) reported that ringed seal densities on ice in the vicinity of a man-made island in the Beaufort Sea did not change significantly before and after construction and drilling activities.

Southall *et al.* (2007) reviewed literature describing responses of pinnipeds to non-pulsed sound and reported that the limited data suggest exposures between approximately 90 and 140 dB generally do not appear to induce strong behavioral responses in pinnipeds exposed to non-pulse sounds in water; no data exist regarding exposures at higher levels. It is important to note that among these studies, there are some apparent differences in responses between field and laboratory conditions. In contrast to the mid-frequency odontocetes, captive pinnipeds responded more strongly at lower levels than did animals in the field. Again, contextual issues are the likely cause of this difference.

Jacobs and Terhune (2002) observed harbor seal reactions to AHDs (source level in this study was 172 dB) deployed around aquaculture sites. Seals were generally unresponsive to sounds from the AHDs. During two specific events, individuals came within 141 and 144 ft (43 and 44 m) of active AHDs and failed to demonstrate any measurable behavioral response; estimated received levels based on the measures given were approximately 120 to 130 dB.

Costa *et al.* (2003) measured received noise levels from an Acoustic Thermometry of Ocean Climate (ATOC) program sound source off northern California using acoustic data loggers placed on translocated elephant seals. Subjects were captured on land, transported to sea, instrumented with archival acoustic tags, and released such that their transit would lead them near an active ATOC source (at 939-m depth; 75-Hz signal with 37.5- Hz bandwidth; 195 dB maximum source level, ramped up from 165 dB over 20 min) on their return to a haul-out site. Received exposure levels of the ATOC source for experimental subjects averaged 128 dB (range 118 to 137) in the 60- to 90-Hz band. None of the instrumented animals terminated dives or radically altered behavior upon exposure, but some statistically significant changes in diving parameters were documented in nine individuals. Translocated northern elephant seals exposed to this particular non-pulse source began to demonstrate subtle behavioral changes at exposure to received levels of approximately 120 to 140 dB.

Kastelein *et al.* (2006) exposed nine captive harbor seals in an approximately 82 × 98 ft (25 × 30 m) enclosure to non-pulse sounds used in underwater data communication systems (similar to acoustic modems). Test signals were frequency modulated tones, sweeps, and bands of noise with fundamental frequencies between 8 and 16 kHz; 128 to 130 [± 3] dB source levels; 1- to 2-s duration [60–80 percent duty cycle]; or 100 percent duty cycle. They recorded seal positions and the mean number of individual surfacing behaviors during control periods (no exposure), before exposure, and in 15-min experimental sessions (n = 7 exposures for each sound type). Seals generally swam away from each source at received levels of approximately 107 dB, avoiding it by approximately 16 ft (5 m), although they did not haul out of the water or change surfacing behavior. Seal reactions did not appear to wane over repeated exposure (i.e., there was no obvious habituation), and the colony of seals generally returned to baseline conditions following exposure. The seals were not reinforced with food for remaining in the sound field.

Potential effects to pinnipeds from aircraft activity could involve both acoustic and non-acoustic effects. It is uncertain if the seals react to the sound of the helicopter or to its physical presence flying overhead. Typical reactions of hauled out pinnipeds to aircraft that have been observed include looking up at the aircraft, moving on the ice or land, entering a breathing hole or crack in the ice, or entering the water. Ice seals hauled out on the ice have been observed diving into the water when approached by a low-flying aircraft or helicopter (Burns and Harbo, 1972, cited in Richardson *et al.,* 1995a; Burns and Frost, 1979, cited in Richardson *et al.,* 1995a). Richardson *et al.* (1995a) note that responses can vary based on differences in aircraft type, altitude, and flight pattern. Additionally, a study conducted by Born *et al.* (1999) found that wind chill was also a factor in level of response of ringed seals hauled out on ice, as well as time of day and relative wind direction.

Blackwell *et al.* (2004a) observed 12 ringed seals during low-altitude overflights of a Bell 212 helicopter at Northstar in June and July 2000 (9 observations took place concurrent with pipe-driving activities). One seal showed no reaction to the aircraft while the remaining 11 (92%) reacted, either by looking at the helicopter (n=10) or by departing from their basking site (n=1). Blackwell *et al.* (2004a) concluded that none of the reactions to helicopters were strong or long lasting, and that seals near Northstar in June and July 2000 probably had habituated to industrial sounds and visible activities that had occurred often during the preceding winter and spring. There have been few systematic studies of pinniped reactions to aircraft overflights, and most of the available data concern pinnipeds hauled out on land or ice rather than pinnipeds in the water (Richardson *et al.,* 1995a; Born *et al.,* 1999).

Born *et al.* (1999) determined that 49 percent of ringed seals escaped (i.e., left the ice) as a response to a helicopter flying at 492 ft (150 m) altitude. Seals entered the water when the helicopter was 4,101 ft (1,250 m) away if the seal was in front of the helicopter and at 1,640 ft (500 m) away if the seal was to the side of the helicopter. The authors noted that more seals reacted to helicopters than to fixed-wing aircraft. The study concluded that the risk of scaring ringed seals by small-type helicopters could be substantially reduced if they do not approach closer than 4,921 ft (1,500 m).

Spotted seals hauled out on land in summer are unusually sensitive to aircraft overflights compared to other species. They often rush into the water when an aircraft flies by at altitudes up to 984–2,461 ft (300–750 m). They occasionally react to aircraft flying as high as 4,495 ft (1,370 m) and at lateral distances as far as 1.2 mi (2 km) or more (Frost and Lowry, 1990; Rugh *et al.,* 1997).

(4) Hearing Impairment and Other Physiological Effects

Temporary or permanent hearing impairment is a possibility when marine mammals are exposed to very strong sounds. Non-auditory physiological effects might also occur in marine mammals exposed to strong underwater sound. Possible types of non-auditory physiological effects or injuries that theoretically might occur in mammals close to a strong sound source include stress, neurological effects, bubble formation, 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. Additional information regarding the possibilities of TTS, permanent threshold shift (PTS), and non-auditory physiological effects, such as stress, is discussed for both exploratory drilling activities and VSP surveys in the following section (''*Potential Effects from VSP Activities''*).

Potential Effects from VSP Activities

(1) Tolerance

Numerous studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers. 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). For additional information on tolerance of marine mammals to anthropogenic sound, see the previous subsection in this document (''*Potential Effects from Exploratory Drilling Activities*'').

(2) Masking

As stated earlier in this document, masking is the obscuring of sounds of interest by other sounds, often at similar frequencies. For full details about masking, see the previous subsection in this document (''*Potential Effects from Exploratory Drilling Activities''*). Some additional information regarding pulsed sounds is provided here.

There is evidence of some marine mammal species continuing to call in the presence of industrial activity. McDonald *et al.* (1995) heard blue and fin whale calls between seismic pulses in the Pacific. Although there has been one report that sperm whales cease calling when exposed to pulses from a very distant seismic ship (Bowles *et al.,* 1994), a more recent study reported that sperm whales off northern Norway continued calling in the presence of seismic pulses (Madsen *et al.,* 2002). Similar results were also reported during work in the Gulf of Mexico (Tyack *et al.,* 2003). Bowhead whale calls are frequently detected in the presence of seismic pulses, although the numbers of calls detected may sometimes be reduced (Richardson *et al.,* 1986; Greene *et al.,* 1999; Blackwell *et al.,* 2009a). Bowhead whales in the Beaufort Sea may decrease their call rates in response to seismic operations, although movement out of the area might also have contributed to the lower call detection rate (Blackwell *et al.,* 2009a,b). Additionally, there is increasing evidence that, at times, there is enough reverberation between airgun pulses such that detection range of calls may be significantly reduced. In contrast, Di Iorio and Clark (2009) found evidence of increased calling by blue whales during operations by a lower-energy seismic source, a sparker.

There is little concern regarding masking due to the brief duration of these pulses and relatively longer silence between airgun shots (9–12 seconds) near the sound source. However, at long distances (over tens of kilometers away) in deep water, due to multipath propagation and reverberation, the durations of airgun pulses can be ''stretched'' to seconds with long decays (Madsen *et al.,* 2006; Clark and Gagnon, 2006). Therefore it could affect communication signals used by low frequency mysticetes when they occur near the noise band and thus reduce the communication space of animals (e.g., Clark *et al.,* 2009a,b) and cause increased stress levels (e.g., Foote *et al.,* 2004; Holt *et al.,* 2009). Nevertheless, the intensity of the noise is also greatly reduced at long distances. Therefore, masking effects are anticipated to be limited, especially in the case of odontocetes, given that they typically communicate at frequencies higher than those of the airguns. Moreover, because of the extremely short time period over which airguns will be used during operations (a total of 2 hrs per well), masking is not anticipated to occur.

(3) Behavioral Disturbance Reactions

As was described in more detail in the previous sub-section (''*Potential Effects of Exploratory Drilling Activities*''), behavioral responses to sound are highly variable and context-specific. Summaries of observed reactions and studies are provided next.

Baleen Whales—Baleen whale responses to pulsed sound (e.g., seismic airguns) have been studied more thoroughly than responses to continuous sound (e.g., drillships). Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable. Whales are often reported to show no overt reactions to pulses from large arrays of airguns at distances beyond a few kilometers, even though the airgun pulses remain well above ambient noise levels out to much greater distances (Miller *et al.,* 2005). However, baleen whales exposed to strong noise pulses often react by deviating from their normal migration route (Richardson *et al.,* 1999). Migrating gray and bowhead whales were observed avoiding the sound source by displacing their migration route to varying degrees but within the natural boundaries of the migration corridors (Schick and Urban, 2000; Richardson *et al.,* 1999; Malme *et al.,* 1983). Baleen whale responses to pulsed sound however may depend on the type of activity in which the whales are engaged. Some evidence suggests that feeding bowhead whales may be more tolerant of underwater sound than migrating bowheads (Miller *et al.,* 2005; Lyons *et al.,* 2009; Christie *et al.,* 2010).

Results of studies of gray, bowhead, and humpback whales have determined that received levels of pulses in the 160–170 dB re 1 μPa rms range seem to cause obvious avoidance behavior in a substantial fraction of the animals exposed. In many areas, seismic pulses from large arrays of airguns diminish to those levels at distances ranging from 2.8–9 mi (4.5–14.5 km) from the source. For the much smaller airgun array used during the VSP survey (total discharge volume of 760 in^3), distances to received levels in the 170–160 dB re 1 μPa rms range are estimated to be 1.44–3 mi (2.31–5 km). Baleen whales within those distances may show avoidance or other strong disturbance reactions to the airgun array. Subtle behavioral changes sometimes become evident at somewhat lower received levels, and recent studies have shown that some species of baleen whales, notably bowhead and humpback whales, at times show strong avoidance at received levels lower than 160–170 dB re 1 μPa rms. Bowhead whales migrating west across the Alaskan Beaufort Sea in autumn, in particular, are unusually responsive, with avoidance occurring out to distances of 12.4–18.6 mi (20–30 km) from a medium-sized airgun source (Miller *et al.,* 1999; Richardson *et al.,* 1999). However, more recent research on bowhead whales (Miller *et al.,* 2005) corroborates earlier evidence that, during the summer feeding season, bowheads are not as sensitive to seismic sources. In summer, bowheads typically begin to show avoidance reactions at a received level of about 160–170 dB re 1 μPa rms (Richardson et al., 1986; Ljungblad *et al.,* 1988; Miller *et al.,* 2005).

Malme *et al.* (1986, 1988) studied the responses of feeding eastern 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 ceased 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. Those findings were generally consistent with the results of experiments conducted on larger numbers of gray whales that were migrating along the California coast and on observations of the distribution of feeding Western Pacific gray whales off Sakhalin Island, Russia, during a seismic survey (Yazvenko *et al.,* 2007).

Data on short-term reactions (or lack of reactions) of cetaceans to impulsive noises do not necessarily provide information about long-term effects. While it is not certain whether impulsive noises affect reproductive rate or distribution and habitat use in subsequent days or years, certain species have continued to use areas ensonified by airguns and have continued to increase in number despite successive years of anthropogenic activity in the area. Gray whales continued to migrate annually along the west coast of North America despite intermittent seismic exploration and much ship traffic in that area for decades (Appendix A in Malme *et al.,* 1984). Bowhead whales continued to travel to the eastern Beaufort Sea each summer despite seismic exploration in their summer and autumn range for many years (Richardson *et al.,* 1987). Populations of both gray whales and bowhead whales grew substantially during this time. Bowhead whales have increased by approximately 3.4% per year for the last 10 years in the Beaufort Sea (Allen and Angliss, 2012). In any event, the brief exposures to sound pulses from the proposed airgun source (the airguns will only be fired for a period of 2 hrs for each of the two wells) are highly unlikely to result in prolonged effects.

Toothed Whales—Few systematic data are available describing reactions of toothed whales to noise pulses. Few studies similar to the more extensive baleen whale/seismic pulse work summarized earlier in this document have been reported for toothed whales. However, systematic work on sperm whales is underway (Tyack *et al.,* 2003), and there is an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies (e.g., Stone, 2003; Smultea *et al.,* 2004; Moulton and Miller, 2005).

Seismic operators and marine mammal observers sometimes see dolphins and other small toothed whales near operating airgun arrays, but, in general, there seems to be a tendency for most delphinids to show some limited avoidance of seismic vessels operating large airgun systems. However, some dolphins seem to be attracted to the seismic vessel and floats, and some ride the bow wave of the seismic vessel even when large arrays of airguns are firing. Nonetheless, there have been indications that small toothed whales sometimes move away or maintain a somewhat greater distance from the vessel when a large array of airguns is operating than when it is silent (e.g., Goold, 1996a, b, c; Calambokidis and Osmek, 1998; Stone, 2003). The beluga may be a species that (at least at times) shows long-distance avoidance of seismic vessels. Aerial surveys during seismic operations in the southeastern Beaufort Sea recorded much lower sighting rates of beluga whales within 6.2–12.4 mi (10–20 km) of an active seismic vessel. These results were consistent with the low number of beluga sightings reported by observers aboard the seismic vessel, suggesting that some belugas might be avoiding the seismic operations at distances of 6.2–12.4 mi (10–20 km) (Miller *et al.,* 2005).

Captive bottlenose dolphins and (of more relevance in this project) beluga whales exhibit changes in behavior when exposed to strong pulsed sounds similar in duration to those typically used in seismic surveys (Finneran *et al.,* 2002, 2005). However, the animals tolerated high received levels of sound (p–p level >200 dB re 1 μPa) before exhibiting aversive behaviors.

Reactions of toothed whales to large arrays of airguns are variable and, at least for delphinids, seem to be confined to a smaller radius than has been observed for mysticetes. However, based on the limited existing evidence, belugas should not be grouped with delphinids in the ''less responsive'' category.

Pinnipeds—Pinnipeds are not likely to show a strong avoidance reaction to the airgun sources proposed for use. Visual monitoring from seismic vessels has shown only slight (if any) avoidance of airguns by pinnipeds and only slight (if any) changes in behavior. Ringed seals frequently do not avoid the area within a few hundred meters of operating airgun arrays (Harris *et al.,* 2001; Moulton and Lawson, 2002; Miller *et al.,* 2005). Monitoring work in the Alaskan Beaufort Sea during 1996–2001 provided considerable information regarding the behavior of seals exposed to seismic pulses (Harris *et al.,* 2001; Moulton and Lawson, 2002). These seismic projects usually involved arrays of 6 to 16 airguns with total volumes of 560 to 1,500 in^3. The combined results suggest that some seals avoid the immediate area around seismic vessels. In most survey years, ringed seal sightings tended to be farther away from the seismic vessel when the airguns were operating than when they were not (Moulton and Lawson, 2002). However, these avoidance movements were relatively small, on the order of 328 ft (100 m) to a few hundreds of meters, and many seals remained within 328–656 ft (100–200 m) of the trackline as the operating airgun array passed by. Seal sighting rates at the water surface were lower during airgun array operations than during no-airgun periods in each survey year except 1997. Similarly, seals are often very tolerant of pulsed sounds from seal-scaring devices (Mate and Harvey, 1987; Jefferson and Curry, 1994; Richardson *et al.,* 1995a). However, initial telemetry work suggests that avoidance and other behavioral reactions by two other species of seals to small airgun sources may at times be stronger than evident to date from visual studies of pinniped reactions to airguns (Thompson *et al.,* 1998). Even if reactions of the species occurring in the present study area are as strong as those evident in the telemetry study, reactions are expected to be confined to relatively small distances and durations, with no long-term effects on pinniped individuals or populations. Additionally, the airguns are only proposed to be used for a very short time during the entire exploration drilling program (approximately 2 hrs for each well, for a total of 4 hrs over the entire open-water season, which lasts for approximately 4 months, if both wells are drilled).

(4) Hearing Impairment and Other Physiological Effects

TTS—TTS is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter, 1985). While experiencing TTS, the hearing threshold rises, and a sound must be stronger in order to be heard. At least in terrestrial mammals, TTS can last from minutes or hours to (in cases of strong TTS) days, can be limited to a particular frequency range, and can be in varying degrees (i.e., a loss of a certain number of dBs of sensitivity). 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.

Marine mammal hearing plays a critical role in communication with conspecifics and in interpretation of environmental cues for purposes such as predator avoidance and prey capture. Depending on the degree (elevation of threshold in dB), duration (i.e., recovery time), and frequency range of TTS and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious. For example, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that takes place during a time when the animal is traveling through the open ocean, where ambient noise is lower and there are not as many competing sounds present. Alternatively, a larger amount and longer duration of TTS sustained during a time when communication is critical for successful mother/calf interactions could have more serious impacts if it were in the same frequency band as the necessary vocalizations and of a severity that it impeded communication. The fact that animals exposed to levels and durations of sound that would be expected to result in this physiological response would also be expected to have behavioral responses of a comparatively more severe or sustained nature is also notable and potentially of more importance than the simple existence of a TTS.

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 activity, COP expects no cases of TTS given the strong likelihood that baleen whales would avoid the airguns before being exposed to levels high enough for TTS to occur. The source levels of the drillship are far lower than those of the airguns.

In pinnipeds, TTS thresholds associated with exposure to brief pulses (single or multiple) of underwater sound have not been measured. However, systematic TTS studies on captive pinnipeds have been conducted (Bowles *et al.,* 1999; Kastak *et al.,* 1999, 2005, 2007; Schusterman *et al.,* 2000; Finneran *et al.,* 2003; Southall *et al.,* 2007). 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; cf. Au *et al.,* 2000). The TTS threshold for pulsed sounds has been indirectly estimated as being an SEL of approximately 171 dB re 1 $\mu Pa^2 \cdot s$ (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). For harbor seal, which is closely related to the ringed seal, TTS onset apparently occurs at somewhat lower received energy levels than for odonotocetes. The sound level necessary to cause TTS in pinnipeds depends on exposure duration, as in other mammals; with longer exposure, the level necessary to elicit TTS is reduced (Schusterman *et al.,* 2000; Kastak *et al.,* 2005, 2007). For very short exposures (e.g., to a single sound pulse), the level necessary to cause TTS is very high (Finneran *et al.,* 2003). For pinnipeds exposed to in-air sounds, auditory fatigue has been measured in response to single pulses and to non-pulse noise (Southall *et al.,* 2007), although high exposure levels were required to induce TTS-onset (SEL: 129 dB re: 20 $\mu Pa^2 \cdot s$; Bowles *et al.,* unpub. data).

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) and are used to establish exclusion zones (EZs), as appropriate. Additionally, based on the summary provided here and the fact that modeling indicates the source level of the drill rig will be below the 180 dB threshold (O'Neill *et al.,* 2012), TTS is not expected to occur in any marine mammal species that may occur in the proposed drilling area since the source level will not reach levels thought to induce even mild TTS. While the source level of the airgun is higher than the 190-dB threshold level, an animal would have to be in very close proximity to be exposed to such levels. Additionally, the 180- and 190-dB radii for the airgun are 0.6 mi (920 m) and 525 ft (160 m), respectively, from the source. Because of the short duration that the airguns will be used (no more than 4 hrs throughout the entire open-water season) and mitigation and monitoring measures described later in this document, hearing impairment is not anticipated.

PTS—When PTS occurs, there is physical damage to the sound receptors in the ear. In some cases, there can be total or partial deafness, 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 underwater industrial sound associated with oil exploration can cause PTS in any marine mammal (see Southall *et al.,* 2007). However, given the possibility that mammals might incur TTS, there has been further speculation about the possibility that some individuals occurring very close to such activities 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 in terrestrial mammals. Relationships between TTS and PTS thresholds have not been studied in marine mammals but are assumed to be similar to those in humans and other terrestrial mammals (Southall *et al.,* 2007; Le Prell, in press). PTS might occur at a received sound level at least several decibels above that inducing mild TTS. 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).

It is highly unlikely that marine mammals could receive sounds strong enough (and over a sufficient duration) to cause PTS during the proposed exploratory drilling program. As mentioned previously in this document, the source levels of the drillship are not considered strong enough to cause even slight TTS. Given the higher level of sound necessary to cause PTS, it is even less likely that PTS could occur. In fact, based on the modeled source levels for the drillship, the levels immediately adjacent to the drillship may not be sufficient to induce PTS, even if the animals remain in the immediate vicinity of the activity. Modeled source levels for a jack-up drill rig suggest that marine mammals located immediately adjacent to the rig would likely not be exposed to received sound levels of a magnitude strong enough to induce PTS, even if the animals remain in the immediate vicinity of the proposed activity location for a prolonged period of time. Because the source levels do not reach the thresholds of 190 dB currently used for pinnipeds and 180 dB currently used for cetaceans, it is highly unlikely that any type of hearing impairment, temporary or permanent, would occur as a result of the exploration drilling activities. Additionally, Southall *et al.* (2007) proposed that the thresholds for injury of marine mammals exposed to ''discrete'' noise events (either single or multiple exposures over a 24-hr period) are higher than the 180- and 190-dB re 1 µPa (rms) in-water threshold currently used by NMFS. Table 1 in this document summarizes the sound pressure levels (SPL) and SEL levels thought to cause auditory injury to cetaceans and pinnipeds in-water. For more information, please refer to Southall *et al.* (2007).

TABLE 1—INJURY CRITERIA FOR CETACEANS AND PINNIPEDS EXPOSED TO ''DISCRETE'' NOISE EVENTS (EITHER SINGLE PULSES, MULTIPLE PULSES, OR NON-PULSES WITHIN A 24-HR PERIOD; CITED IN SOUTHALL ET AL., 2007). THIS TABLE REFLECTS THRESHOLDS BASED ON STUDIES REVIEWED IN SOUTHALL ET AL. (2007) BUT DO NOT INFLUENCE THE ESTIMATION OF TAKE IN THIS PROPOSED IHA NOTICE AS NO INJURY IS ANTICIPATED TO OCCUR

	Single pulses	Multiple pulses	Non pulses
Low-frequency cetaceans			
Sound pressure level	230 dB re 1 µPa (peak) (flat)	230 dB re 1 µPa (peak) (flat)	230 dB re 1 µPa (peak) (flat)
Sound exposure level	198 dB re 1 µPa²-s (M_{lf})	198 dB re 1 µPa²-s (M_{lf})	215 dB re 1 µPa²-s (M_{lf})
Mid-frequency cetaceans			
Sound pressure level	230 dB re 1 µPa (peak) (flat)	230 dB re 1 µPa (peak) (flat)	230 dB re 1 µPa (peak) (flat)
Sound exposure level	198 dB re 1 µPa²-s (M_{lf})	198 dB re 1 µPa²-s (M_{lf})	215 dB re 1 µPa²-s (M_{lf})
High-frequency cetaceans			
Sound pressure level	230 dB re 1 µPa (peak) (flat)	230 dB re 1 µPa (peak) (flat)	230 dB re 1 µPa (peak) (flat)
Sound exposure level	198 dB re 1 µPa²-s (M_{lf})	198 dB re 1 µPa²-s (M_{lf})	215 dB re 1 µPa²-s (M_{lf})
Pinnipeds (in water)			
Sound pressure level	218 dB re 1 µPa (peak) (flat)	218 dB re 1 µPa (peak) (flat)	218 dB re 1 µPa (peak) (flat)
Sound exposure level	186 dB re 1 µPa²-s (M_{pw})	186 dB re 1 µPa²-s (M_{pw})	203 dB re 1 µPa²-s (M_{pw})

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, and other types of organ or tissue damage (Cox *et al.,* 2006; Southall *et al.,* 2007). Studies examining any such effects are limited. If any such effects do occur, they probably would be limited to unusual situations when animals might be exposed at close range for unusually long periods. It is doubtful that any single marine mammal would be exposed to strong sounds for sufficiently long that significant physiological stress would develop.

Classic stress responses begin when an animal's central nervous system perceives a potential threat to its homeostasis. That perception triggers stress responses regardless of whether a stimulus actually threatens the animal; the mere perception of a threat is sufficient to trigger a stress response (Moberg, 2000; Sapolsky *et al.,* 2005; Seyle, 1950). Once an animal's central nervous system perceives a threat, it mounts a biological response or defense that consists of a combination of the four general biological defense responses: behavioral responses; autonomic nervous system responses; neuroendocrine responses; or immune responses.

In the case of many stressors, an animal's first and most economical (in terms of biotic costs) response is behavioral avoidance of the potential stressor or avoidance of continued exposure to a stressor. An animal's second line of defense to stressors involves the sympathetic part of the autonomic nervous system and the classical ''fight or flight'' response, which includes the cardiovascular system, the gastrointestinal system, the exocrine glands, and the adrenal medulla to produce changes in heart rate, blood pressure, and gastrointestinal activity that humans commonly associate with ''stress.'' These responses have a relatively short duration and may or may not have significant long-term effects on an animal's welfare.

An animal's third line of defense to stressors involves its neuroendocrine or sympathetic nervous systems; the system that has received the most study has been the hypothalmus-pituitary-adrenal system (also known as the HPA axis in mammals or the hypothalamus-pituitary-interrenal axis in fish and some reptiles). Unlike stress responses associated with the autonomic nervous system, virtually all neuroendocrine functions that are affected by stress—including immune competence, reproduction, metabolism, and behavior—are regulated by pituitary hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction (Moberg, 1987; Rivier, 1995), altered metabolism (Elasser *et al.,* 2000), reduced immune competence (Blecha, 2000), and behavioral disturbance. Increases in the circulation of glucocorticosteroids (cortisol, corticosterone, and aldosterone in marine mammals; see Romano *et al.,* 2004) have been equated with stress for many years.

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and distress is the biotic cost of the response. During a stress response, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response would not pose a risk to the animal's welfare. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other biotic functions, which impair those functions that experience the diversion. For example, when mounting a stress response diverts energy away from growth in young animals, those animals may experience stunted growth. When mounting a stress response diverts energy from a fetus, an animal's reproductive success and fitness will suffer. In these cases, the animals will have entered a pre-pathological or pathological state which is called ''distress'' (sensu Seyle, 1950) or ''allostatic loading'' (sensu McEwen and Wingfield, 2003). This pathological state will last until the animal replenishes its biotic reserves sufficient to restore normal function. Note that these examples involved a long-term (days or weeks) stress response exposure to stimuli.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses have also been documented fairly well through controlled experiment; because this physiology exists in every vertebrate that has been studied, it is not surprising that stress responses and their costs have been documented in both laboratory and free-living animals (for examples see, Holberton *et al.,* 1996; Hood *et al.,* 1998; Jessop *et al.,* 2003; Krausman *et al.,* 2004; Lankford *et al.,* 2005; Reneerkens *et al.,* 2002; Thompson and Hamer, 2000). Although no information has been collected on the physiological responses of marine mammals to anthropogenic sound exposure, studies of other marine animals and terrestrial animals would lead us to expect some marine mammals to experience physiological stress responses and, perhaps, physiological responses that would be classified as ''distress'' upon exposure to anthropogenic sounds.

For example, Jansen (1998) reported on the relationship between acoustic exposures and physiological responses that are indicative of stress responses in humans (e.g., elevated respiration and increased heart rates). Jones (1998) reported on reductions in human performance when faced with acute, repetitive exposures to acoustic disturbance. Trimper *et al.* (1998) reported on the physiological stress responses of osprey to low-level aircraft noise while Krausman *et al.* (2004) reported on the auditory and physiology stress responses of endangered Sonoran pronghorn to military overflights. Smith *et al.* (2004a, 2004b) identified noise-induced physiological transient stress responses in hearing-specialist fish (i.e., goldfish) that accompanied short- and long-term hearing losses. Welch and Welch (1970) reported physiological and behavioral stress responses that accompanied damage to the inner ears of fish and several mammals.

Hearing is one of the primary senses marine mammals use to gather information about their environment and communicate with conspecifics. Although empirical information on the relationship between sensory impairment (TTS, PTS, and acoustic masking) on marine mammals remains limited, it seems reasonable to assume that reducing an animal's ability to gather information about its environment and to communicate with other members of its species would be stressful for animals that use hearing as their primary sensory mechanism. Therefore, we assume that acoustic exposures sufficient to trigger onset PTS or TTS would be accompanied by physiological stress responses because terrestrial animals exhibit those responses under similar conditions (NRC, 2003). More importantly, marine mammals might experience stress responses at received levels lower than those necessary to trigger onset TTS. Based on empirical studies of the time required to recover from stress responses (Moberg, 2000), NMFS also assumes that stress responses could persist beyond the time interval required for animals to recover from TTS and might result in pathological and pre-pathological states that would be as significant as behavioral responses to TTS. However, as stated previously in this document, the source level of the drill rig is not loud enough to induce PTS or even TTS.

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 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 exploration drilling area.

In general, very little is known about the potential for strong, anthropogenic 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. The low levels of continuous sound that will be produced by the drillship are not expected to cause such effects. Additionally, marine mammals that show behavioral avoidance of the proposed activities, including most baleen whales, some odontocetes (including belugas), and some pinnipeds, are especially unlikely to incur auditory impairment or other 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; they have been replaced entirely by airguns or related non-explosive pulse generators. Underwater sound from drilling, support activities, and airgun arrays is less energetic and has slower rise times, and there is no proof that they can cause serious injury, death, or stranding, even in the case of large airgun arrays. However, the association of mass strandings of beaked whales with naval exercises involving mid-frequency active sonar, and, in one case, a Lamont-Doherty Earth Observatory (L–DEO) seismic survey (Malakoff, 2002; Cox *et al.,* 2006), has raised the possibility that beaked whales exposed to strong pulsed sounds may be especially susceptible to injury and/or behavioral reactions that can lead to stranding (e.g., Hildebrand, 2005; Southall *et al.,* 2007).

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

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

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

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

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

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 or exploratory drilling programs (Cox *et al.,* 2006; Southall *et al.,* 2007).

Both seismic pulses and continuous drillship sounds are quite different from mid-frequency sonar signals, and some mechanisms by which sonar sounds have been hypothesized to affect beaked whales are unlikely to apply to airgun pulses or drill rigs. Sounds produced by airgun arrays are broadband impulses with most of the energy below 1 kHz, and the low-energy continuous sounds produced by drill rigs have most of the energy between 20 and 1,000 Hz. Additionally, the non-impulsive, continuous sounds produced by the jack-up rig proposed to be used by COP does not have rapid rise times. Rise time is the fluctuation in sound levels of the source. The type of sound that would be produced during the proposed drilling program will be constant and will not exhibit any sudden fluctuations or changes. 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 them 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 oil and gas industry operations 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 exploratory drilling program because none occur in the proposed area.

Oil Spill Response Preparedness and Potential Impacts of an Oil Spill

As noted above, the specified activity involves the drilling of exploratory wells and associated activities in the Chukchi Sea during the 2012 open-water season. The impacts to marine mammals that are reasonably expected to occur will be acoustic in nature. The likelihood of a large or very large oil spill occurring during COP's proposed exploratory drilling program is remote. A total of 35 exploration wells have been drilled between 1982 and 2003 in the Chukchi and Beaufort seas, and there have been no blowouts. In addition, no blowouts have occurred from the approximately 98 exploration wells drilled within the Alaskan OCS (MMS, 2007a). BOEM's Supplemental Environmental Impact Statement for the Chukchi Sea Oil and Gas Lease Sale 193 (BOEM, 2011) provides a discussion of the extremely low likelihood of an oil spill occurring (available on the Internet at: *http://www.boem.gov/About-BOEM/BOEM-Regions/Alaska-Region/Environment/Environmental-Analysis/OCS-EIS/EA-BOEMRE-2011-041.aspx*). For more recent updates on occurrence rates for offshore oil spills from drilling platforms, including spills greater than or equal to 1,000 barrels (bbls) and greater than or equal to 10,000 bbls, we refer to the BOEM-funded study of McMahon-Anders *et al.* (2012). However, this study did not focus solely on the Alaskan OCS. Another BOEM-directed study discusses most recent oil spill occurrence estimators and their variability for the Beaufort and Chukchi Seas for various sizes of spills as small as 50 bbls (Bercha, 2011). Bercha (2011) notes that because of the difference in oil spill indicators between non-Arctic OCS areas and the Beaufort and Chukchi Seas OCS areas, the non-Arctic areas are likely to result in a somewhat higher oil spill occurrence probability than comparable developments in the Chukchi or Beaufort Seas.

COP will have various measures and protocols in place that will be implemented to prevent oil releases from the wellbore, such as:

- Using information from previous wells in addition to recent data collected from 3D seismic and shallow hazard surveys, where applicable, to increase knowledge of the subsurface environment;
- Using skilled personnel and providing them with project-specific training. Implementing frequent drills to keep personnel alert;
- Implementation of visual and automated procedures for the early detection of a spill:

◦ The drilling operation will be monitored continuously by Pit-Volume Totalizer equipment and visual monitoring of the mud circulating system.

◦ Alarms will be sounded if there is a significant volume increase of drilling mud in the pits due to an influx into the wellbore.

◦ Multiple walk-through inspections of the rig are performed every day by each crew to inspect and verify all control systems are functioning properly.

◦ Mobile Offshore Drilling Unit's (MODU) Central Control & Radio Room monitors all safety aspects of the rig and is manned 24 hrs per day by qualified rig personnel.

◦ Established emergency shutdown philosophies will be documented in the Contractor's Operations manuals and the crews will be trained accordingly. An emergency shutdown can be initiated manually by operators at the instrument/control panels or automatically under certain conditions.

• Maintaining a minimum of two barriers; the jack-up rig has the capability of utilizing advanced well control barriers:

◦ Surface blow out preventer (BOP) located on the rig in a place that is easily accessible. This BOP can close in well on drill pipe or open hole.

◦ Thick walled high strength riser designed to contain full well pressure.

◦ Pre-Positioned Capping Device (PCD) will be installed above the wellhead on the sea floor. The PCD can keep the well isolated with pressure containment, even if the rig is moved off location. The PCD can be triggered remotely from the drill rig or from support vessels.

Mechanical containment and recovery is COP's primary form of response. Actual spill response decisions depend on safety considerations, weather, and other environmental conditions. It is the discretion of the Incident Commander and Unified Command to select any sequence, response measure, or take as much time as necessary, to employ an effective response. COP's spill response fleet is mobile and capable of responding to incidents affecting open-water, nearshore, and shoreline environments. Offshore spill response would be provided by the following vessels:

• Oil Spill Response Vessel (OSRV), the primary offshore oil spill response platform, located within about 5.5 mi (9 km) of the drilling rig;

• Offshore Supply Vessel (OSV), a vessel of opportunity response platform, located within about 5.5 mi (9 km) of the drilling rig;

• Four workboats, two are located on the OSRV and two on the OSV; and

• One Oil Spill Tanker (OST), with a storage capacity of at least 520,000 barrels, also located within about 5.5 mi (9 km) from the drilling rig.

Alaska Clean Seas personnel will be stationed on OSRV, OSV, and the drill rig. OSRV is the primary spill response vessel; it will also be used to support refueling of the jack-up rig. In the event of an emergency, OSV will provide oil spill response and fast response craft capability near the ware vessel. During non-emergency operations, OSV will provide operational drill rig support, including standby support during vessel refueling operations. From the standby locations, it will take about 30 min for the vessels to arrive at the rig.

Spill response support for nearshore operations will be located about 5.5 mi (9 km) from the drill rig location and approximately 5 mi (8 km) offshore of Wainwright. Nearshore spill response operations are provided by the following vessels:

• One Oil Spill Response Barge (OSRB) and tug with a storage capacity of 40,000 bbls;

• Four workboats, located on the OSRB;

• One large landing craft, located adjacent to the OSRB; and

• Four 32-foot shallow draft landing craft located on the large landing craft.

The OSRB and large landing craft are designed to carry and deploy a majority of the nearshore and onshore spill response assets. In the event of a spill, additional responders would be mobilized to man the OSRB, large landing craft, and other support vessels. From 5 mi (8 km) offshore of Wainwright it will take about 24 hrs for the OSRB to arrive at the rig, assuming a travel speed of 5 knots and including notification time. However, because this barge is equipped primarily for nearshore response, it is unlikely to be needed offshore near the rig.

Despite concluding that the risk of serious injury or mortality from an oil spill in this case is extremely remote, NMFS has nonetheless evaluated the potential effects of an oil spill on marine mammals. While an oil spill is not a component of COP's specified activity for which NMFS is proposing to authorize take, potential impacts on marine mammals from an oil spill are discussed in more detail below and will be addressed further in the Environmental Assessment.

Potential Effects of Oil on Cetaceans

The specific effects an oil spill would have on cetaceans are not well known. While mortality is unlikely, exposure to spilled oil could lead to skin irritation, baleen fouling (which might reduce feeding efficiency), respiratory distress from inhalation of hydrocarbon vapors, consumption of some contaminated prey items, and temporary displacement from contaminated feeding areas. Geraci and St. Aubin (1990) summarize effects of oil on marine mammals, and Bratton *et al.* (1993) provides a synthesis of knowledge of oil effects on bowhead whales. The number of cetaceans that might be contacted by a spill would depend on the size, timing, and duration of the spill and where the oil is in relation to the animals. Whales may not avoid oil spills, and some have been observed feeding within oil slicks (Goodale *et al.,* 1981). These topics are discussed in more detail next.

In the case of an oil spill occurring during migration periods, disturbance of the migrating cetaceans from cleanup activities may have more of an impact than the oil itself. Human activity associated with cleanup efforts could deflect whales away from the path of the oil. However, noise created from cleanup activities likely will be short term and localized. In fact, whale avoidance of clean-up activities may benefit whales by displacing them from the oil spill area.

There is no direct evidence that oil spills, including the much studied Santa Barbara Channel and Exxon Valdez spills, have caused any deaths of cetaceans (Geraci, 1990; Brownell, 1971; Harvey and Dahlheim, 1994). It is suspected that some individually identified killer whales that disappeared from Prince William Sound during the time of the Exxon Valdez spill were casualties of that spill. However, no clear cause and effect relationship between the spill and the disappearance could be established (Dahlheim and Matkin, 1994). The AT–1 pod of transient killer whales that sometimes inhabits Prince William Sound has continued to decline after the Exxon Valdez oil spill (EVOS). Matkin *et al.* (2008) tracked the AB resident pod and the AT–1 transient group of killer whales from 1984 to 2005. The results of their photographic surveillance indicate a much higher than usual mortality rate for both populations the year following the spill (33% for AB Pod and 41% for AT–1 Group) and lower than average rates of increase in the 16 years after the spill (annual increase of about 1.6% for AB Pod compared to an annual increase of about 3.2% for other Alaska killer whale pods). In killer whale pods, mortality rates are usually higher for non-reproductive animals and very low for reproductive animals and adolescents

(Olesiuk *et al.,* 1990, 2005; Matkin *et al.,* 2005). No effects on humpback whales in Prince William Sound were evident after the EVOS (von Ziegesar *et al.,* 1994). There was some temporary displacement of humpback whales out of Prince William Sound, but this could have been caused by oil contamination, boat and aircraft disturbance, displacement of food sources, or other causes.

Migrating gray whales were apparently not greatly affected by the Santa Barbara spill of 1969. There appeared to be no relationship between the spill and mortality of marine mammals. The higher than usual counts of dead marine mammals recorded after the spill represented increased survey effort and therefore cannot be conclusively linked to the spill itself (Brownell, 1971; Geraci, 1990). The conclusion was that whales were either able to detect the oil and avoid it or were unaffected by it (Geraci, 1990).

(1) Oiling of External Surfaces

Whales rely on a layer of blubber for insulation, so oil would have little if any effect on thermoregulation by whales. Effects of oiling on cetacean skin appear to be minor and of little significance to the animal's health (Geraci, 1990). Histological data and ultrastructural studies by Geraci and St. Aubin (1990) showed that exposures of skin to crude oil for up to 45 minutes in four species of toothed whales had no effect. They switched to gasoline and applied the sponge up to 75 minutes. This produced transient damage to epidermal cells in whales. Subtle changes were evident only at the cell level. In each case, the skin damage healed within a week. They concluded that a cetacean's skin is an effective barrier to the noxious substances in petroleum. These substances normally damage skin by getting between cells and dissolving protective lipids. In cetacean skin, however, tight intercellular bridges, vital surface cells, and the extraordinary thickness of the epidermis impeded the damage. The authors could not detect a change in lipid concentration between and within cells after exposing skin from a white-sided dolphin to gasoline for 16 hours in vitro.

Bratton *et al.* (1993) synthesized studies on the potential effects of contaminants on bowhead whales. They concluded that no published data proved oil fouling of the skin of any free-living whales, and conclude that bowhead whales contacting fresh or weathered petroleum are unlikely to suffer harm. Although oil is unlikely to adhere to smooth skin, it may stick to rough areas on the surface (Henk and Mullan, 1997). Haldiman *et al.* (1985) found the epidermal layer to be as much as seven to eight times thicker than that found on most whales. They also found that little or no crude oil adhered to preserved bowhead skin that was dipped into oil up to three times, as long as a water film stayed on the skin's surface. Oil adhered in small patches to the surface and vibrissae (stiff, hairlike structures), once it made enough contact with the skin. The amount of oil sticking to the surrounding skin and epidermal depression appeared to be in proportion to the number of exposures and the roughness of the skin's surface. It can be assumed that if oil contacted the eyes, effects would be similar to those observed in ringed seals; continued exposure of the eyes to oil could cause permanent damage (St. Aubin, 1990).

(2) Ingestion

Whales could ingest oil if their food is contaminated, or oil could also be absorbed through the respiratory tract. Some of the ingested oil is voided in vomit or feces but some is absorbed and could cause toxic effects (Geraci, 1990). When returned to clean water, contaminated animals can depurate this internal oil (Engelhardt, 1978, 1982). Oil ingestion can decrease food assimilation of prey eaten (St. Aubin, 1988). Cetaceans may swallow some oil-contaminated prey, but it likely would be only a small part of their food. It is not known if whales would leave a feeding area where prey was abundant following a spill. Some zooplankton eaten by bowheads and gray whales consume oil particles and bioaccumulation can result. Tissue studies by Geraci and St. Aubin (1990) revealed low levels of naphthalene in the livers and blubber of baleen whales. This result suggests that prey have low concentrations in their tissues, or that baleen whales may be able to metabolize and excrete certain petroleum hydrocarbons. Whales exposed to an oil spill are unlikely to ingest enough oil to cause serious internal damage (Geraci and St. Aubin, 1980, 1982) and this kind of damage has not been reported (Geraci, 1990).

(3) Fouling of Baleen

Baleen itself is not damaged by exposure to oil and is resistant to effects of oil (St. Aubin *et al.,* 1984). Crude oil could coat the baleen and reduce filtration efficiency; however, effects may be temporary (Braithwaite, 1983; St. Aubin *et al.,* 1984). If baleen is coated in oil for long periods, it could cause the animal to be unable to feed, which could lead to malnutrition or even death. Most of the oil that would coat the baleen is removed after 30 min, and less than 5% would remain after 24 hr (Bratton *et al.,* 1993). Effects of oiling of the baleen on feeding efficiency appear to be minor (Geraci, 1990). However, a study conducted by Lambertsen *et al.* (2005) concluded that their results highlight the uncertainty about how rapidly oil would depurate at the near zero temperatures in arctic waters and whether baleen function would be restored after oiling.

(4) Avoidance

Some cetaceans can detect oil and sometimes avoid it, but others enter and swim through slicks without apparent effects (Geraci, 1990; Harvey and Dahlheim, 1994). Bottlenose dolphins in the Gulf of Mexico apparently could detect and avoid slicks and mousse but did not avoid light sheens on the surface (Smultea and Wursig, 1995). After the Regal Sword spill in 1979, various species of baleen and toothed whales were observed swimming and feeding in areas containing spilled oil southeast of Cape Cod, MA (Goodale *et al.,* 1981). For months following EVOS, there were numerous observations of gray whales, harbor porpoises, Dall's porpoises, and killer whales swimming through light-to-heavy crude-oil sheens (Harvey and Dalheim, 1994, cited in Matkin *et al.,* 2008). However, if some of the animals avoid the area because of the oil, then the effects of the oiling would be less severe on those individuals.

(5) Factors Affecting the Severity of Effects

Effects of oil on cetaceans in open water are likely to be minimal, but there could be effects on cetaceans where both the oil and the whales are at least partly confined in leads or at ice edges (Geraci, 1990). In spring, bowhead and beluga whales migrate through leads in the ice. At this time, the migration can be concentrated in narrow corridors defined by the leads, thereby creating a greater risk to animals caught in the spring lead system should oil enter the leads. This situation would only occur if there were an oil spill late in the season and COP could not complete cleanup efforts prior to ice covering the area. The oil would likely then be trapped in the ice until it began to thaw in the spring.

In fall, the migration route of bowheads can be close to shore (Blackwell *et al.,* 2009c). If fall migrants were moving through leads in the pack ice or were concentrated in nearshore waters, some bowhead whales might not be able to avoid oil slicks and could be subject to prolonged contamination. However, the autumn migration through the Chukchi Sea extends over several weeks, and some of the whales travel along routes north or inland of the area, thereby reducing the number of whales that could approach patches of spilled oil. Additionally, vessel activity associated with spill cleanup efforts may deflect whales traveling near the Devils Paw prospect in the Chukchi Sea, thereby reducing the likelihood of contact with spilled oil.

Bowhead and beluga whales overwinter in the Bering Sea (mainly from November to March). In the summer, the majority of the bowhead whales are found in the Canadian Beaufort Sea, although some have recently been observed in the U.S. Beaufort and Chukchi Seas during the summer months (June to August). Data from the Barrow-based boat surveys in 2009 (George and Sheffield, 2009) showed that bowheads were observed almost continuously in the waters near Barrow, including feeding groups in the Chukchi Sea at the beginning of July. The majority of belugas in the Beaufort stock migrate into the Beaufort Sea in April or May, although some whales may pass Point Barrow as early as late March and as late as July (Braham *et al.,* 1984; Ljungblad *et al.,* 1984; Richardson *et al.,* 1995a). Therefore, a spill in summer would not be expected to have major impacts on these species. Additionally, humpback and fin whales are only sighted in the Chukchi Sea in small numbers in the summer, as this is thought to be the extreme northern edge of their range. Therefore, impacts to these species from an oil spill would be extremely limited.

Potential Effects of Oil on Pinnipeds

Ice seals are present in open-water areas during summer and early autumn. Externally oiled phocid seals often survive and become clean, but heavily oiled seal pups and adults may die, depending on the extent of oiling and characteristics of the oil. Prolonged exposure could occur if fuel or crude oil was spilled in or reached nearshore waters, was spilled in a lead used by seals, or was spilled under the ice when seals have limited mobility (NMFS, 2000). Adult seals may suffer some temporary adverse effects, such as eye and skin irritation, with possible infection (MMS, 1996). Such effects may increase stress, which could contribute to the death of some individuals. Ringed seals may ingest oil-contaminated foods, but there is little evidence that oiled seals will ingest enough oil to cause lethal internal effects. There is a likelihood that newborn seal pups, if contacted by oil, would die from oiling through loss of insulation and resulting hypothermia. These potential effects are addressed in more detail in subsequent paragraphs.

Reports of the effects of oil spills have shown that some mortality of seals may have occurred as a result of oil fouling; however, large scale mortality had not been observed prior to the EVOS (St. Aubin, 1990). Effects of oil on marine mammals were not well studied at most spills because of lack of baseline data and/or the brevity of the post-spill surveys. The largest documented impact of a spill, prior to EVOS, was on young seals in January in the Gulf of St. Lawrence (St. Aubin, 1990). Brownell and Le Boeuf (1971) found no marked effects of oil from the Santa Barbara oil spill on California sea lions or on the mortality rates of newborn pups.

Intensive and long-term studies were conducted after the EVOS in Alaska. There may have been a long-term decline of 36% in numbers of molting harbor seals at oiled haul-out sites in Prince William Sound following EVOS (Frost *et al.,* 1994a). However, in a reanalysis of those data and additional years of surveys, along with an examination of assumptions and biases associated with the original data, Hoover-Miller *et al.* (2001) concluded that the EVOS effect had been overestimated. The decline in attendance at some oiled sites was more likely a continuation of the general decline in harbor seal abundance in Prince William Sound documented since 1984 (Frost *et al.,* 1999) rather than a result of EVOS. The results from Hoover-Miller *et al.* (2001) indicate that the effects of EVOS were largely indistinguishable from natural decline by 1992. However, while Frost *et al.* (2004) concluded that there was no evidence that seals were displaced from oiled sites, they did find that aerial counts indicated 26% fewer pups were produced at oiled locations in 1989 than would have been expected without the oil spill. Harbor seal pup mortality at oiled beaches was 23% to 26%, which may have been higher than natural mortality, although no baseline data for pup mortality existed prior to EVOS (Frost *et al.,* 1994a). There was no conclusive evidence of spill effects on Steller sea lions (Calkins *et al.,* 1994). Oil did not persist on sea lions themselves (as it did on harbor seals), nor did it persist on sea lion haul-out sites and rookeries (Calkins *et al.,* 1994). Sea lion rookeries and haul out sites, unlike those used by harbor seals, have steep sides and are subject to high wave energy (Calkins *et al.,* 1994).

(1) Oiling of External Surfaces

Adult seals rely on a layer of blubber for insulation, and oiling of the external surface does not appear to have adverse thermoregulatory effects (Kooyman *et al.,* 1976, 1977; St. Aubin, 1990). Contact with oil on the external surfaces can potentially cause increased stress and irritation of the eyes of ringed seals (Geraci and Smith, 1976; St. Aubin, 1990). These effects seemed to be temporary and reversible, but continued exposure of eyes to oil could cause permanent damage (St. Aubin, 1990). Corneal ulcers and abrasions, conjunctivitis, and swollen nictitating membranes were observed in captive ringed seals placed in crude oil-covered water (Geraci and Smith, 1976) and in seals in the Antarctic after an oil spill (Lillie, 1954).

Newborn seal pups rely on their fur for insulation. Newborn ringed seal pups in lairs on the ice could be contaminated through contact with oiled mothers. There is the potential that newborn ringed seal pups that were contaminated with oil could die from hypothermia. However, COP's activities will not occur during pupping season or when lairs are built.

(2) Ingestion

Marine mammals can ingest oil if their food is contaminated. Oil can also be absorbed through the respiratory tract (Geraci and Smith, 1976; Engelhardt *et al.,* 1977). Some of the ingested oil is voided in vomit or feces but some is absorbed and could cause toxic effects (Engelhardt, 1981). When returned to clean water, contaminated animals can depurate this internal oil (Engelhardt, 1978, 1982, 1985). In addition, seals exposed to an oil spill are unlikely to ingest enough oil to cause serious internal damage (Geraci and St. Aubin, 1980, 1982).

(3) Avoidance and Behavioral Effects

Although seals may have the capability to detect and avoid oil, they apparently do so only to a limited extent (St. Aubin, 1990). Seals may abandon the area of an oil spill because of human disturbance associated with cleanup efforts, but they are most likely to remain in the area of the spill. One notable behavioral reaction to oiling is that oiled seals are reluctant to enter the water, even when intense cleanup activities are conducted nearby (St. Aubin, 1990; Frost *et al.,* 1994b, 2004).

(4) Factors Affecting the Severity of Effects

Seals that are under natural stress, such as lack of food or a heavy infestation by parasites, could potentially die because of the additional stress of oiling (Geraci and Smith, 1976; St. Aubin, 1990; Spraker *et al.,* 1994). Female seals that are nursing young would be under natural stress, as would molting seals. In both cases, the seals would have reduced food stores and may be less resistant to effects of oil than seals that are not under some type of natural stress. Seals that are not under natural stress (e.g., fasting, molting) would be more likely to survive oiling.

In general, seals do not exhibit large behavioral or physiological reactions to limited surface oiling or incidental exposure to contaminated food or vapors (St. Aubin, 1990; Williams *et al.,* 1994). Effects could be severe if seals surface in heavy oil slicks in leads or if oil accumulates near haul-out sites (St. Aubin, 1990). An oil spill in open-water is less likely to impact seals.

Potential Effects Conclusion

The potential effects to marine mammals 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).

Anticipated Effects on Marine Mammal Habitat

The primary potential impacts to marine mammals and other marine species are associated with elevated sound levels produced by the exploratory drilling program (i.e. the drill rig and the airguns). However, other potential impacts are also possible to the surrounding habitat from physical disturbance, discharges, and an oil spill (should one occur). This section describes the potential impacts to marine mammal habitat from the specified activity. Because the marine mammals in the area feed on fish and/or invertebrates there is also information on the species typically preyed upon by the marine mammals in the area.

Common Marine Mammal Prey in the Area

All of the marine mammal species that may occur in the proposed project area prey on either marine fish or invertebrates. The ringed seal feeds on fish and a variety of benthic species, including crabs and shrimp. Bearded seals feed mainly on benthic organisms, primarily crabs, shrimp, and clams. Spotted seals feed on pelagic and demersal fish, as well as shrimp and cephalopods. They are known to feed on a variety of fish including herring, capelin, sand lance, Arctic cod, saffron cod, and sculpins. Ribbon seals feed primarily on pelagic fish and invertebrates, such as shrimp, crabs, squid, octopus, cod, sculpin, pollack, and capelin. Juveniles feed mostly on krill and shrimp.

Bowhead whales feed in the eastern Beaufort Sea during summer and early autumn but continue feeding to varying degrees while on their migration through the central and western Beaufort Sea in the late summer and fall (Richardson and Thomson [eds.], 2002). Aerial surveys in recent years have sighted bowhead whales feeding in Camden Bay on their westward migration through the Beaufort Sea. When feeding in relatively shallow areas, bowheads feed throughout the water column. However, feeding is concentrated at depths where zooplankton is concentrated (Wursig *et al.,* 1984, 1989; Richardson [ed.], 1987; Griffiths *et al.,* 2002). Lowry and Sheffield (2002) found that copepods and euphausiids were the most common prey found in stomach samples from bowhead whales harvested in the Kaktovik area from 1979 to 2000. Areas to the east of Barter Island in the Beaufort Sea appear to be used regularly for feeding as bowhead whales migrate slowly westward across the Beaufort Sea (Thomson and Richardson, 1987; Richardson and Thomson [eds.], 2002). However, in some years, sizable groups of bowhead whales have been seen feeding as far west as the waters just east of Point Barrow (which is more than 200 mi [322 km] east of COP's proposed drill sites in the Chukchi Sea) near the Plover Islands (Braham *et al.,* 1984; Ljungblad *et al.,* 1985; Landino *et al.,* 1994). The situation in September–October 1997 was unusual in that bowheads fed widely across the Alaskan Beaufort Sea, including higher numbers in the area east of Barrow than reported in any previous year (S. Treacy and D. Hansen, MMS, pers. comm.). However, by the time most bowhead whales reach the Chukchi Sea (October), they will likely no longer be feeding, or if it occurs it will be very limited. The location near Point Barrow is currently under intensive study as part of the BOWFEST program (BOWFEST, 2011).

Beluga whales feed on a variety of fish, shrimp, squid, and octopus (Burns and Seaman, 1985). Like several of the other species in the area, harbor porpoise feed on demersal and benthic species, mainly schooling fish and cephalopods. Killer whales from resident stocks primarily feed on salmon while killer whales from transient stocks feed on other marine mammals, such as harbor seals, harbor porpoises, gray whale calves and other pinniped and cetacean species.

Gray whales are primarily bottom feeders, and benthic amphipods and isopods form the majority of their summer diet, at least in the main summering areas west of Alaska (Oliver *et al.,* 1983; Oliver and Slattery, 1985). Farther south, gray whales have also been observed feeding around kelp beds, presumably on mysid crustaceans, and on pelagic prey such as small schooling fish and crab larvae (Hatler and Darling, 1974). Based on data collected from recent Aerial Survey of Arctic Marine Mammals (ASAMM, formerly referred to as BWASP for the Beaufort Sea or COMIDA for the Chukchi Sea) flights (Clarke and Ferguson, 2010; Clarke *et al.,* in prep.; Clarke *et al.,* 2011; Clarke *et al.,* 2012) three primary feeding grounds have been identified as currently used by gray whales in the Chukchi Sea: (1) Between Point Barrow and Icy Cape within approximately 56 mi (90 km) of shore; (2) nearshore from south of Point Hope to east of Cape Lisburne; and (3) in the south-central Chukchi Sea. These latter two locations are located substantial distances from COP's operating area. With the exception of vessel transits, the first feeding area is also located outside of COP's drilling area.

Three other baleen whale species may occur in the proposed project area, although likely in very small numbers: minke, humpback, and fin whales. Minke whales opportunistically feed on crustaceans (e.g., krill), plankton (e.g., copepods), and small schooling fish (e.g., anchovies, dogfish, capelin, coal fish, cod, eels, herring, mackerel, salmon, sand lance, saury, and wolfish) (Reeves *et al.,* 2002). Fin whales tend to feed in northern latitudes in the summer months on plankton and shoaling pelagic fish (Jonsgard, 1966a,b). Like many of the other species in the area, humpback whales primarily feed on euphausiids, copepods, and small schooling fish (e.g., herring, capelin, and sand lance) (Reeves *et al.,* 2002). However, the primary feeding grounds for these species do not occur in the northern Chukchi Sea.

Two kinds of fish inhabit marine waters in the study area: (1) true marine fish that spend all of their lives in salt water, and (2) anadromous species that reproduce in fresh water and spend parts of their life cycles in salt water.

Most arctic marine fish species are small, benthic forms that do not feed high in the water column. The majority of these species are circumpolar and are found in habitats ranging from deep offshore water to water as shallow as

16.4–33 ft (5–10 m; Fechhelm *et al.,* 1995). The most important pelagic species, and the only abundant pelagic species, is the Arctic cod. The Arctic cod is a major vector for the transfer of energy from lower to higher trophic levels (Bradstreet *et al.,* 1986). In summer, Arctic cod can form very large schools in both nearshore and offshore waters (Craig *et al.,* 1982; Bradstreet *et al.,* 1986). Locations and areas frequented by large schools of Arctic cod cannot be predicted but can be almost anywhere. The Arctic cod is a major food source for beluga whales, ringed seals, and numerous species of seabirds (Frost and Lowry, 1984; Bradstreet *et al.,* 1986).

Anadromous Dolly Varden char and some species of whitefish winter in rivers and lakes, migrate to the sea in spring and summer, and return to fresh water in autumn. Anadromous fish form the basis of subsistence, commercial, and small regional sport fisheries. Dolly Varden char migrate to the sea from May through mid-June (Johnson, 1980) and spend about 1.5–2.5 months there (Craig, 1989). They return to rivers beginning in late July or early August with the peak return migration occurring between mid-August and early September (Johnson, 1980). At sea, most anadromous corregonids (whitefish) remain in nearshore waters within several kilometers of shore (Craig, 1984, 1989). They are often termed ''amphidromous'' fish in that they make repeated annual migrations into marine waters to feed, returning each fall to overwinter in fresh water.

Benthic organisms are defined as bottom dwelling creatures. Infaunal organisms are benthic organisms that live within the substrate and are often sedentary or sessile (bivalves, polychaetes). Epibenthic organisms live on or near the bottom surface sediments and are mobile (amphipods, isopods, mysids, and some polychaetes). The northeastern Chukchi Sea supports a higher biomass of benthic organisms than do surrounding areas (Grebmeier and Dunton, 2000). Some benthic-feeding marine mammals, such as walruses and gray whales, take advantage of the abundant food resources and congregate in these highly productive areas. Harold and Hanna Shoals are two known highly productive areas in the Chukchi Sea rich with benthic animals.

Many of the nearshore benthic marine invertebrates of the Arctic are circumpolar and are found over a wide range of water depths (Carey *et al.,* 1975). Species identified include polychaetes (*Spio filicornis, Chaetozone setosa, Eteone longa*), bivalves (*Cryrtodaria kurriana, Nucula tenuis, Liocyma fluctuosa*), an isopod (*Saduria entomon*), and amphipods (*Pontoporeia femorata, P. affinis*). Additionally, kelp beds occur in at least two areas in the nearshore areas of the Chukchi Sea (Mohr *et al.,* 1957; Phillips *et al.,* 1982; Phillips and Reiss, 1985), but they are located within about 15.5 mi (25 km) of the coast, which is much closer nearshore than COP's proposed activities.

Potential Impacts From Seafloor Disturbance on Marine Mammal Habitat

There is a possibility of seafloor disturbance or increased turbidity in the vicinity of the drill sites. Seafloor disturbance could occur with bottom founding of the drill rig legs and anchoring system and also with the anchoring systems of support vessels. These activities could lead to direct effects on bottom fauna, through either displacement or mortality. Increase in suspended sediments from seafloor disturbance also has the potential to indirectly affect bottom fauna and fish. The amount and duration of disturbed or turbid conditions will depend on sediment material.

Placement of the drill rig onto the seabed will include firm establishment of its legs onto the seafloor. No anchors are required to be deployed for stabilization of the rig. Displacement or mortality of bottom organisms will likely occur in the area covered by the spud can of the legs. The area of seabed that will be covered by these spud cans is about 2,165 ft ^{2} (200 m ^{2}) per spud, which is a total of 6,500 ft ^{2} (600 m ^{2}) for three legs or 8,660 ft ^{2} (800 m^2) for four legs. The mean abundance of benthic organisms in the Klondike area was about 800 individuals/m ^{2} (Blanchard *et al.,* 2010) and consisted mostly of polychaete worms and mollusks. The drill rig is a temporary structure that will be removed at the end of the field season. Because of the placement of the spud cans, benthic organisms are expected to decolonize the relatively small disturbed patches from adjacent areas. Impacts to marine mammals from such disturbance are anticipated to be inconsequential.

Placement and demobilization of the drill rig can lead to an increase in suspended sediment in the water column, with the potential to affect zooplankton, including fish eggs and larvae. The magnitude of any impact strongly depends on the concentration of suspended sediments, the type of sediment, the duration of exposure, and also of the natural turbidity in the area. Fish eggs and larvae have been found to exhibit greater sensitivity to suspended sediments (Wilber and Clarke, 2001) and other stresses than adult fish, which is thought to be related to their relative lack of motility (Auld and Schubel, 1978). Sedimentation could potentially affect fish by causing egg morbidity of demersal fish feeding near or on the ocean floor (Wilber and Clarke, 2001). However, the increase in suspended sediments from drill rig placement, demobilization and anchor handling is very limited, localized and temporary, and will likely be indistinguishable from natural variations in turbidity and sedimentation. No impacts on zooplankton are therefore expected considering the high inter-annual variability in abundance and biomass in the Devils Paw Prospect, influenced by timing of sea ice melt, water temperatures, northward transport of water masses, and nutrients and chlorophyll (Hopcroft *et al.,* 2011).

Benthic organisms inhabiting the Devils Paw Prospect will likely be displaced or smothered. However, due to the limited area and duration of the proposed drilling program and because the area is mainly characterized as a pelagic system (Day *et al.,* 2012) with a low density of benthic feeding marine mammals, the limited loss or modification of habitat is not expected to result in impacts to marine mammals or their populations. Less than 0.0000001 percent of the fish habitat in the Lease Sale 193 area would be directly affected by the bottom founding of the drill rig legs and anchoring.

Potential Impacts from Sound Generation

With regard to fish as a prey source for odontocetes and seals, fish are known to hear and react to sounds and to use sound to communicate (Tavolga *et al.,* 1981) and possibly avoid predators (Wilson and Dill, 2002). Experiments have shown that fish can sense both the strength and direction of sound (Hawkins, 1981). Primary factors determining whether a fish can sense a sound signal, and potentially react to it, are the frequency of the signal and the strength of the signal in relation to the natural background noise level.

Fishes produce sounds that are associated with behaviors that include territoriality, mate search, courtship, and aggression. It has also been speculated that sound production may provide the means for long distance communication and communication under poor underwater visibility conditions (Zelick *et al.,* 1999), although the fact that fish communicate at low-frequency sound levels where the masking effects of ambient noise are naturally highest suggests that very long distance communication would rarely be possible. Fishes have evolved a diversity of sound generating organs and acoustic signals of various temporal and spectral contents. Fish sounds vary in structure, depending on the mechanism used to produce them (Hawkins, 1993). Generally, fish sounds are predominantly composed of low frequencies (less than 3 kHz).

Since objects in the water scatter sound, fish are able to detect these objects through monitoring the ambient noise. Therefore, fish are probably able to detect prey, predators, conspecifics, and physical features by listening to environmental sounds (Hawkins, 1981). There are two sensory systems that enable fish to monitor the vibration-based information of their surroundings. The two sensory systems, the inner ear and the lateral line, constitute the acoustico-lateralis system.

Although the hearing sensitivities of very few fish species have been studied to date, it is becoming obvious that the intra- and inter-specific variability is considerable (Coombs, 1981). Nedwell *et al.* (2004) compiled and published available fish audiogram information. A noninvasive electrophysiological recording method known as auditory brainstem response is now commonly used in the production of fish audiograms (Yan, 2004). Generally, most fish have their best hearing in the low-frequency range (i.e., less than 1 kHz). Even though some fish are able to detect sounds in the ultrasonic frequency range, the thresholds at these higher frequencies tend to be considerably higher than those at the lower end of the auditory frequency range.

Literature relating to the impacts of sound on marine fish species can be divided into the following categories: (1) Pathological effects; (2) physiological effects; and (3) behavioral effects. Pathological effects include lethal and sub-lethal physical damage to fish; physiological effects include primary and secondary stress responses; and behavioral effects include changes in exhibited behaviors of fish. Behavioral changes might be a direct reaction to a detected sound or a result of the anthropogenic sound masking natural sounds that the fish normally detect and to which they respond. The three types of effects are often interrelated in complex ways. For example, some physiological and behavioral effects could potentially lead to the ultimate pathological effect of mortality. Hastings and Popper (2005) reviewed what is known about the effects of sound on fishes and identified studies needed to address areas of uncertainty relative to measurement of sound and the responses of fishes. Popper *et al.* (2003/2004) also published a paper that reviews the effects of anthropogenic sound on the behavior and physiology of fishes.

Potential effects of exposure to continuous sound on marine fish include TTS, physical damage to the ear region, physiological stress responses, and behavioral responses such as startle response, alarm response, avoidance, and perhaps lack of response due to masking of acoustic cues. Most of these effects appear to be either temporary or intermittent and therefore probably do not significantly impact the fish at a population level. The studies that resulted in physical damage to the fish ears used noise exposure levels and durations that were far more extreme than would be encountered under conditions similar to those expected during COP's proposed exploratory drilling activities.

The level of sound at which a fish will react or alter its behavior is usually well above the detection level. Fish have been found to react to sounds when the sound level increased to about 20 dB above the detection level of 120 dB (Ona, 1988); however, the response threshold can depend on the time of year and the fish's physiological condition (Engas *et al.,* 1993). In general, fish react more strongly to pulses of sound rather than a continuous signal (Blaxter *et al.,* 1981), such as the type of sound that will be produced by the drillship, and a quicker alarm response is elicited when the sound signal intensity rises rapidly compared to sound rising more slowly to the same level.

Investigations of fish behavior in relation to vessel noise (Olsen *et al.,* 1983; Ona, 1988; Ona and Godo, 1990) have shown that fish react when the sound from the engines and propeller exceeds a certain level. Avoidance reactions have been observed in fish such as cod and herring when vessels approached close enough that received sound levels are 110 dB to 130 dB (Nakken, 1992; Olsen, 1979; Ona and Godo, 1990; Ona and Toresen, 1988). However, other researchers have found that fish such as polar cod, herring, and capeline are often attracted to vessels (apparently by the noise) and swim toward the vessel (Rostad *et al.,* 2006). Typical sound source levels of vessel noise in the audible range for fish are 150 dB to 170 dB (Richardson *et al.,* 1995a). (Based on models, the 160 dB radius for the jack-up rig would extend approximately 33 ft [10 m] approximately 0.4 mi [710 m] when a support vessel is in DP mode next to the drill rig; therefore, fish would need to be in close proximity to the drill rig for the noise to be audible). In calm weather, ambient noise levels in audible parts of the spectrum lie between 60 dB to 100 dB.

Sound will also occur in the marine environment from the various support vessels. Reported source levels for vessels during ice-management have ranged from 175 dB to 185 dB (Brewer *et al.,* 1993, Hall *et al.,* 1994). However, ice management activities are not expected to be necessary throughout most of the drilling season, so impacts from that activity would occur less frequently than sound from the drill rig. Sounds generated by drilling and ice-management are generally low frequency and within the frequency range detectable by most fish.

COP also proposes to conduct seismic surveys with an airgun array for a short period of time during the drilling season (a total of approximately 2–4 hours over the course of the entire proposed drilling program). Airguns produce impulsive sounds as opposed to continuous sounds at the source. Short, sharp sounds can cause overt or subtle changes in fish behavior. Chapman and Hawkins (1969) tested the reactions of whiting (hake) in the field to an airgun. When the airgun was fired, the fish dove from 82 to 180 ft (25 to 55 m) depth and formed a compact layer. The whiting dove when received sound levels were higher than 178 dB re 1 μPa (Pearson *et al.,* 1992).

Pearson *et al.* (1992) conducted a controlled experiment to determine effects of strong noise pulses on several species of rockfish off the California coast. They used an airgun with a source level of 223 dB re 1 μPa. They noted:

• Startle responses at received levels of 200–205 dB re 1 μPa and above for two sensitive species, but not for two other species exposed to levels up to 207 dB;

• Alarm responses at 177–180 dB for the two sensitive species, and at 186 to 199 dB for other species;

• An overall threshold for the above behavioral response at about 180 dB;

• An extrapolated threshold of about 161 dB for subtle changes in the behavior of rockfish; and

• A return to pre-exposure behaviors within the 20–60 minute exposure period.

In summary, fish often react to sounds, especially strong and/or intermittent sounds of low frequency. Sound pulses at received levels of 160 dB re 1 μPa may cause subtle changes in behavior. Pulses at levels of 180 dB may cause noticeable changes in behavior (Chapman and Hawkins, 1969;

Pearson *et al.,* 1992; Skalski *et al.,* 1992). It also appears that fish often habituate to repeated strong sounds rather rapidly, on time scales of minutes to an hour. However, the habituation does not endure, and resumption of the strong sound source may again elicit disturbance responses from the same fish. Underwater sound levels from the drill rig and other vessels produce sounds lower than the response threshold reported by Pearson *et al.* (1992), and are not likely to result in major effects to fish near the proposed drill sites.

Based on a sound level of approximately 140 dB, there may be some avoidance by fish of the area near the jack-up while drilling, around ice management vessels in transit and during ice management, and around other support and supply vessels when underway. Any reactions by fish to these sounds will last only minutes (Mitson and Knudsen, 2003; Ona *et al.,* 2007) longer than the vessel is operating at that location or the drillship is drilling. Any potential reactions by fish would be limited to a relatively small area within about 33 ft (10 m) of the drill rig during drilling. Avoidance by some fish or fish species could occur within portions of this area. No important spawning habitats are known to occur at or near the drilling locations.

Some of the fish species found in the Arctic are prey sources for odontocetes and pinnipeds. A reaction by fish to sounds produced by COP's proposed operations would only be relevant to marine mammals if it caused concentrations of fish to vacate the area. Pressure changes of sufficient magnitude to cause that type of reaction would probably occur only very close to the sound source, if any would occur at all due to the low energy sounds produced by the majority of equipment proposed for use. Impacts on fish behavior are predicted to be inconsequential. Thus, feeding odontocetes and pinnipeds would not be adversely affected by this minimal loss or scattering, if any, which is not expected to result in reduced prey abundance.

Some mysticetes, including bowhead whales, feed on concentrations of zooplankton. Bowhead whales primarily feed off Point Barrow in September and October. Reactions of zooplankton to sound are, for the most part, not known. Their ability to move significant distances is limited or nil, depending on the type of zooplankton. A reaction by zooplankton to sounds produced by the exploratory drilling program would only be relevant to whales if it caused concentrations of zooplankton to scatter. Pressure changes of sufficient magnitude to cause that type of reaction would probably occur only very close to the sound source, if any would occur at all due to the low energy sounds produced by the drillship. However, Barrow is located approximately 200 mi (322 km) east of COP's Devils Paw prospect. Impacts on zooplankton behavior are predicted to be inconsequential. Thus, bowhead whales feeding off Point Barrow would not be adversely affected.

Gray whales are bottom feeders and suck sediment and the benthic amphipods that are their prey from the seafloor. The species primary feeding habitats are in the northern Bering Sea and Chukchi Sea (Nerini, 1984; Moore *et al.,* 1986; Weller *et al.,* 1999). As noted earlier in this document, most gray whale feeding locations in the Chukchi Sea are located closer to shore. Several of the primary feeding grounds are located much further south in the Chukchi Sea than COP's proposed activity area. Additionally, Yazvenko *et al.* (2007) studied the impacts of seismic surveys off Sakhalin Island, Russia, on feeding gray whales and found that the seismic activity had no measurable effect on bottom feeding gray whales in the area.

Potential Impacts From Drill Cuttings

Discharging drill cuttings or other liquid waste streams generated by the drilling vessel could potentially affect marine mammal habitat. Toxins could persist in the water column, which could have an impact on marine mammal prey species. However, despite a considerable amount of investment in research on exposures of marine mammals to organochlorines or other toxins, there have been no marine mammal deaths in the wild that can be conclusively linked to the direct exposure to such substances (O'Shea, 1999).

Drilling muds and cuttings discharged to the seafloor can lead to localized increased turbidity and increase in background concentrations of barium and occasionally other metals in sediments and may affect lower trophic organisms. Drilling muds are composed primarily of bentonite (clay), and the toxicity is therefore low. Heavy metals in the mud may be absorbed by benthic organisms, but studies have shown that heavy metals do not bio-magnify in marine food webs (Neff *et al.,* 1989). There have been no field monitoring studies of effects of water-based muds and cuttings discharges on biological communities of the Alaskan Chukchi Sea and only a few in the development area of the Alaskan Beaufort Sea (Neff *et al.,* 2010). However, the results of these studies are consistent with the results of many more comprehensive microcosm and ecological investigations near cuttings discharge sites in cold-water environments of the North Sea, the Barents Sea, off Sakhalin Island in the Russian Far East, and in the Canadian Beaufort Sea off the Mackenzie River (Neff *et al.,* 2010). All the studies show that water-based muds and cuttings discharges have no, or minimal and very short-lived effects on zooplankton communities. This might, in part, be due to the large inter-annual differences observed in the planktonic communities. In the Chukchi Sea the inter-annual variability of zooplankton biomass and community structure is influenced by differences in ice melt timing, water temperatures, and the northward rate of transport of water masses, and nutrients and chlorophyll (Hopcroft *et al.,* 2011). Effects on benthic communities are nearly always restricted to a zone within about 328 to 492 ft (100 to 150 m) of the discharge, where cuttings accumulations are greatest.

Discharges and drill cuttings could impact fish by displacing them from the affected area. Additionally, sedimentation could impact fish, as demersal fish eggs could be smothered if discharges occur in a spawning area during the period of egg production. However, this is unlikely in deeper offshore locations, and no specific demersal fish spawning locations have been identified at the Devils Paw well locations. The most abundant and trophically important marine fish, the Arctic cod, spawns with planktonic eggs and larvae under the sea ice during winter and will therefore have little exposure to discharges. Based on this information, drilling muds and cutting wastes are not anticipated to have long-term impacts to marine mammals or their prey.

Potential Impacts From Drill Rig Presence

The horizontal dimensions of the jack-up rig will be approximately 230 x 225 ft (70 x 68 m). Maximum dimension of one leg spud can, which is the part on the seafloor, is about 60 ft (18 m). The dimensions of the drill rig (less than one football field on either side) are not significant enough to cause a large-scale diversion from the animals' normal swim and migratory paths. Additionally, the eastward spring bowhead whale migration will occur prior to the beginning of COP's proposed exploratory drilling program. Moreover, any deflection of bowhead whales or other marine mammal species due to the physical presence of the drillship or its support vessels would be very minor. The drill rig's physical footprint is small relative to the size of the geographic region it will occupy and will likely not cause marine mammals to deflect greatly from their typical migratory route. Also, even if animals may deflect because of the presence of the drill rig, the Chukchi Sea is much larger in size than the length of the drill rig (many dozens to hundreds of miles vs. less than one football field), and animals would have other means of passage around the drill rig. While there are other vessels that will be on location to support the drill rig, most of those vessels will remain within a 5.5 mi (9 km) of the drill rig (with the exception of the ice management vessels which will remain approximately 75 mi [121 km] from the drill rig when conducting ice reconnaissance). In sum, the physical presence of the drill rig is not likely to cause a significant deflection to migrating marine mammals.

Potential Impacts From an Oil Spill

Lower trophic organisms and fish species are primary food sources for Arctic marine mammals. However, as noted earlier in this document, the offshore areas of the Chukchi Sea are not primary feeding grounds for many of the marine mammals that may pass through the area. Therefore, impacts to lower trophic organisms (such as zooplankton) and marine fishes from an oil spill in the proposed drilling area would not be likely to have long-term or significant consequences to marine mammal prey. Impacts would be greater if the oil moves closer to shore, as many of the marine mammals in the area have been seen feeding at nearshore sites (such as bowhead and gray whales).

Due to their wide distribution, large numbers, and rapid rate of regeneration, the recovery of marine invertebrate populations is expected to occur soon after the surface oil passes. Spill response activities are not likely to disturb the prey items of whales or seals sufficiently to cause more than minor effects. Spill response activities could cause marine mammals to avoid the disturbed habitat that is being cleaned. However, by causing avoidance, animals would avoid impacts from the oil itself. Additionally, the likelihood of an oil spill is expected to be very low, as discussed earlier in this document.

Potential Impacts From Ice Management Activities

Ice management activities include the physical pushing or moving of ice to create more open-water in the proposed drilling area and to prevent ice floes from striking the drill rig. Based on extensive satellite data analyses of historic and present ice conditions in the northeastern Chukchi Sea, it is unlikely that hazardous ice will be present in the vicinity of the jack-up rig. COP therefore expects that physical management of ice will not be required. However, to ensure safe drilling operations, COP has developed an Ice Alerts Plan designed to form an integral part of the drilling operations. The Ice Alerts Plan contains procedures that will allow early predictions in advance of potential hazardous ice that could cause damage if it were to come into contact with the jack-up rig.

The first method of prevention is to identify the presence of hazardous ice at a large distance from the rig (tens of miles). The ice edge position will be tracked in near real time using observations from satellite images and from vessels. Generally, the ice management vessel will remain within 5.5 mi (9 km) of the drill rig, unless deployed to investigate migrating ice floes. When investigating ice, vessels will likely not travel farther than 75 mi (121 km) from the rig. The Ice Alerts Plan contains procedures for determining how close hazardous ice can approach before the well needs to be secured and the jack-up moved. This critical distance is a function of rig operations at that time, the speed and direction of the ice, the weather forecast, and the method of ice management.

Based on available historical and more recent ice data, there is low probability of ice entering the drilling area during the open-water season. However, if hazardous ice is on a trajectory to approach the rig, the ice management vessel will be available to respond. One option for responding is to use the vessel's fire monitor (water cannon) to modify the trajectory of the floe. Another option is to redirect the ice by applying pressure with the bow of the ice management vessel, slowly pushing the ice away from the direction of the drill rig. At these slow speeds, the vessel uses low power and slow propeller rotation speed, thereby reducing noise generation from propeller rotation effects in the water. In case the jack-up rig needs to be moved due to approaching ice, the support vessels will tow the rig to a secure location.

Ringed, bearded, spotted, and ribbon seals (along with the walrus) are dependent on sea ice for at least part of their life history. Sea ice is important for life functions such as resting, breeding, and molting. These species are dependent on two different types of ice: Pack ice and landfast ice. Should ice management activities be necessary during the proposed drilling program, COP would only manage pack ice. Landfast ice would not be present during COP's proposed operations.

The ringed seal is the most common pinniped species in the proposed project area. While ringed seals use ice year-round, they do not construct lairs for pupping until late winter/early spring on the landfast ice. Therefore, since COP plans to conclude drilling by October 31, COP's activities would not impact ringed seal lairs or habitat needed for breeding and pupping in the Chukchi Sea. Aerial surveys in the eastern Chukchi Sea conducted in late May-early June 1999–2000 found that ringed seals were four to ten times more abundant in nearshore fast and pack ice environments than in offshore pack ice (Bengtson *et al.,* 2005). Ringed seals can be found on the pack ice surface in the late spring and early summer in the northern Chukchi Sea, the latter part of which may overlap with the start of COP's proposed drilling activities. If an ice floe is pushed into one that contains hauled out seals, the animals may become startled and enter the water when the two ice floes collide.

Bearded seals breed in the Bering and Chukchi Seas from mid-March through early May (several months prior to the start of COP's operations). Bearded seals require sea ice for molting during the late spring and summer period. Because this species feeds on benthic prey, bearded seals occur over the pack ice front over the Chukchi Sea shelf in summer (Burns and Frost, 1979) but were not associated with the ice front when it receded over deep water (Kingsley *et al.,* 1985).

The spotted seal does not breed in the Chukchi Sea. Spotted seals molt most intensely during May and June and then move to the coast after the sea ice has melted. Ribbon seals are not known to breed in the Chukchi Sea. From July–October, when sea ice is absent, the ribbon seal is entirely pelagic, and its distribution is not well known (Burns, 1981; Popov, 1982). Therefore, ice used by bearded, spotted, and ribbon seals needed for life functions such as breeding and molting would not be impacted as a result of COP's drilling program since these life functions do not occur in the proposed project area or at the same time as COP's operations. For ringed seals, ice management activities would occur during a time when life functions such as breeding, pupping, and molting do not occur in the proposed activity area. Additionally, these life functions normally occur on landfast ice, which will not be impacted by COP's activity.

Based on the preceding discussion of potential types of impacts to marine mammal habitat, overall, the proposed specified activity is not expected to cause significant impacts on habitats used by the marine mammal species in the proposed project area or on the food sources that they utilize.

Proposed Mitigation

In order to issue an incidental take authorization (ITA) under Sections 101(a)(5)(A) and (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 certain subsistence uses (where relevant). This section summarizes the mitigation measures proposed for implementation by COP. Later in this document in the ''Proposed Incidental Harassment Authorization'' section, NMFS lays out the proposed conditions for review, as they would appear in the final IHA (if issued).

Exclusion radii for marine mammals around sound sources are customarily defined as the distances within which received sound levels are greater than or equal to 180 dB re 1 μPa (rms) for cetaceans and greater than or equal to 190 dB re 1 μPa (rms) for pinnipeds. These exclusion criteria are based on an assumption that sounds at lower received levels will not injure these animals or impair their hearing abilities, but that higher received levels might have such effects. It should be understood that marine mammals inside these exclusion zones will not necessarily be injured, as the received sound thresholds which determine these zones were established prior to the current understanding that significantly higher levels of sound would be required before injury would likely occur (see Southall *et al.,* 2007). With respect to Level B harassment, NMFS' practice has been to apply the 120 dB re 1 μPa (rms) received level threshold for underwater continuous sound levels and the 160 dB re 1 μPa (rms) received level threshold for underwater impulsive sound levels. As noted earlier in this document and in O'Neill *et al.* (2012), the source level of the drill rig does not meet the criteria requiring exclusion zones. Therefore, mitigation measures similar to those required for seismic surveys are not proposed for the drilling only portion of the program.

General Mitigation Measures

COP proposes to implement several mitigation measures regarding operation of vessels and aircraft. These measures would limit speed and vessel movements in the presence of marine mammals and restrict flight altitudes except during takeoff, landing, and in emergency situations. The exact measures (as proposed) can be found later in this document in the ''Proposed Incidental Harassment Authorization'' section.

VSP Airgun Mitigation Measures

COP proposes to implement standard mitigation measures used in previous seismic surveys, including ramp-ups, power downs, and shutdowns. The received sound levels have been estimated using an acoustic model (see Attachment A of COP's IHA application). These modeled distances will be used to establish exclusion zones for the implementation of the mitigation measures during the first VSP data acquisition run. The exclusion zones (i.e., 180 dB rms for cetaceans and 190 dB rms for pinnipeds) might change for subsequent VSP data acquisition runs after the distances have been verified based on acoustic field measures (more details are provided in the ''Proposed Monitoring and Reporting'' section later in this document). The VSP data acquisition runs will start during daylight hours.

A ramp up of an airgun array provides a gradual increase in sound levels and involves a step-wise increase in the number and total volume of airguns firing until the full volume is achieved. The purpose of a ramp up (or ''soft start'') is to ''warn'' cetaceans and pinnipeds in the vicinity of the airguns and to provide the time for them to leave the area and thus avoid any potential injury or impairment of their hearing abilities.

Ramp-up will begin with the smallest airgun in the array. COP intends to double the number of operating airguns at 1-min intervals. Since the airgun operation at each geophone station only lasts about 1 min, this interval should be adequate and also reduces the total emission of airgun sounds. During the ramp-up, observers will scan the exclusion zone for the full airgun array for presence of marine mammals.

The entire exclusion zone must be visible during the 30-minute lead-in to a full ramp up. If the entire exclusion zone is not visible, then ramp up from a cold start cannot begin. If a marine mammal(s) is sighted within the exclusion zone during the 30-minute watch prior to ramp up, ramp up will be delayed until the marine mammal(s) is sighted outside of the applicable exclusion zone or the animal(s) is not sighted for at least 15 minutes for small odontocetes and pinnipeds or 30 minutes for baleen whales. No ramp-up of airguns will be conducted between 1-min airgun operations at subsequent geophone stations (i.e., following the relocation of the geophone within the wellbore) if the duration of the relocation is 30 min or less, if the exclusion zone of the full array has been visible, and no marine mammals have been sighted within the applicable exclusion zones or during poor visibility or darkness if one airgun has been operating continuously during the geophone relocation period.

A power down is the immediate reduction in the number of operating energy sources from all firing to some smaller number. A shutdown is the immediate cessation of firing of all energy sources. The arrays will be immediately powered down whenever a marine mammal is sighted approaching close to or within the applicable exclusion zone of the full arrays but is outside the applicable exclusion zone of the single source. If a marine mammal is sighted within the applicable exclusion zone of the single energy source, the entire array will be shutdown (i.e., no sources firing). The same 15 and 30 minute sighting times described for ramp up also apply to starting the airguns again after either a power down or shutdown.

Oil Spill Response Plan

In accordance with BSEE regulations, COP has developed an Oil Spill Response Plan (OSRP) for its Chukchi Sea exploration drilling program. The OSRP is currently under review by DOI and will be shared with other agencies, including NOAA, for their review as well. A final determination on the adequacy of the COP's OSRP is expected prior to the start of drilling operations. In the unlikely event of a large or very large oil spill, COP would work with the Unified Command, including representatives of the local communities, to use methods that would mitigate impacts of a response on subsistence activities.

Proposed Mitigation Measure Conclusion

NMFS has carefully evaluated COP'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.

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)(D) 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.

Monitoring Measures Proposed by COP

The monitoring plan proposed by COP can be found in the Marine Mammal Monitoring and Mitigation Plan (4MP; Attachment B of COP's application; see **ADDRESSES**). The plan may be modified or supplemented based on comments or new information received from the public during the public comment period or from the peer review panel (see the ''Monitoring Plan Peer Review'' section later in this document). A summary of the primary components of the plan follows. Later in this document in the ''Proposed Incidental Harassment Authorization'' section, NMFS lays out the proposed monitoring and reporting conditions, as well as the mitigation conditions, for review, as they would appear in the final IHA (if issued).

(1) Visual Observers

The distances at which received sound levels occur that have the potential to cause Level B behavioral harassment (120 dB rms for continuous sounds) are 689 ft (210 m) for drilling only and about 5 mi (8 km) for drilling and support vessel activity (O'Neill *et al.,* 2011). Protected Species Observers (PSOs) at the drill rig will monitor this zone, using big eye binoculars, documenting presence and behavior of marine mammals during these activities. At least four PSOs will be located on the drill rig to collect marine mammal data during drilling and resupply operations. The PSOs will also collect data and implement mitigation measures during the VSP data acquisition runs. Two PSOs will be present on the ice management vessel, which will be on standby within 5.5 mi (9 km) of the drill rig, except when conducting ice reconnaissance.

Biologist-observers will have previous marine mammal observation experience, and field crew leaders will be highly experienced with previous vessel-based marine mammal monitoring projects. Resumes for those individuals will be provided to NMFS so that NMFS can review and accept their qualifications. Inupiat observers will be experienced in the region, familiar with the marine mammals of the area, and complete a NMFS approved observer training course designed to familiarize individuals with monitoring and data collection procedures. A handbook, adapted for the specifics of the planned COP drilling program, will be prepared and distributed beforehand to all PSOs.

PSOs will watch for marine mammals from the best available vantage point on the drillship and support vessels. PSOs will scan systematically with the unaided eye and 7 x 50 reticle binoculars, supplemented with ''Big-eye'' binoculars. Personnel on the bridge will assist the PSOs in watching for marine mammals.

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

• Species, group size, number of juveniles (where possible), behavior when first sighted and after initial sighting, heading (if consistent), bearing and distance from PSO, apparent reaction to activities, and pace;

• Time, location, vessel speed and activity (where applicable), sea state, ice cover, visibility, and sun glare;

• Positions of other vessels in the vicinity of the PSO location or the position and distance of the jack-up rig from the vessel, where applicable; and

• Ship's position and speed (for PSO on vessels) or the drill rig activity (i.e. drilling or not, for PSOs on the drill rig), water depth, sea state, ice cover, visibility, and sun glare during the watch.

During helicopter transfers to and from the drill rig, PSOs will observe and record marine mammal sightings according to a standardized protocol.

PSOs may use a laser rangefinder to test and improve their abilities for visually estimating distances to objects in the water. However, previous experience showed that a Class 1 eye-safe device was not able to measure distances to seals more than about 230 ft (70 m) away. The device was very useful in improving the distance estimation abilities of the observers at distances up to about 1968 ft (600 m)—the maximum range at which the device could measure distances to highly reflective objects such as other vessels. Humans observing objects of more-or-less known size via a standard observation protocol, in this case from a standard height above water, quickly become able to estimate distances within about ±20% when given immediate feedback about actual distances during training.

(2) Acoustic Monitoring

Sound levels from drilling activities and vessels are expected to vary significantly with time due to variations in the operations and the different types of equipment used at different times onboard the drill rig. The goals of the project-specific acoustic monitoring program are to (1) Quantify the absolute sound levels produced by drilling and to monitor their variations with time, distance and direction from the drill rig; (2) measure the sound levels produced by vessels operating in support of drilling operations; (3) measure sounds from VSP data acquisition runs; and (4) detect vocalization of marine mammals. To accomplish these goals, implementation of autonomous monitoring using bottom-founded acoustic recorders is proposed during exploration drilling.

COP proposes that monitoring of sound levels from drilling and vessel activities, as well as from the VSP airguns, will occur on a continuous basis throughout the entire drilling season with a set of bottom-founded acoustic recorders. At least four recorders will be deployed on the seafloor at distances of approximately 0.31 mi (0.5 km), 0.62 mi (1 km), 2.5 mi (4 km), and 6.2 mi (10 km) from the drill rig. The bottom-founded recorders will be set to record at a sample rate of 16 or 32 kilohertz (kHz), providing useful acoustic bandwidth to 8 or 16 kHz. Calibrated reference hydrophones will be used for the measurements, capable of measuring absolute broadband sound levels between 90 and 200 dB re μPa rms. The deployment of the bottom-founded acoustic monitoring equipment will occur just prior to placement of the drill rig at the location(s) where COP intends to drill an exploration well.

After the first VSP data acquisition run, the recorders will be retrieved and the data downloaded. Recorders will then be deployed again and will remain in place until completion of all drilling activities. The three main objectives of the bottom-founded autonomous hydrophones are: (1) Provide long duration recordings capturing sound levels of all operations performed at the drill rig and of all vessel movements in the vicinity through post-season analyses; (2) calculate source levels, and distances to sound levels of 160 dB and 120 dB re 1μPa rms from drilling activities and vessels supporting the drill rig and distances to 160 dB from VSP airgun sounds; and (3) record marine mammal vocalizations during the drilling season to be compared with visual observations during post-season analyses.

Additional details on data analysis for the types of monitoring described here (i.e., visual PSO and acoustic) can be found in the 4MP in COP's application (see **ADDRESSES**).

Monitoring Plan Peer Review

The MMPA requires that monitoring plans be independently peer reviewed ''where the proposed activity may affect the availability of a species or stock for taking for subsistence uses'' (16 U.S.C. 1371(a)(5)(D)(ii)(III)). Regarding this requirement, NMFS' implementing regulations state, ''Upon receipt of a complete monitoring plan, and at its discretion, [NMFS] will either submit the plan to members of a peer review panel for review or within 60 days of receipt of the proposed monitoring plan, schedule a workshop to review the plan'' (50 CFR 216.108(d)).

NMFS convened an independent peer review panel, comprised of experts in the fields of marine mammal ecology and underwater acoustics, to review COP's 4MP for Offshore Exploration Drilling in the Devils Paw Prospect, Chukchi Sea, Alaska. The panel met on January 8–9, 2013. NMFS anticipates receipt of the panel's report containing their recommendations on the 4MP shortly. NMFS will consider all recommendations made by the panel, incorporate appropriate changes into the monitoring requirements of the IHA (if issued), and publish the panel's findings and recommendations in the final IHA notice of issuance or denial document.

Reporting Measures

(1) Sound Source Verification and Characterization Report

COP will be required to submit a report of the acoustic monitoring results noting the source levels and received levels (in 10 dB increments down to 120 dB) from the jack-up rig, support vessels (also while in DP mode), and of the VSP airgun array. Additional information to be reported is contained in COP's 4MP. Initial measurements must be provided to NMFS within 120 hr of collection and analysis of those data. This report will specify the distances of the exclusion zones that were adopted for the VSP data acquisition runs. Prior to completion of these measurements, COP will use the radii outlined in their application and elsewhere in this document.

(2) Technical Reports

The results of COP's 2014 Chukchi Sea exploratory drilling monitoring program (i.e., vessel-based, aerial, and acoustic) will be presented in the ''90-day'' and Final Technical reports, as required by NMFS under the proposed IHA. COP proposes that the Technical Reports will include: (1) Summaries of monitoring effort (e.g., total hours of effort for rig-based observations or observations from the ice management vessel when stationary and total kilometer of effort for non-stationary vessel-based observations); (2) effective area of observation and marine mammal distribution through study period (accounting for sea state and other factors affecting visibility and detectability of marine mammals); (3) analyses of the effects of various factors influencing detectability of marine mammals (e.g., sea state, number of observers, and fog/glare); (4) species composition, occurrence, and distribution of marine mammal sightings, including date, numbers, age/size/gender categories (if determinable), group sizes, and ice cover; (5) sighting rates of marine mammals during periods with and without drilling activities (and other variables that could affect detectability); (6) initial sighting distances and closest point of approach versus drilling state; (7) observed behaviors and types of movements versus drilling state; (8) numbers of sightings/individuals seen versus drilling state; (9) distribution around the drill rig and support vessels versus drilling state; and (10) estimates of take by harassment.

The initial technical report is due to NMFS within 90 days of the completion of COP's Chukchi Sea exploratory drilling program. The ''90-day'' report will be subject to review and comment by NMFS. Any recommendations made by NMFS must be addressed in the final report prior to acceptance by NMFS.

(3) Notification of Injured or Dead Marine Mammals

COP will be required to notify NMFS' Office of Protected Resources and NMFS' Stranding Network of any sighting of an injured or dead marine mammal. Based on different circumstances, COP may or may not be required to stop operations upon such a sighting. COP will provide NMFS with the species or description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available). The specific language describing what COP must do upon sighting a dead or injured marine mammal can be found in the ''Proposed Incidental Harassment Authorization'' section of this document.

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 behavioral harassment is anticipated as a result of the proposed drilling program. Noise propagation from the drill rig, associated support vessels in DP mode, and the airgun array are expected to harass, through behavioral disturbance, affected marine mammal species or stocks. Additional disturbance to marine mammals may result from aircraft overflights and visual disturbance of the drill rig or support vessels. However, based on the flight paths and altitude, impacts from aircraft operations are anticipated to be localized and minimal in nature.

The full suite of potential impacts to marine mammals from various industrial activities was described in detail in the ''Potential Effects of the Specified Activity on Marine Mammals'' section found earlier in this document. The potential effects of sound from the proposed exploratory drilling program might include one or more of the following: tolerance; masking of natural sounds; behavioral disturbance; non-auditory physical effects; and, at least in theory, temporary or permanent hearing impairment (Richardson *et al.,* 1995b).

As discussed earlier in this document, NMFS estimates that COP's activities will most likely result in behavioral disturbance, including avoidance of the ensonified area or changes in speed, direction, and/or diving profile of one or more marine mammals. For reasons discussed previously in this document, hearing impairment (TTS and PTS) is highly unlikely to occur based on the fact that most of the equipment to be used during COP's proposed drilling program does not have source levels high enough to elicit even mild TTS and/or the fact that certain species are expected to avoid the ensonified areas close to the operations. Additionally, non-auditory physiological effects are anticipated to be minor, if any would occur at all. Finally, based on the proposed mitigation and monitoring measures described earlier in this document and the fact that the source level for the drill rig is estimated to be below 170 dB re 1 μPa (rms), no injury or mortality of marine mammals is anticipated as a result of COP's proposed exploratory drilling program.

For continuous sounds, such as those produced by drilling operations and during DP, NMFS uses a received level of 120-dB (rms) to indicate the onset of Level B harassment. For impulsive sounds, such as those produced by the airgun array during the VSP surveys, NMFS uses a received level of 160-dB (rms) to indicate the onset of Level B harassment. COP provided calculations for the 120-dB isopleths produced by the jack-up rig and the support vessels in DP and then used those isopleths to estimate takes by harassment. Additionally, COP provided calculations for the 160-dB isopleth produced by the airgun array and then used that isopleth to estimate takes by harassment. COP provides a full description of the methodology used to estimate takes by harassment in its IHA application (see **ADDRESSES**), which is also provided in the following sections.

COP has requested authorization to take bowhead, gray, fin, humpback, minke, killer, and beluga whales, harbor porpoise, and ringed, spotted, bearded, and ribbon seals incidental to exploration drilling, support vessels operating in DP mode, ice management, and VSP activities.

COP's density estimates are based on the best available peer reviewed scientific data, when available. In cases where the best available data were collected in regions, habitats, or seasons that differ from the proposed survey activities, adjustments to reported population or density estimates were made to account for these differences insofar as possible. In cases where the best available peer reviewed data were based on data from more than a decade old, more recent information was used. Species abundance information in the northeastern Chukchi Sea from the 2008–2010 COMIDA (now referred to as ASAMM) marine mammal aerial surveys (Clarke and Ferguson, 2010; Clarke *et al.,* 2011) and the 2008–2010 vessel-based Chukchi Sea Environmental Studies Program (CSESP; Aerts *et al.,* 2011) contain current knowledge of some whale and seal species. The data from the COMIDA aerial survey have undergone several reviews, so although not officially peer reviewed, these recent abundance and distribution data were determined to be more representative than older peer reviewed publications for bowhead and gray whales. The CSESP data are as of yet preliminary so are presently only used as a comparison to available peer reviewed data, unless no other information was available. In those cases the CSESP data were used to estimate densities. After reviewing the density estimates, NMFS determined that the data used are appropriate.

Because most cetacean species show a distinct seasonal distribution, density estimates for the northeastern Chukchi Sea have been derived for two time periods: the summer period (covering July and August) and the fall period (covering September and October). Animal densities encountered in the Chukchi Sea during both of these time periods will further depend on the presence of ice. However, if ice is present close to the project area, drilling operations will not start or will be halted, so cetacean densities related to ice conditions are not included in COP's IHA application. Pinniped species in the Chukchi Sea do not show a distinct seasonal distribution during the period July–October (Aerts *et al.,* 2011) and as such density estimates derived for seal species are used for both the summer and fall periods.

Some sources from which densities were used include correction factors to account for perception and availability bias in the reported densities. Perception bias is associated with diminishing probability of sighting with increasing lateral distance from the trackline, where an animal is present at the surface but could be missed. Availability bias refers to the fact that the animal might be present but is not available at the surface. In cases where correction factors were not included in the reported densities, the best available correction factors were applied.

To account for variability in marine mammal presence, COP derived maximum density estimates were in addition to average density estimates. Except where specifically noted, the maximum estimates have been calculated as double the average estimates. COP determined that this factor was large enough to allow for chance encounters with unexpected large groups of animals or for overall higher densities than expected. Table 8 in COP's IHA application indicates that the ''average estimate'' for humpback, fin, minke, and killer whales is either zero or one. Additionally, Table 8 in the application indicates that the ''average estimate'' for harbor porpoise and beluga whales is low. Therefore, to account for the fact that these species listed as being potentially taken by harassment in this document may occur in COP's proposed drilling sites during active operations, NMFS either used the ''maximum estimates'' or made an estimate based on typical group size for a particular species.

Estimated densities of marine mammals in the Chukchi Sea project area during the summer (July–August) and fall (September–October) periods are presented in Table 4 in COP's application and Table 1 here. Descriptions of the individual density estimates shown in the tables are presented next.

Cetacean Densities

Eight cetacean species are known to occur in the northeastern Chukchi Sea. Of these, bowhead, beluga, gray, and killer whales and harbor porpoise are likely to be encountered in the proposed project area. Fin, humpback, and minke whales may occur but likely in lower numbers than the other cetacean species.

(1) Beluga Whales

Summer densities of belugas in offshore waters of the Chukchi Sea are expected to be low, with higher densities at the ice-margin and in nearshore areas. Aerial surveys have recorded few belugas in the offshore Chukchi Sea during the summer months (Moore *et al.,* 2000b). COMIDA aerial surveys flown in 2008, 2009, and 2010 reported a total of 733 beluga sightings during >32,202 mi (51,824 km) of on-transect effort, resulting in 0.0141 beluga whales per km (Clarke *et al.,* 2011). Belugas were seen every month except September, with most sightings in July.

There was one sighting of nearly 300 belugas nearshore between Wainwright and Icy Cape in 2009, and several hundred belugas were sighted in Elson Lagoon, east of Pt. Barrow in 2010. Group size ranged from 1 to 480 individuals. Highest sighting rate per depth zone was in shallow water (≤ 115 ft [35 m] depth), which was likely due to the large groups described above. No beluga whales were sighted during the 2008–2010 vessel-based marine mammal CSESP surveys that covered the Devils Paw prospect and two other lease areas in the northeastern Chukchi Sea (Brueggeman *et al.,* 2009b, 2010; Aerts *et al.,* 2011). Some beluga vocalizations were detected in October 2009 around Barrow and in the Burger lease area by acoustic recorders deployed as part of the CSESP program, but none in the Devils Paw prospect (Delarue *et al.,* 2011). Also, no beluga sightings were reported during >11,185 mi (18,000 km) of vessel-based effort in good visibility conditions during 2006–2008 industry operations in the northeastern Chukchi Sea (Haley *et al.,* 2010).

The COMIDA aerial survey summer and fall data (Clarke *et al.,* 2011) were used to calculate expected average densities in the Devils Paw prospect. Because the reported densities (Whales Per Unit Effort) are not corrected for perception or availability bias, a f(0) value of 2.841 and g(0) value of 0.58 from Harwood *et al.* (1996) were applied to arrive at estimated corrected densities, using the equation from Buckland *et al.* (2001). In the months July and August, two on-transect beluga sightings of five animals were observed in water depths of 118–164 ft (36–50 m) along 7,447 mi (11,985 km) line transect. After applying the correction factors mentioned above, this resulted in a density of 0.0010 whales/km^2 (Table 4 in COP's application and Table 1 here). The three on-transect beluga sightings of six animals recorded in the period September–October along 6,236 mi (10,036 km) effort resulted in a corrected density of 0.0015 whales/km^2.

The absence of any beluga sightings during the 2008–2010 CSESP marine mammal research (Brueggeman *et al.,* 2009b, 2010; Aerts *et al.,* 2011), the 2006–2008 industry programs (Haley *et al.,* 2010), and the low number of acoustic detections in the vicinity of the project area (Delarue *et al.,* 2011), are consistent with the relative low summer and fall densities in water depths of 118–164 ft (36–50 m) as calculated with the COMIDA aerial survey data.

(2) Bowhead Whales

Most bowhead whales that will be observed in the northeastern Chukchi Sea are either migrating north to feeding grounds in the eastern Beaufort Sea during spring (prior to the start of COP's proposed activities), or migrating south to their wintering grounds in the Bering Sea during the fall. By July, most bowhead whales have passed Point Barrow, although some have been visually and acoustically detected during the entire summer in low numbers in the northeastern Chukchi Sea (Moore *et al.,* 2010; Thomas *et al.,* 2010; Quakenbush *et al.,* 2010; Clarke and Ferguson, in prep.). Bowheads are more widely scattered in the northeastern Chukchi Sea during the fall migration but generally keep an offshore route. During aerial surveys in the COMIDA area from 1982–1991 and 2008–2010, a total of 88 on-effort sightings of 121 bowhead whales were observed. Bowhead whales were seen in all months from June to October, with the greatest number of sightings occurring in October (Clarke *et al.,* 2011; Clarke and Ferguson, in prep.). Similarly, bowhead whales were sighted in July–August during nearshore aerial surveys conducted in 2006–2008 in the northeastern Chukchi Sea but with increasing number of sightings in September and October (Thomas *et al.,* 2010). Vessel-based CSESP marine mammal surveys conducted in Devils Paw prospect and two other lease areas in the northeastern Chukchi Sea recorded a total of 40 sightings of 59 animals during 2008–2010 with all but one sighting in October (Brueggeman *et al.,* 2009, 2010; Aerts *et al.,* 2011).

The estimate of summer and fall bowhead whale density in the Chukchi Sea was calculated using the 2008–2010 COMIDA aerial survey data (Clarke and Ferguson, in prep.). No bowhead whales were sighted during the 7,447 mi (11,985 km) of survey effort in waters of 118–164 ft (36–50 m) during July–August. However, for density estimates in this IHA, COP assumed there was one sighting of one bowhead. To improve the understanding of what factors significantly affect bowhead whale detections from aerial surveys, a distance detection function was estimated using 25 years of aerial line transect surveys in the Bering, Chukchi and Beaufort Seas (Givens *et al.,* 2010). Because the correction factor from this study is lower than the estimates by Thomas *et al.* (2002), COP used the higher values to estimate densities for the purpose of this IHA. When applying a f(0) value of 2 and a g(0) value of 0.07 from Thomas *et al.* (2002), the summer density was estimated to be 0.0012 whales/km^2 (Table 4 in COP's application and Table 1 here). Clarke and Ferguson (in prep.) reported 14 sightings of 15 individuals during 6,236 mi (10,036 km) of on transect aerial survey effort in September and October 2008–2010. Applying the same f(0) and g(0) values as for the summer density estimate, the bowhead density estimate for the fall is 0.0214 whales/km^2 (Table 4 in COP's application and Table 1 here). A total of 36 on-transect sightings of 55 bowheads were observed along 8,169 mi (13,146 km) transect effort during the vessel-based CSESP marine mammal surveys in September and October. Applying the same correction factors as above resulted in a corrected bowhead density of 0.0598 whales/km^2. This high density coincided with a peak in whale migration the first week of October, which was also apparent on the acoustic records (Delarue *et al.,* 2011). Although none of these sightings were in the Devils Paw prospect, the maximum fall bowhead density estimate has been calculated as triple the average estimates, to cover for such migration peaks.

(3) Gray Whales

Gray whale densities are expected to be highest in nearshore areas during the summer months with decreasing numbers in the fall. Moore *et al.* (2000b) reported a scattered distribution of gray whales generally limited to nearshore areas where most whales were observed in water less than 115 ft (35 m) deep. Nearshore aerial surveys along the Chukchi coast also reported substantial declines in the sighting rates of gray whales in the fall (Thomas *et al.,* 2010). The average open-water summer and fall densities presented in Table 4 in COP's application and Table 1 here were calculated from the 2008–2010 COMIDA aerial survey data (Clarke and Ferguson, in prep.). The summer data for water depths 118–164 ft (36–50 m) included 54 sightings of 73 individuals during 7,447 mi (11,985 km) of on-transect effort. Applying the correction factors f(0) = 2.49 and g(0) = 0.95 (Forney and Barlow, 1998 Table 1, based on aerial survey data) resulted in a summer density of 0.0080 whales/km^2 (Table 4 in COP's application and Table 1 here). The number of gray whale sightings in the offshore study areas during the 2008–2010 CSESP marine mammal survey were limited in July and August; eight sightings of nine animals along 4,223 mi (6,796 km) on-transect effort. Most of these animals were observed nearshore of Wainwright (Brueggeman *et al.,* 2009, 2010; Aerts *et al.,* 2011) and only two sightings of three animals were recorded in the Devils Paw Prospect. Densities from vessel based surveys in the Chukchi Sea during non-seismic periods and locations in July and August of 2006–2008 (Haley *et al.,* 2010) ranged from 0.0021 to 0.0080 whales/km^2 with a maximum 95 percent CI of 0.0336.

In the fall, gray whales may be dispersed more widely through the northern Chukchi Sea (Moore *et al.,* 2000b; Clarke and Ferguson, in prep.), but overall densities are likely to be decreasing as the whales begin migrating south. The average fall density was calculated from 15 sightings of 19 individuals during 6,236 mi (10,036 km) of on-transect effort in water 118–164 ft (36–50 m) deep during September and October (Clarke and Ferguson, in prep.). Applying the same f(0) and g(0) values as for the summer density, resulted in 0.0025 whales/km² (Table 4 in COP's application and Table 1 here). During the CSESP survey in September and October, 25 gray whale sightings of 36 individuals were observed along 8,169 mi (13,146 km) of on-transect effort, resulting in an uncorrected density of 0.0027 whales/km². Most of these whales were, however, observed nearshore of Wainwright (within 31 mi [50 km] from the coast) and none in the Devils Paw Prospect. Densities from vessel based surveys in the Chukchi Sea during non-seismic periods and locations in July and August of 2006–2008 (Haley *et al.,* 2010) ranged from 0.0026 to 0.0042 whales/km² with a maximum 95% CI of 0.0277.

(4) Harbor Porpoise

Distribution and abundance data of harbor porpoise were very limited prior to 2006, and presence of the harbor porpoise was expected to be very low in the northeastern Chukchi Sea.

Starting in 2006, several vessel-based marine mammal observer programs took place in the northeastern Chukchi Sea as part of seismic and shallow hazard survey monitoring and mitigation plans (Haley *et al.,* 2010). During these surveys, 37 sightings of 61 harbor porpoises were reported. Three on-transect sightings of seven harbor porpoises were observed in the Devils Paw prospect in July and August along 4,223 mi (6,796 km) of on-transect effort during the CSESP marine mammal surveys. No harbor porpoises were observed in the fall (Brueggeman *et al.,* 2009, 2010; Aerts *et al.,* 2011). COP used the 2008–2010 CSESP data to calculate densities for the purpose of this IHA. The uncorrected average density for the summer based on the three year CSESP data is 0.0010 porpoises/km² (Table 4 in COP's application and Table 1 here). As a comparison, summer density estimates from 2006–2008 marine mammal monitoring and mitigation programs during non-seismic periods ranged from 0.0008 to 0.0015 animals/km² with a maximum 95 percent CI of 0.0079 animals/km² (Haley *et al.,* 2010).

Assuming that one sighting of one animal would have been observed along 8,169 mi (13,146 km) transect effort during the 2008–2010 CSESP surveys in the fall, the average uncorrected fall density is 0.0001 porpoises/km² (Table 4 in COP's application and Table 1 here). Harbor porpoise densities recorded during non-seismic periods in the fall months of 2006–2008 ranged from 0.0002 to 0.0011 animals/km² with a maximum 95 percent CI of 0.0093 animals/km². The maximum value of 0.0011 animals/km² from these surveys was used as the maximum fall density estimate for this IHA (Table 4 in COP's application and Table 1 here).

(5) Other Cetaceans

The remaining cetacean species that could be encountered in the Chukchi Sea during COP's planned activities include the humpback, fin, minke, and killer whales. The northeastern Chukchi Sea is at the northern edge of the known distribution range of most of these animals, although in recent years several sightings of some of these cetaceans were recorded in the area. During the 2008–2010 marine mammal aerial surveys in the COMIDA area, one humpback and one fin whale were observed, but none were observed in 1982–1991 in the same area (Clarke *et al.,* 2011). Two sightings of four fin whales were recorded in 2008 in the northeastern Chukchi Sea during 2006–2008 marine mammal monitoring programs from seismic and shallow hazard survey vessels (Haley *et al.,* 2010). During the vessel-based 2008–2010 CSESP marine mammal surveys, two killer whale pods of 9 individuals were observed in the Devils Paw prospect and also one minke whale (Brueggeman *et al.,* 2009, 2010; Aerts *et al.,* 2011). Although there is evidence of the occurrence of these animals in the Chukchi Sea, it is unlikely that more than a few individuals will be encountered during the proposed activities. The expected average densities of these species for the purpose of this IHA are therefore estimated at 0.0001 animal/km². The maximum density estimates have been calculated as quadruple the average estimates to account for the increasing trend in number of observations during recent years (Table 4 in COP's application and Table 1 here).

Pinniped Densities

Four species of pinnipeds under NMFS jurisdiction occur in the Chukchi Sea during COP's proposed activities of which three are most likely to be encountered: ringed seal, bearded seal, and spotted seal. Each of these species is associated with presence of ice and the nearshore area. For ringed and bearded seals the ice margin is considered preferred habitat during most seasons (as compared to the nearshore areas). Spotted seals are considered to be predominantly a coastal species except in the spring when they may be found in the southern margin of the retreating sea ice. Satellite tagging studies have shown that spotted seals sometimes undertake long excursions into offshore waters during summer (Lowry *et al.,* 1994, 1998). Ribbon seals were observed during the vessel-based CSESP surveys in 2008, when ice was present in the area (Brueggeman *et al.,* 2009), and they were also reported in very small numbers within the northeastern Chukchi Sea by observers on industry vessels (Haley *et al.,* 2010).

TABLE 1—ESTIMATED DENSITIES OF CETACEANS AND PINNIPEDS IN THE NORTHEASTERN CHUKCHI SEA EXPECTED DURING THE PROPOSED DRILLING OPERATIONS IN THE DEVILS PAW PROSPECT DURING THE 2014 OPEN-WATER SEASON

Density in numbers per square km	July/August		September/October	
	Avg	Max	Avg	Max
Beluga whale	0.0010	0.0020	0.0015	0.0030
Killer whale	0.0001	0.0004	0.0001	0.0004
Harbor porpoise	0.0010	0.0020	0.0001	0.0011
Bowhead whale	*0.0012*	*0.0024*	*0.0214*	*0.0641*
Gray whale	0.0080	0.0160	0.0025	0.0050
Humpback whale	*0.0001*	*0.0004*	*0.0001*	*0.0004*
Fin whale	*0.0001*	*0.0004*	*0.0001*	*0.0004*
Minke whale	0.0001	0.0004	0.0001	0.0004

TABLE 1—ESTIMATED DENSITIES OF CETACEANS AND PINNIPEDS IN THE NORTHEASTERN CHUKCHI SEA EXPECTED DURING THE PROPOSED DRILLING OPERATIONS IN THE DEVILS PAW PROSPECT DURING THE 2014 OPEN-WATER SEASON—Continued

Density in numbers per square km	July/August		September/October	
	Avg	Max	Avg	Max
Bearded seal	0.0135	0.0248	0.0135	0.0248
Ringed seal	0.0516	0.1256	0.0516	0.1256
Spotted seal	0.0244	0.0355	0.0244	0.0355
Ribbon seal	0.0020	0.0060	0.0020	0.0060

Note: Species listed under the U.S. ESA as Endangered are in italics.

TABLE 2—MODELED DISTANCES TO RECEIVED SOUND PRESSURE LEVEL CRITERIA USED BY NMFS FOR THE RELEVANT SOUND SOURCES OF THE PROPOSED PROJECT AND THE AREAS USED TO ESTIMATE THE NUMBER OF POTENTIAL TAKES BY HARASSMENT

Sound source	Received SPL (dB re 1 μPa)	Modeled distance (km)	Area (km^2) used *
Continuous sound source			
Drilling	160 db	<0.01	
	120 dB	0.21	
Support vessel in dynamic positioning	160 dB	0.71	
	120 dB	7.90	201
Ice management	160 dB	0.71	
	120 dB	7.90	201
Pulsed sound source			
VSP airguns	190 dB	0.16	
	180 dB	0.92	
	160 dB	4.90	78.5
	120 dB	** 71.0	

* *Areas ensonified with continuous sound levels of 120 dB and pulsed sound levels of 160 dB displayed in this column were used to estimate the number of marine mammals potentially exposed to these levels (see Section 6.2.1).—means not applicable*

** *Contours of 120 dB re 1 μPa for airgun sounds extended beyond the modeling area and as such the distance shown is based on extrapolation of the data and therefore uncertain.*

Aerial survey data from Bengston *et al.* (2005) were initially used for bearded and ringed seal densities. However, because these surveys were conducted in the spring during the seal basking season, the reported densities might not be applicable for the open-water summer and fall period. Therefore, the 2008–2010 CSESP vessel-based marine mammal survey data were used to calculate seal densities. The densities for spotted and ribbon seals were also based on the 2008–2010 CSESP marine mammal survey data (Aerts *et al.,* 2011). Perception bias was accounted for in the CSESP densities, but the number of animals missed because they were not available for detection was not taken into account. The assumption was made that all animals available at distance zero from the observer, this is on the transect line, were detected [g(0)=1]. The amount of animals missed due to perception bias was calculated using distance sampling methodology (Buckland *et al.,* 2001; Buckland *et al.,* 2004). Program Distance 6.1 release 1 (Thomas *et al.,* 2010) was used to analyze effects of distance and environmental factors (e.g., sea state, visibility) on the probability of detecting marine mammal species.

During the CSESP studies, a relatively large percentage of seal sightings were classified as ringed/spotted seals (meaning it was either a spotted or a ringed seal) and unidentified seals (meaning it could be any of the four seal species observed). These sightings had to be taken into account to avoid an underestimation of densities for each separate seal species. The ratio of ringed versus spotted seal densities for each study area and year was used to estimate the proportional density of each of these two species from the combined ringed/spotted seal densities. This estimated proportional density was then added to the observed densities. The same method was used to proportionally divide the unidentified seal sightings over spotted, ringed, and bearded seal sightings. Applying the ratio of identified seal species to the unidentified individuals assumes that the disability of identification is similar for each species. Considering the conditions of these occurrences (animals either far away or only at the surface for a very brief moment), this is likely to be true. The above described adjustment increased densities for each species but did not change observed trends in occurrence.

(1) Bearded Seals

Densities from 1999–2000 spring surveys in the offshore pack ice zone (zone 12P) of the northern Chukchi Sea (Bengtson *et al.,* 2005) were initially consulted for bearded seal average and maximum summer densities. A correction factor for bearded seal availability bias, based on haul out and diving patterns was not available and therefore not included in the reported densities. Average density of bearded seals on the offshore pack ice in zone 12P was 0.018 seals/km^2, with a maximum density of 0.027 seals/km^2 (Bengston *et al.,* 2005). During the 2008–2010 CSESP marine mammal survey, bearded seal density in the Devils Paw prospect from July-October was 0.025 seals/km^2 in 2008, 0.004 seals/km^2 in 2009, and 0.011 seals/km^2 in 2010 (Aerts *et al.,* 2011). The average density over these three years was 0.014 seals/km^2, and the maximum density was 0.025 seals/km^2. The average density of the CSESP surveys is about 30% lower than reported by Bengston *et al.* (2005) and the maximum CSESP densities about 10% lower. It was decided to use the CSESP average and maximum densities data as these were gathered in the area of operation during the same season as the proposed operations (Table 4 in COP's application and Table 1 here).

(2) Ringed Seals

Ringed seal average and maximum summer densities were also calculated from the 1999–2000 spring aerial survey data in the offshore pack ice zone (zone 12P) of the northern Chukchi Sea (Bengtson *et al.,* 2005). Ringed seal availability bias, g(0), based on haul out and diving patterns was used in the reported densities. Average density of ringed seals on the offshore pack ice in zone 12P was 0.052 seals/km^2 and the maximum density 0.81 seals/km^2 (Bengston *et al.,* 2005). During the 2008–2010 CSESP marine mammal survey, ringed seal density in the Devils Paw prospect from July-October was 0.126 seals/km^2 in 2008, 0.018 seals/km^2 in 2009, and 0.012 seals/km^2 in 2010 (Aerts *et al.,* 2011). The average density over these 3 years was 0.052 seals/km^2 and the maximum density 0.126 seals/km^2. The average density of the CSESP surveys is very similar to that reported by Bengston *et al.* (2005), but the maximum CSESP density was about 6 times lower. As with the bearded seal density, it was decided to use the CSESP average and maximum densities data as these were gathered in the area of operation during the same season as the proposed operations (Table 4 in COP's application and Table 1 here). The maximum density was obtained in a year when ice was present in the area.

(3) Spotted Seals

Little information is available on spotted seal densities in offshore areas of the Chukchi Sea. Spotted seal densities were calculated based on the data collected during the CSESP marine mammal survey (Aerts *et al.,* 2011). Spotted seal density in the Devils Paw prospect from July–October was 0.036 seals/km^2 in 2008, 0.019 seals/km^2 in 2009, and 0.018 seals/km^2 in 2010 (Aerts *et al.,* 2011). The average density over these three years was 0.024 seals/km^2 and the maximum density 0.036 seals/km^2 (Table 4 in COP's application and Table 1 here).

(4) Ribbon Seals

Four ribbon seal sightings of four individuals were recorded in the Devils Paw prospect during the CSESP survey from July-October 2008 (Brueggeman *et al.,* 2009). No ribbon seals were sighted in 2009 and 2010 (Brueggeman *et al.,* 2010; Aerts *et al.,* 2011). Density calculated from this limited number of sightings in 2008 was 0.006 seals/km^2. The average and maximum densities were 0.002 seals/km^2 and 0.006 seals/km^2, respectively. Note that the 2008 density calculated for this IHA had, as expected, an extremely large coefficient of variation due to the limited number of sightings.

Estimated Area Exposed to Sounds >120 dB or >160 dB re 1 μPa rms

An acoustic propagation model (i.e. JASCO's Marine Operations Noise Model) was used to estimate distances to received rms SPLs of 190, 180, 160, and 120 dB re 1μPa from the drill rig, support vessel on DP alongside the drill rig, and from the VSP airguns. The distances to reach received sound levels of 120 dB re 1 μPa (for continuous sound sources, such as drilling activities, support vessels, and ice management) and 160 dB re 1 μPa (for pulsed sound sources, such as the VSP airguns) are used to calculate the potential numbers of marine mammals potentially harassed by the proposed activities. The distances to received levels of 180 dB and 190 dB re 1 μPa (rms) will be used to establish exclusion zones for mitigation purposes (see the ''Proposed Mitigation'' section earlier in this document). Three scenarios were considered for modeling:

1. Jack-up rig performing drilling operations (without support vessels);
2. Jack-up rig performing drilling operations with the support vessel alongside in DP mode, i.e., maintaining position using thrusters; and
3. 760 in^3 ITAGA airgun array operating at the drill site as representative for VSP data acquisition runs.

The results of these model runs are shown in the report ''Acoustic Modeling of Underwater Noise from Drilling Operations at the Devils Paw prospect in the Chukchi Sea'' (Attachment A of COP's application) and are summarized in Table 5 of COP's application and Table 2 here.

The ice management vessel is part of an ice alerts system and available to assist operations by conducting ice reconnaissance trips and protecting the rig from potential ice hazards if necessary. COP does not expect physical management of ice to be necessary during the open-water season and does not intend to engage in icebreaking. If ice floes are determined to require a managed response to protect the drill rig, the use of fire monitors (water cannons) or the vessel itself to modify ice floe trajectory is the most likely response. As summarized earlier in this document, an SPL of about 193 dB re 1μPa at 1 m was estimated to be a reasonable peak value for ice management vessels during different sea ice conditions and modes of propulsion level (Roth and Schmidt, 2010). Sound levels generated during physical management of ice are not expected to be as intense as during icebreaking activities described in most literature. Instead of actually breaking ice, the vessel will redirect and reposition the ice with slow movements, pushing it away from the direction of the drill rig at slow speeds so that the ice floe does not form any hazard to the drilling operations. At these slow speeds the vessel uses low power, with slow propeller rotation speed, thereby reducing noise generation from propeller rotation effects in the water. For the purpose of estimating the number of marine mammals potentially eliciting behavioral responses, COP assumed that the distance to received sound pressure levels of 120 dB re 1μPa from physical ice management is similar to that modeled for the support vessel on DP, i.e. 4.9 mi (7.9 km). This is considered to be an overestimation, since source levels from the proposed physical management of ice are expected to be much lower than the 204 dB re 1μPa used for the support vessel and also lower than the 193 dB re 1μPa reported for icebreaking activities.

Potential Number of Takes by Harassment

Although a marine mammal may be exposed to drilling, DP, or ice management sounds ≥120 dB (rms) or airgun sounds ≥160 dB (rms), not all animals react to sounds at this low level, and many will not show strong reactions (and in some cases any reaction) until sounds are much stronger. There are several variables that determine whether or not an individual animal will exhibit a response to the sound, such as the age of the animal, previous exposure to this type of anthropogenic sound, habituation, etc.

The 160 dB criterion is applied to pulsed sounds generated by airguns during the two or three VSP data acquisition runs that will be of short duration (with a total of about 2 hrs of airgun activity for two to three runs per well, not including time required for ramp up). The 120 dB criterion is applied to sounds from the drill rig for situations where the support vessel is located alongside the drill rig in DP mode, i.e., the scenario with highest sound production. This situation will occur about four times a week for a maximum of 6 hrs per occurrence, i.e., about 318 hrs of DP based on 53 trips over the entire drilling season for the ware vessel and 4.5 times a week, i.e., about 378 hrs for the OSV. The 120 dB criterion is also applied to any physical management of ice that might occur. For analytical purposes, physical ice management was conservatively estimated at up to 72 hrs, only in July and August. The area ensonified with continuous sound levels of 120 dB re1 μPa (rms) during drilling activity only is so small (<0.2 km²) that it does not appreciably add to the total estimated number of marine mammal exposures and is therefore not included in the calculations.

The area around the drill rig ensonified with pulsed sound levels ≥160 dB re1 μPa (rms) during VSP runs is estimated at 30 mi² (78.5 km²; radius of 3.1 mi or 5 km), and 78 mi² (201 km²; radius of 5 mi or 8 km) for continuous sound levels of ≥120 dB re1 μPa (rms) during times when the support vessel is attending the rig and during physical management of ice (Table 5 in COP's application and Table 2 here).

The potential number of each species that might be exposed to received continuous SPLs of ≥120 dB re 1 μPa (rms) and pulsed SPLs of ≥160 dB re 1 μPa (rms) was calculated by multiplying:

- The expected (seasonal) species density as provided in Table 4 of COP's application and Table 1 here;
- the anticipated area to be ensonified by the 120 dB re 1 μPa (rms) SPL (support vessel in DP mode and ice management activity) and 160 dB re 1 μPa (rms) SPL (VSP airgun operations); and
- the estimated total duration of each of the three activities within each season expressed in days (24 hrs).

To derive at an estimated total duration for each of the three activities for each season (summer and fall) the following assumptions were made:

- The total duration during which the support vessel will be in DP mode is 318 + 378 = 696 hrs. This is the equivalent of 29 days over the entire season, with 14.5 days in July/August and 14.5 days in September/October.
- Physical management of ice was assumed to take place only in the early season, and, for analytical purpose, estimated at a total of 72 hrs. No physical management of ice is assumed in September or October. If sea ice becomes an issue in October, drilling activities will likely be halted and the drill rig prepared for demobilization.
- The ensonified area of 120 dB re 1μPa for continuous sounds of the support vessel in DP mode and active ice management are assumed to be similar. To be conservative, COP assumed that the ensonified areas of these two activities will not overlap. The duration of both of these activities combined, used to calculate marine mammal exposures to 120 dB re 1 μPa (rms), is therefore17.5 days (=14.5 + 3) for July/August and 14.5 days for September/October.
- The total duration of the two or three VSP data acquisition runs per well is estimated to be 24 hrs, during which the airguns will be operating a total of about 2 hrs. Assuming COP will do additional VSP data acquisition runs for a second well, the total time of operating airgun activity is estimated about 4 hrs. To be conservative, COP included airgun time for ramp ups. Therefore, COP used 12 hrs (0.5 day) in July/August and 12 hrs (0.5 day) in September/October for the calculations of potential exposures.

Table 6 in COP's application summarizes the number of marine mammals potentially exposed to continuous SPLs of 120 dB re 1 μPa from support vessels on DP and physical ice management. Table 7 in COP's application summarizes the estimated number of marine mammals potentially exposed to pulsed SPLs of 160 dB re 1 μPa during the VSP runs. The total number of potential marine mammal exposures from all three activities combined is provided in Table 8 of COP's application. Additional information is contained in Section 6 of COP's IHA application.

NMFS is proposing to authorize the maximum take estimates provided in Table 8 of COP's application, except for the species noted earlier in this section to account for typical group size of those species. Table 3 in this document outlines the abundance, proposed take, and percentage of each stock or population for the 12 species that may be exposed to sounds ≥120 dB from the drill rig with support vessels in DP mode and ice management activities and to sounds ≥160 dB from VSP activities in COP's proposed Chukchi Sea drilling area. Less than 1.3% of each species or stock would potentially be exposed to sounds above the Level B harassment thresholds. The take estimates presented here do not take any of the mitigation measures presented earlier in this document into consideration. These take numbers also do not consider how many of the exposed animals may actually respond or react to the proposed exploration drilling program. Instead, the take estimates are based on the presence of animals, regardless of whether or not they react or respond to the activities.

TABLE 3—POPULATION ABUNDANCE ESTIMATES, TOTAL PROPOSED LEVEL B TAKE ESTIMATES (WHEN COMBINING TAKES FROM DRILL RIG OPERATIONS, ICE MANAGEMENT, DP, AND VSP SURVEYS), AND PERCENTAGE OF STOCK OR POPULATION THAT MAY BE TAKEN FOR THE POTENTIALLY AFFECTED SPECIES THAT MAY OCCUR IN COP'S PROPOSED CHUKCHI SEA DRILLING AREA

Species	Abundance [1]	Total proposed take	Percentage of stock or population
Beluga Whale	3,710	16	0.4
Killer Whale	656	20	3
Harbor Porpoise	48,215	10	0.02
Bowhead Whale	[2] 15,750	200	1.3
Fin Whale	5,700	5	0.09
Gray Whale	18,017	72	0.4
Humpback Whale	2,845	5	0.2
Minke Whale	810–1,233	5	0.4–0.6
Bearded Seal	[3] 155,000	161	0.1
Ribbon Seal	49,000	15	0.03
Ringed Seal	208,000–252,000	818	0.3–0.4
Spotted Seal	141,479	231	0.2

[1] Unless stated otherwise, abundance estimates are taken from Allen and Angliss (2012).

[2] Estimate from George *et al.* (2004) with an annual growth rate of 3.4%.
[3] Beringia Distinct Population Segment (NMFS, 2010).

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.

No injuries or mortalities are anticipated to occur as a result of COP's proposed Chukchi Sea exploratory drilling program, and none are proposed to be authorized. Injury, serious injury, or mortality could occur if there were a large or very large oil spill. However, as discussed previously in this document, the likelihood of a spill is extremely remote. COP has implemented many design and operational standards to mitigate the potential for an oil spill of any size. NMFS does not propose to authorize take from an oil spill, as it is not part of the specified activity. Additionally, animals in the area are not expected to incur hearing impairment (i.e., TTS or PTS) or non-auditory physiological effects. Instead, any impact that could result from COP's activities is most likely to be behavioral harassment and is expected to be of limited duration. Although it is possible that some individuals may be exposed to sounds from drilling operations more than once, during the migratory periods it is less likely that this will occur since animals will continue to move across the Chukchi Sea towards their wintering grounds.

Bowhead and beluga whales are less likely to occur in the proposed project area in July and August, as they are found mostly in the Canadian Beaufort Sea at this time. The animals are more likely to occur later in the season (mid-September through October), as they head west towards Russia or south towards the Bering Sea. Additionally, while bowhead whale tagging studies revealed that animals occurred in the Lease Sale 193 area, a higher percentage of animals were found outside of the Lease Sale 193 area in the fall (Quakenbush *et al.,* 2010). Bowhead whales are not known to feed in areas near COP's leases in the Chukchi Sea. The closest primary feeding ground is near Point Barrow, which is more than 200 mi (322 km) east of COP's Devils Paw prospect. Therefore, if bowhead whales stop to feed near Point Barrow during COP's proposed operations, the animals would not be exposed to continuous sounds from the drill rig or support operations above 120 dB or to impulsive sounds from the airguns above 160 dB, as those sound levels only propagate 689 ft (210 m), 4.9 mi (7.9 km), and 3 mi (4.9 km), respectively. Additionally, the 120-dB radius for the airgun array has been modeled to propagate 44 mi (71 km) from the source. Therefore, sounds from the operations would not reach the feeding grounds near Point Barrow. Gray whales occur in the northeastern Chukchi Sea during the summer and early fall to feed. However, the primary feeding grounds lies outside of the 120-dB and 160-dB ensonified areas from COP's activities. While some individuals may swim through the area of active drilling, it is not anticipated to interfere with their feeding in the Chukchi Sea. Other cetacean species are much rarer in the proposed project area. The exposure of cetaceans to sounds produced by exploratory drilling operations (i.e., drill rig, DP, ice management, and airgun operations) is not expected to result in more than Level B harassment.

Few seals are expected to occur in the proposed project area, as several of the species prefer more nearshore waters. Additionally, as stated previously in this document, pinnipeds appear to be more tolerant of anthropogenic sound, especially at lower received levels, than other marine mammals, such as mysticetes. COP's proposed activities would occur at a time of year when the ice seal species found in the region are not molting, breeding, or pupping. Therefore, these important life functions would not be impacted by COP's proposed activities. The exposure of pinnipeds to sounds produced by COP's proposed exploratory drilling operations in the Chukchi Sea is not expected to result in more than Level B harassment of the affected species or stock.

Of the 12 marine mammal species likely to occur in the proposed drilling area, three are listed as endangered under the ESA—the bowhead, humpback, and fin whales—and two are listed as threatened—ringed and bearded seals. All five species are also designated as ''depleted'' under the MMPA. Despite these designations, the Bering-Chukchi-Beaufort stock of bowheads has been increasing at a rate of 3.4% annually for nearly a decade (Allen and Angliss, 2012), even in the face of ongoing industrial activity. Additionally, during the 2001 census, 121 calves were counted, which was the highest yet recorded. The calf count provides corroborating evidence for a healthy and increasing population (Allen and Angliss, 2011). An annual increase of 4.8% was estimated for the period 1987–2003 for North Pacific fin whales. While this estimate is consistent with growth estimates for other large whale populations, it should be used with caution due to uncertainties in the initial population estimate and about population stock structure in the area (Allen and Angliss, 2012). Zeribini *et al.* (2006, cited in Allen and Angliss, 2012) noted an increase of 6.6% for the Central North Pacific stock of humpback whales in Alaska waters. There are currently no reliable data on trends of the ringed and bearded seal stocks in Alaska. Certain stocks or populations of gray and beluga whales and spotted seals are listed as endangered or are proposed for listing under the ESA; however, none of those stocks or populations occur in the proposed activity area. The ribbon seal is a ''species of concern.'' None of the other species that may occur in the project area are listed as threatened or endangered under the ESA or designated as depleted under the MMPA. There is currently no established critical habitat in the proposed project area for any of these 12 species.

Potential impacts to marine mammal habitat were discussed previously in this document (see the ''Anticipated Effects on Habitat'' section). Although some disturbance is possible to food sources of marine mammals, the impacts are anticipated to be minor. Based on the vast size of the Arctic Ocean where feeding by marine mammals occurs versus the localized area of the drilling program, any missed feeding opportunities in the direct project area would be of little consequence, as marine mammals would have access to other feeding grounds.

The estimated takes proposed to be authorized represent less than 1.3% of the affected population or stock for all species. These estimates represent the percentage of each species or stock that could be taken by Level B behavioral harassment if each animal is taken only once. The estimated take numbers are likely somewhat of an overestimate. First, COP did not account for potential overlap of some of the sound sources if they are operating simultaneously. This leads to an overestimation of ensonified area. Additionally, the mitigation and monitoring measures (described previously in this document) proposed for inclusion in the IHA (if issued) are expected to reduce even further any potential disturbance to marine mammals. Last, some marine mammal individuals, including mysticetes, have been shown to avoid the ensonified area around airguns at certain distances (Richardson *et al.,* 1999), and, therefore, some individuals would not likely enter into the Level B harassment zones for the various types of activities.

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 proposed mitigation and monitoring measures, NMFS preliminarily finds that the proposed exploration drilling program will result in the incidental take of small numbers of marine mammals, by Level B harassment only, and that the total taking from the drilling program 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

The disturbance and potential displacement of marine mammals by sounds from drilling activities are the principal concerns related to subsistence use of the area. 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.

The subsistence communities in the Chukchi Sea that have the potential to be impacted by COP's offshore drilling program include Point Hope, Point Lay, Wainwright, Barrow, and possibly Kotzebue and Kivalina (however, these two communities are much farther to the south of the proposed project area). Point Lay, Wainwright, Point Hope, Barrow, and Kivalina are approximately 90 mi (145 km), 120 mi (193 km), 175 mi (282 km), 200 mi (322 km), and 225 mi (362 km) from the Devils Paw prospect, respectively. The communities of Gambell and Savoonga on St. Lawrence Island also have the potential to be impacted if vessels pass close by the island during times of active hunting.

(1) Bowhead Whales

Bowhead whale hunting is a key activity in the subsistence economies of northwest Arctic communities. The whale harvests have a great influence on social relations by strengthening the sense of Inupiat culture and heritage in addition to reinforcing family and community ties.

An overall quota system for the hunting of bowhead whales was established by the International Whaling Commission (IWC) in 1977. The quota is now regulated through an agreement between NMFS and the Alaska Eskimo Whaling Commission (AEWC). The AEWC allots the number of bowhead whales that each whaling community may harvest annually (USDOI/BLM, 2005). The annual take of bowhead whales has varied due to (a) changes in the allowable quota level and (b) year-to-year variability in ice and weather conditions, which strongly influence the success of the hunt.

Bowhead whales migrate around northern Alaska twice each year, during the spring and autumn, and are hunted in both seasons. Bowhead whales are hunted from Barrow during the spring and the fall migration. The spring hunt along Chukchi villages and at Barrow occurs after leads open due to the deterioration of pack ice; the spring hunt typically occurs from early April until the first week of June. From 1984–2009, bowhead harvests by the villages of Wainwright, Point Hope, and Point Lay occurred only between April 14 and June 24 and only between April 23 and June 15 in Barrow (George and Tarpley, 1986; George *et al.,* 1987, 1988, 1990, 1992, 1995, 1998, 1999, 2000; Philo *et al.,* 1994; Suydam *et al.,* 1995b, 1996, 1997, 2001b, 2002, 2003, 2004, 2005b, 2006, 2007, 2008, 2009, 2010). Point Lay landed its first whale in more than 70 years during the spring hunt in 2009 and another whale during the 2011 spring hunt. COP will not mobilize and move into the Chukchi Sea prior to July 1.

The fall migration of bowhead whales that summer in the eastern Beaufort Sea typically begins in late August or September. Fall migration into Alaskan waters is primarily during September and October. 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 50 mi (80 km). The autumn bowhead hunt usually begins in Barrow in mid-September and mainly occurs in the waters east and northeast of Point Barrow. Fall bowhead whaling has not typically occurred in the villages of Wainwright, Point Hope, and Point Lay in recent years. However, a Wainwright whaling crew harvested the first fall bowhead whale in 90 years or more on October 8, 2010, and again landed a whale in October 2011. Because of changing ice conditions, there is the potential for these villages to resume a fall bowhead harvest.

Barrow participates in a fall hunt each year. From 1984–2009, Barrow whalers harvested bowhead whales between August 31 and October 29. While this time period overlaps with that of COP's proposed operations, the drill sites are located more than 200 mi (322 km) west of Barrow, so the whales would reach the Barrow hunting grounds before entering the sound field of COP's operations. COP will be flying helicopters out to the drillship for resupply missions. In the past 35 years, however, Barrow whaling crews have harvested almost all whales in the Beaufort Sea to the east of Point Barrow (Suydam *et al.,* 2008), indicating that relatively little fall hunting occurs to the west where the flight corridor is located. COP intends to base its flights out of Wainwright.

(2) Beluga Whales

Beluga whales are available to subsistence hunters along the coast of Alaska in the spring when pack-ice conditions deteriorate and leads open up. Belugas may remain in coastal areas or lagoons through June and sometimes into July and August. The community of Point Lay is heavily dependent on the hunting of belugas in Kasegaluk Lagoon for subsistence meat. From 1983–1992 the average annual harvest was approximately 40 whales (Fuller and George, 1997). Point Hope residents hunt beluga primarily in the lead system during the spring (late March to early June) bowhead hunt but also in open-water along the coastline in July and August. Belugas are harvested in coastal waters near these villages, generally within a few miles from shore.

In Wainwright and Barrow, hunters usually wait until after the spring bowhead whale hunt is finished before turning their attention to hunting belugas. The average annual harvest of beluga whales taken by Barrow for 1962–1982 was five (MMS, 1996). The Alaska Beluga Whale Committee (ABWC) 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, 1997; ABWC, 2002 cited in USDOI/BLM, 2005). Barrow residents typically hunt for belugas between Point Barrow and Skull Cliffs in the Chukchi Sea (primarily April-June) and later in the summer (July-August) on both sides of the barrier island in Elson Lagoon/Beaufort Sea (MMS, 2008). Harvest rates indicate that the hunts are not frequent. Wainwright residents hunt beluga in April-June in the spring lead system, but this hunt typically occurs only if there are no bowheads in the area. Communal hunts for beluga are conducted along the coastal lagoon system later in July-August.

COP's proposed exploration drilling activities take place well offshore, far away from areas that are used for beluga hunting by the Chukchi Sea communities. For vessel movements in nearshore areas, such as the alternate drill rig staging area or presence of oil spill response vessels, COP will consult with the communities on measures to mitigate potential impacts on subsistence hunts.

(3) Ringed Seals

Ringed seals are hunted mainly in the Chukchi Sea from late March through July; however, they can be hunted year-round. In winter, leads and cracks in the ice off points of land and along the barrier islands are used for hunting ringed seals. The average annual ringed seal harvest was 49 seals in Point Lay, 86 in Wainwright, and 394 in Barrow (Braund *et al.,* 1993; USDOI/BLM, 2003, 2005). Although ringed seals are available year-round, the planned activities will not occur during the primary period when these seals are typically harvested (March-July). Also, the activities will be largely in offshore waters where they will not influence ringed seals in the nearshore areas where they are hunted.

(4) Spotted Seals

Most subsistence harvest of the spotted seal is conducted by the communities of Wainwright and Point Lay during the fall (September and October), when spotted seals migrate back to their wintering habitats in the Bering Sea (USDOI/BLM, 2003). Available maps of recent and past subsistence use areas for spotted seals indicate harvest of this species within 30–40 mi (48–64 km) of the coastline. Spotted seals are also occasionally hunted in the area off Point Barrow and along the barrier islands of Elson Lagoon to the east (USDOI/BLM, 2005). The planned activities will remain offshore of the coastal harvest area of these seals and should not conflict with harvest activities.

(5) Bearded Seals

Bearded seals, although generally not favored for their meat, are important to subsistence activities in Barrow and Wainwright 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. While bearded seals can be hunted year-round in the Chukchi Sea, they are primarily harvested in spring during breakup of the ice (Bacon *et al.,* 2009). The animals inhabit the environment around the ice floes in the drifting nearshore ice pack, so hunting usually occurs from boats in the drift ice. Most bearded seals are harvested in coastal areas inshore of the proposed exploration drilling area, so no conflicts with the harvest of bearded seals are expected.

Potential Impacts to Subsistence Uses

NMFS has defined ''unmitigable adverse impact'' in 50 CFR 216.103 as an impact resulting from the specified activity that is likely to reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs by causing the marine mammals to abandon or avoid hunting areas; directly displacing subsistence users; or placing physical barriers between the marine mammals and the subsistence hunters; and that cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met.

Noise and general activity during COP's proposed drilling program have 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. Helicopter activity also has the potential to disturb cetaceans and pinnipeds by causing them to vacate the area. Additionally, general vessel presence in the vicinity of traditional hunting areas could negatively impact a hunt. Native knowledge indicates that bowhead whales become increasingly ''skittish'' in the presence of seismic noise. Whales are more wary around the hunters and tend to expose a much smaller portion of their back when surfacing (which makes harvesting more difficult). Additionally, natives report that bowheads exhibit angry behaviors in the presence of seismic activity, such as tail-slapping, which translate to danger for nearby subsistence harvesters.

Plan of Cooperation (POC)

Regulations at 50 CFR 216.104(a)(12) require IHA 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. COP has developed a Draft POC for its 2014 Chukchi Sea, Alaska, exploration drilling program to minimize any adverse impacts on the availability of marine mammals for subsistence uses. A copy of the POC was provided to NMFS with the IHA application (see **ADDRESSES** for availability). COP began conducting meetings with potentially affected communities in 2008. Exhibit 1 of COP's POC contains a list of all meetings that have taken place through November 2012. Communities contacted include: Barrow, Kivalina, Kotzebue, Point Hope, Point Lay, and Wainwright. COP also presented this program at the 2012 Open Water Meeting in Anchorage, Alaska, and plans to present at the 2013 Open Water Meeting, scheduled for March 5–7, 2013, in Anchorage, Alaska.

COP intends to meet with the North Slope Borough, Northwest Arctic Borough, and Alaska Native marine mammal commissions before and after operations. COP will also communicate throughout operations as needed.

In order to reduce impacts on subsistence hunts, COP intends to implement a Communication Plan. COP will establish a central communication station (Com-Station) located at Wainwright and communication outposts in Point Hope, Poing Lay, and Barrow. The Wainwright Com-Station will coordinate communication between the drilling rig, marine vessels, aircraft, and the communication outposts in each community as well as the subsistence hunters in Wainwright. Personnel on the drilling rig or ice management vessel will provide information to the Com-Center about the timing and location of planned vessel activity. The communication outposts will provide information to the Com-Station about the timing and location of planned hunts. The Com-Station will relay information and facilitate communication so that vessel activities can be modified as necessary to prevent avoidable conflicts with subsistence hunting. Communication outposts may also be established and manned in other villages, such as Kivalina and Kotzebue, if subsistence activities associated with those villages are occurring near the exploration operations. A communication representative may also be present in Wales and Savoonga during mobilization and demobilization activities if subsistence activities are occurring.

The Com-Station and outposts will be staffed by Inupiat communicators, if available. The duty of the Com-Station operator will be to stay in communication with outposts and with hunters regarding their subsistence hunting activities, and to relay information about subsistence hunting locations and activities to the drilling rig and marine vessels. The Com-Station operator will also provide the location of the drilling rig and marine vessels to the subsistence hunters and outposts.

The drill rig, ice management vessel, and monitoring vessel will carry on-board an Inupiat Communicator, who will also serve as a PSO, during the operating season. If a vessel that is part of the drilling program is in the vicinity of a hunting area and the hunters have launched their boats, the Inupiat Communicator's primary duty will be to stay in communication with the hunters and relay information to the vessel captain about hunting location, activities, timing, and overall plans. At all other times, the Inupiat Communicator will be serving as a PSO and will be responsible for monitoring for bowhead whales and other marine mammals.

COP will plan vessel routes to minimize potential conflict with marine mammals and subsistence activities related to marine mammals. Vessels will avoid areas of active hunting through communication with the established Com-Station by the Inupiat Communicator stationed on the rig. Moreover, many of the mitigation measures described earlier in this document (see the ''Proposed Mitigation'' section) will also help reduce impacts to subsistence hunts and subsistence uses of marine mammals. These include vessel operating measures when in the vicinity of marine mammals and helicopter flight altitude restrictions. Additionally, COP will not enter the Chukchi Sea prior to July 1 and will begin demobilization by October 31 so as to transit out of the Bering Strait no later than November 15.

Unmitigable Adverse Impact Analysis and Preliminary Determination

COP's drill sites are located more than 70 mi (113 km) from shore, and some of the activities will not begin until after the close of spring hunts. Seal hunts typically do not co-occur with COP's proposed activities and those that do occur close to shore. COP will utilize Com-Stations to avoid conflicts with active hunts. After the close of the July beluga whale hunts in the Chukchi Sea villages, very little whaling occurs in Wainwright, Point Hope, and Point Lay. Although the fall bowhead whale hunt in Barrow will occur while COP is still operating (mid- to late September to October), Barrow is located 200 mi (322 km) east of the proposed drill sites. Based on these factors, COP's Chukchi Sea survey is not expected to interfere with the fall bowhead harvest in Barrow. In recent years, bowhead whales have occasionally been taken in the fall by coastal villages along the Chukchi coast, but the total number of these animals has been small. Wainwright landed its first fall whale in more than 90 years in October 2010 and again landed a whale in October 2011. Hunters from the northwest Arctic villages prefer to harvest whales within 50 mi (80 km) so as to avoid long tows back to shore.

COP will also support village Com-Stations in the Arctic communities and employ local advisors from the Chukchi Sea villages to provide consultation and guidance regarding the whale migration and subsistence hunt. They will provide advice to COP on ways to minimize and mitigate potential impacts to subsistence resources during the drilling season. Support activities, such as helicopter flights, could impact nearshore subsistence hunts. However, COP will use flight paths and agreed upon flight altitudes to avoid adverse impacts to hunts and will communicate regularly with the Com-Station.

In the unlikely event of a major oil spill in the Chukchi Sea, there could be major impacts on the availability of marine mammals for subsistence uses. As discussed earlier in this document, the probability of a major oil spill occurring over the life of the project is low. Additionally, COP developed an OSRP, which is currently under review by DOI and will also be reviewed by NOAA. COP has also incorporated several mitigation measures into its operational design to reduce further the risk of an oil spill. Based on the information available, the proposed mitigation measures that COP will implement, and the extremely low likelihood of a major oil spill occurring, NMFS has preliminarily determined that COP's activities will not have an unmitigable adverse impact on the availability of marine mammals for subsistence uses.

Proposed Incidental Harassment Authorization

This section contains a draft of the IHA itself. The wording contained in this section is proposed for inclusion in the IHA (if issued).

(1) This Authorization is valid from July 1, 2014, through October 31, 2014.

(2) This Authorization is valid only for activities associated with COP's 2014 Devils Paw, Chukchi Sea, exploration drilling program. The specific areas where COP's exploration drilling program will be conducted are within COP lease holdings in the Outer Continental Shelf Lease Sale 193 area in the Chukchi Sea.

(3)(a) The incidental taking of marine mammals, by Level B harassment only, is limited to the following species: bowhead whale; gray whale; beluga whale; minke whale; fin whale; humpback whale; killer whale; harbor porpoise; ringed seal; bearded seal; spotted seal; and ribbon seal.

(3)(b) The taking by injury (Level A harassment), serious injury, or death of any of the species listed in Condition 3(a) or the taking of any kind of any other species of marine mammal is prohibited and may result in the modification, suspension or revocation of this Authorization.

(4) The authorization for taking by harassment is limited to the following acoustic sources (or sources with comparable frequency and intensity) and from the following activities:

(a) airgun array with a total discharge volume of 760 in^3;

(b) continuous drill rig sounds during active drilling operations and from support vessels in dynamic positioning mode; and

(c) vessel sounds generated during active ice management.

(5) The taking of any marine mammal in a manner prohibited under this Authorization must be reported immediately to the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS or his designee.

(6) The holder of this Authorization must notify the Chief of the Permits and

Conservation Division, Office of Protected Resources, at least 48 hours prior to the start of exploration drilling activities (unless constrained by the date of issuance of this Authorization in which case notification shall be made as soon as possible).

(7) General Mitigation and Monitoring Requirements: The Holder of this Authorization is required to implement the following mitigation and monitoring requirements when conducting the specified activities to achieve the least practicable impact on affected marine mammal species or stocks:

(a) All vessels shall reduce speed to at least 5 knots when within 300 yards (274 m) of whales. The reduction in speed will vary based on the situation but must be sufficient to avoid interfering with the whales. Those vessels capable of steering around such groups should do so. Vessels may not be operated in such a way as to separate members of a group of whales from other members of the group. For purposes of this Authorization, a group is defined as being three or more whales observed within a 547-yd (500-m) area and displaying behaviors of directed or coordinated activity (e.g., group feeding);

(b) Avoid multiple changes in direction and speed when within 300 yards (274 m) of whales and also operate the vessel(s) to avoid causing a whale to make multiple changes in direction;

(c) When weather conditions require, such as when visibility drops, support vessels must reduce speed and change direction, as necessary (and as operationally practicable), to avoid the likelihood of injury to whales;

(d) Check the waters immediately adjacent to the vessel(s) to ensure that no whales will be injured when the propellers are engaged;

(e) Vessels should remain as far offshore as weather and ice conditions allow and at least 5 mi (8 km) offshore during transit;

(f) Aircraft shall not fly within 1,000 ft (305 m) of marine mammals or below 1,500 ft (457 m) altitude (except during takeoffs, landings, or in emergency situations) while over land or sea;

(g) Utilize NMFS-qualified, vessel-based Protected Species Observers (PSOs) to visually watch for and monitor marine mammals near the drill rig or ice management vessels during active drilling, dynamic positioning, or airgun operations (from nautical twilight-dawn to nautical twilight-dusk) and before and during start-ups of airguns day or night. The vessels' crew shall also assist in detecting marine mammals, when practicable. PSOs shall have access to reticle binoculars (7x50 Fujinon) and big-eye binoculars (25x150). PSO shifts shall last no longer than 4 hours at a time and shall not be on watch more than 12 hours in a 24-hour period. PSOs shall also make observations during daytime periods when active operations are not being conducted for comparison of animal abundance and behavior, when feasible;

(h) When a mammal sighting is made, the following information about the sighting will be recorded:

(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 the PSO, apparent reaction to activities (e.g., none, avoidance, approach, paralleling, etc.), closest point of approach, and behavioral pace;

(ii) Time, location, speed, activity of the vessel, sea state, ice cover, visibility, and sun glare; and

(iii) The positions of other vessel(s) in the vicinity of the PSO location.

(iv) The ship's position, speed of support vessels, and water depth, sea state, ice cover, visibility, and sun glare will also be recorded at the start and end of each observation watch, every 30 minutes during a watch, and whenever there is a change in any of those variables.

(v) Altitude and position of the aircraft if sightings are made during helicopter crew transfers.

(i) PSO teams shall consist of Inupiat observers and experienced field biologists. An experienced field crew leader will supervise the PSO team onboard the survey vessel. New observers shall be paired with experienced observers to avoid situations where lack of experience impairs the quality of observations;

(j) PSOs will complete a training session on marine mammal monitoring, to be conducted shortly before the anticipated start of the 2014 open-water season.

(k) If there are Alaska Native PSOs, the PSO training that is conducted prior to the start of the survey activities shall be conducted with both Alaska Native PSOs and biologist PSOs being trained at the same time in the same room. There shall not be separate training courses for the different PSOs;

(l) PSOs shall be trained using visual aids (e.g., videos, photos) to help them identify the species that they are likely to encounter in the conditions under which the animals will likely be seen;

(m) Within safe limits, the PSOs should be stationed where they have the best possible viewing. Viewing may not always be best from the ship bridge, and in some cases may be best from higher positions with less visual obstructions (e.g., flying bridge);

(n) PSOs should be instructed to identify animals as unknown where appropriate rather than strive to identify a species if there is significant uncertainty;

(o) PSOs should maximize their time with eyes on the water. This may require new means of recording data (e.g., audio recorder) or the presence of a data recorder so that the observers can simply relay information to them; and

(p) PSOs should plot marine mammal sightings in near real-time for their vessel into a GIS software program and relay information regarding the animal(s)' position between platforms and vessels with emphasis placed on relaying sightings with the greatest potential to involve mitigation or reconsideration of the vessel's course.

(8) *VSP Mitigation and Monitoring Measures:* The Holder of this Authorization is required to implement the following mitigation and monitoring requirements when conducting the specified activities to achieve the least practicable impact on affected marine mammal species or stocks:

(a) PSOs shall conduct monitoring while the airgun array is being deployed or recovered from the water;

(b) PSOs shall visually observe the entire extent of the exclusion zone (EZ) (180 dB re 1 μPa [rms] for cetaceans and 190 dB re 1 μPa [rms] for pinnipeds) using NMFS-qualified PSOs, for at least 30 minutes (min) prior to starting the airgun array (day or night). If the PSO finds a marine mammal within the EZ, COP must delay the seismic survey until the marine mammal(s) has left the area. If the PSO sees a marine mammal that surfaces then dives below the surface, the PSO shall continue the watch for 30 min. If the PSO 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 min period (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), the Holder of this Authorization may start the second airgun without observing the entire EZ for 30 min prior, provided no marine mammals are known to be near the EZ;

(c) Establish and monitor a 180 dB re 1 μPa (rms) and a 190 dB re 1 μPa (rms) EZ for marine mammals before the airgun array is in operation; and a 180 dB re 1 μPa (rms) and a 190 dB re 1 μPa (rms) EZ before a single airgun is in operation. For purposes of the field verification tests, described in condition 10(b)(i) below, the 180 dB radius for the airgun array is predicted to be 0.6 mi (920 m) and the 190 dB radius for the airgun array is predicted to be 525 ft (160 m). New radii will be used upon completion of the field verification tests described in the Monitoring Measures section below (condition 10(b)(i));

(d) Implement a ''ramp-up'' procedure when starting up at the beginning of seismic operations, which means start the smallest gun first and double the number of operating airguns at one-minute intervals. During ramp-up, the PSOs 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 shutdown requires that the PSOs be able to view the full EZ;

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

(f) Following a power-down, if the marine mammal approaches the smaller designated EZ, the airguns must then be completely shutdown. Airgun activity shall not resume until the PSO 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 min for species with shorter dive durations (small odontocetes and pinnipeds) or 30 min for species with longer dive durations (mysticetes);

(g) Following a power-down or shutdown and subsequent animal departure, airgun operations may resume following ramp-up procedures described in Condition 8(d) above;

(h) VSP 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;

(i) No initiation of airgun array operations is permitted from a shutdown 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 PSO(s) on duty; and

(j) When utilizing the mitigation airgun, use a reduced duty cycle (e.g., 1 shot/min).

(9) *Subsistence Mitigation Measures:* To ensure no unmitigable adverse impact on subsistence uses of marine mammals, the Holder of this Authorization shall:

(a) Not enter the Chukchi Sea prior to July 1 to minimize effects on spring and early summer whaling;

(b) Implement the Communication Plan before initiating exploration drilling operations to coordinate activities with local subsistence users and Village Whaling Associations in order to minimize the risk of interfering with subsistence hunting activities;

(c) Establish Com-Stations and Com-Station outposts. The Com Centers shall operate 24 hours/day during the 2012 bowhead whale hunt;

(d) Employ local Inupiat communicators from the Chukchi Sea villages to provide consultation and guidance regarding the whale migration and subsistence hunt;

(e) Not operate aircraft below 1,500 ft (457 m) unless engaged in marine mammal monitoring, approaching, landing or taking off, or unless engaged in providing assistance to a whaler or in poor weather (low ceilings) or any other emergency situations; and

(f) Helicopters may not hover or circle above areas with groups of whales or within 0.5 mi (800 m) of such areas.

(10) Monitoring Measures:

(a) Vessel-based Monitoring: The Holder of this Authorization shall designate biologically-trained PSOs to be aboard the drill rig and ice management vessels. The PSOs are required to monitor for marine mammals in order to implement the mitigation measures described in conditions 7 and 8 above;

(b) Acoustic Monitoring:

(i) Field Source Verification: the Holder of this Authorization is required to conduct sound source verification tests for the drill rig, support vessels in DP mode, and the airgun array. Sound source verification shall consist of distances where broadside and endfire directions at which broadband received levels reach 190, 180, 170, 160, and 120 dB re 1 μPa (rms) for all active acoustic sources that may be used during the activities. For the airgun array, the configurations shall include at least the full array and the operation of a single source that will be used during power downs. Initial results must be provided to NMFS within 120 hours of completing the analysis.

(ii) The Holder of this Authorization shall deploy acoustic recorders in the U.S. Chukchi Sea in order to gain information on the distribution of marine mammals in the region. To the extent practicable, this program must be implemented as detailed in the 4MP.

(11) Reporting Requirements: The Holder of this Authorization is required to:

(a) Submit a sound source verification report to NMFS with the results for the drill rig, support vessels (including in DP mode), and the airguns. The reports should report down to the 120-dB radius in 10-dB increments;

(b) Submit daily PSO logs to NMFS;

(c) 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 exploration drilling program. This report must contain and summarize the following information:

(i) summaries of monitoring effort (e.g., total hours, total distances, and marine mammal distribution through the study period, accounting for sea state and other factors affecting visibility and detectability of marine mammals);

(ii) analyses of the effects of various factors influencing detectability of marine mammals (e.g., sea state, number of observers, and fog/glare);

(iii) species composition, occurrence, and distribution of marine mammal sightings, including date, water depth, numbers, age/size/gender categories (if determinable), group sizes, and ice cover;

(iv) sighting rates of marine mammals during periods with and without exploration drilling activities (and other variables that could affect detectability), such as: (A) Initial sighting distances versus drilling state; (B) closest point of approach versus drilling state; (C) observed behaviors and types of movements versus drilling state; (D) numbers of sightings/individuals seen versus drilling state; (E) distribution around the survey vessel versus drilling state; and (F) estimates of take by harassment;

(v) Reported results from all hypothesis tests should include estimates of the associated statistical power when practicable;

(vi) Estimate and report uncertainty in all take estimates. Uncertainty could be expressed by the presentation of confidence limits, a minimum-maximum, posterior probability distribution, etc.; the exact approach would be selected based on the sampling method and data available;

(vii) The report should clearly compare authorized takes to the level of actual estimated takes;

(viii) Sampling of the relative near-field around operations should be corrected for effort to provide the best possible estimates of marine mammals in EZs and exposure zones; and

(ix) If, after the independent monitoring plan peer review changes are made to the monitoring program, those changes must be detailed in the report.

(d) The draft report will be subject to review and comment by NMFS. Any recommendations made by NMFS must be addressed in the final report prior to acceptance by NMFS. The draft report will be considered the final report for this activity under this Authorization if NMFS has not provided comments and recommendations within 90 days of receipt of the draft report.

(12)(a) In the unanticipated event that the drilling program operation 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), COP shall immediately take steps to cease operations and immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, or his designee by phone or email, the Alaska Regional Office, and the Alaska Regional Stranding Coordinators. The report must include the following information: (i) Time, date, and location (latitude/longitude) of the incident; (ii) the name and type of vessel involved; (iii) the vessel's speed during and leading up to the incident; (iv) description of the incident; (v) status of all sound source use in the 24 hours preceding the incident; (vi) water depth; (vii) environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, and visibility); (viii) description of marine mammal observations in the 24 hours preceding the incident; (ix) species identification or description of the animal(s) involved; (x) the fate of the animal(s); (xi) 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 COP to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. COP may not resume their activities until notified by NMFS via letter, email, or telephone.

(b) In the event that COP 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), COP will immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, by phone or email, the Alaska Regional Office, and the NMFS Alaska Stranding Hotline and/or by email to the Alaska Regional Stranding Coordinators. The report must include the same information identified in Condition 12(a) above. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with COP to determine whether modifications in the activities are appropriate.

(c) In the event that COP 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 Condition 2 of this Authorization (e.g., previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), COP shall report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, by phone or email and the NMFS Alaska Stranding Hotline and/or by email to the Alaska Regional Stranding Coordinators, within 24 hours of the discovery. COP shall provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS and the Marine Mammal Stranding Network. Activities may continue while NMFS reviews the circumstances of the incident.

(13) Activities related to the monitoring described in this Authorization do not require a separate scientific research permit issued under section 104 of the Marine Mammal Protection Act.

(14) The Plan of Cooperation outlining the steps that will be taken to cooperate and communicate with the native communities to ensure the availability of marine mammals for subsistence uses must be implemented.

(15) COP is required to comply with the Terms and Conditions of the Incidental Take Statement (ITS) corresponding to NMFS's Biological Opinion issued to NMFS's Office of Protected Resources.

(16) A copy of this Authorization and the ITS must be in the possession of all contractors and PSOs operating under the authority of this Incidental Harassment Authorization.

(17) Penalties and Permit Sanctions: Any person who violates any provision of this Incidental Harassment Authorization is subject to civil and criminal penalties, permit sanctions, and forfeiture as authorized under the MMPA.

(18) This Authorization may be modified, suspended or withdrawn if the Holder fails to abide by the conditions prescribed herein or if the authorized taking is having more than a negligible impact on the species or stock of affected marine mammals, or if there is an unmitigable adverse impact on the availability of such species or stocks for subsistence uses.

Endangered Species Act (ESA)

There are three marine mammal species listed as endangered under the ESA with confirmed or possible occurrence in the proposed project area: the bowhead, humpback, and fin whales. There are two marine mammal species listed as threatened under the ESA with confirmed occurrence in the proposed project area: ringed and bearded seals. NMFS' Permits and Conservation Division will initiate consultation with NMFS' Endangered Species Division under section 7 of the ESA on the issuance of an IHA to COP under section 101(a)(5)(D) of the MMPA for this activity. Consultation will be concluded prior to a determination on the issuance of an IHA.

National Environmental Policy Act (NEPA)

NMFS is currently preparing an Environmental Assessment (EA), pursuant to NEPA, to determine whether the issuance of an IHA to COP for its 2014 drilling activities may have a significant impact on the human environment. NMFS expects to release a draft of the EA for public comment and will inform the public through the **Federal Register** and posting on our Web site once a draft is available (see **ADDRESSES**).

Proposed Authorization

As a result of these preliminary determinations, NMFS proposes to authorize the take of marine mammals incidental to COP for its 2014 open-water exploration drilling program, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated.

Dated: February 12, 2013.

Helen M. Golde,

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

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