APPLICATION FOR INCIDENTAL HARASSMENT AUTHORIZATION TO NATIONAL MARINE FISHERIES SERVICE

FOR

2008 SITE CLEARENCE AND SHALLOW HAZARD SURVEY DURING THE OPEN WATER SEASON IN THE CHUKCHI SEA

Submitted by ConocoPhillips Alaska, Inc. (CPAI)

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1. Description of the Specific Activity or Class of Activities that can be Expected to Result in Incidental Taking of Marine Mammals.

ConocoPhillips Alaska, Inc. (CPAI) is planning to conduct site clearance and shallow hazard surveys of potential exploratory drilling sites in the Chukchi Sea during the 2008 open water season. The surveys will be in two areas within Lease Sale 193. The operation will be active 24 hours per day and use a single vessel to collect the geophysical data. The specific vessel has not been selected at this time, but once selected CPAI will provide the National Marine Fisheries Services (NMFS) a picture of the vessel and its specifications. CPAI anticipate completing the survey in 30-45 days between mid July and the end of November, depending on weather and other operational factors. Site clearance and shallow hazard surveys would begin in August, after completing mobilization in July. CPAI anticipates shooting approximately 5,300 linear kilometers.

Site clearance and shallow hazard surveys will be completed to confirm the seafloor has soil and surface characteristics that will support the safe set-down of a drill rig, and long term occupation of the site by such a vessel. Acoustic instrumentation to be used for the proposed survey is designed to characterize the seabed topography, bathymetry, potential geohazards, and other seafloor features (e.g., boulders) using seafloor imaging, water depth measurements, and high-resolution seismic profiling. The locations and dates of the surveys will not conflict with the subsistence hunts conducted by Barrow, Wainwright, Point Lay, or Point Hope. Furthermore, the sound characteristics of the instrumentation should have no more than a negligible effect on marine mammals and local subsistence activities as discussed later in the application. Descriptions of the functions and features of the possible acoustic instrumentation for the project are provided below.

Seafloor Imagery

A side-scan sonar is a sideward-looking, two-channel, narrow-beam instrument that emits a sound pulse and "listens" for its return. The sound energy transmitted is in the shape sweeps the seafloor resulting in a two-dimensional (2D) image that produces a detailed representation of the seafloor and any features or objects on it. The sonar will be towed behind the vessel. One of the following systems or equivalent will be used in the proposed seafloor surveys:

- Marine Sonics Technology multi-frequency side-scan sonar. The frequency the side-scan sonar emits during operation can be varied from 150 – 1200 kilohertz (kHz). It is expected that the frequency for this acquisition will be in the 150 kHz range. The pulse length is variable from 20 - 300 milliseconds (msec).

- EdgeTech 4200 dual-frequency side-scan sonar: The frequency the side-scan sonar emits during operation is 120 kilohertz (kHz), occasionally reaching frequencies up to 410 kHz. The pulse length is up to 20 milliseconds (msec). The source level reaches 210 decibels (dB) relative (re) 1 microPascal at one meter (1µPa@1m) root mean square (rms). The 160, 180, and 190 dB re 1µPa@1m radii , in the beam below the transducer, would be 316m, 32m, and 10m, respectively, assuming spherical spreading.

- Klein System 3000 dual-frequency digital side scan sonar: The side-scan sonar will typically be run at the 132 kHz frequency band. However, the 445 kHz frequency may be used periodically during any investigation work. The transmission pulse is variable from 25 msec to 400 msec. The peak in the 132 kHz source level beam reaches 234 dB re 1µPa@1m. The peak in the 445 kHz source level beam reaches 242 dB re 1µPa@1m. the 445 kHz frequency band is outside any marine mammal species' hearing range, therefore, there would be no effect to marine mammals when this frequency is chosen. The 160, 180, and 190 dB re 1µPa@1m radii, in the beam below the transducer, would be 1,778m, 178m , and 56m, respectively, assuming spherical spreading.

These side scan sonars operate in an extremely high frequency range (over 120 kHz) relative to marine mammal hearing (Richardson et al., 1995; Southall et al., 2007). The frequency range from these side scan sonars is beyond the hearing range of mysticetes (baleen whales) and pinnipeds. Therefore, these sonars are not expected to affect bowhead, gray, humpback, minke, and other baleen whales and pinniped species in the proposed project area. The frequency range from these side scan sonars falls within the upper end of odontocete (toothed whale) hearing spectrum (Richardson et al., 1995), which means that they are not perceived as loud acoustic signals with frequencies below 120 kHz by these animals. Further, in addition to spreading loss for acoustic propagation in the water column, high frequency acoustic energies are more quickly absorbed through the water column than sounds with lower frequencies (Urick, 1983). Therefore, the potential effects from side scan sonar to marine mammals would be negligible.

Bathymetry

Echosounders measure the time it takes for sound to travel from a transducer, to the seafloor, back to a receiver. The travel time can be converted to a depth value by multiplying it with the sound velocity of the water column. Echosounders are generally mounted to the ship hull or on a side-mounted pole.

Two different echosounding systems will be used to provide bathymetric data during the proposed Chukchi Sea shallow hazards and site clearance surveys: the Odom Hydrotrac digital single beam echosounder and Odom ES3 multibeam echosounder or equivalent.

The first sonar that will be used during the proposed survey is an Odom MK3 Hydrotrac Digital Echo Sounder. This device emits a single pulse of sound directly below the ship along the vessel trackline and provides a continuous recording of water depth along the survey track. Generally these recorders require compensation to rectify the data point. The MK3 Hydrotrac sonar operates at frequencies from 24 - 200 kHz and emits approximately 15 pulses per second (pulse/sec). Each pulse phase is between 0.03 and 0.12 millisecond (msec). The analog prints of the Odom Hydrotrac data will also be reviewed for any evidence of water column anomalies which could indicate gas escaping into the water column. Any water column anomalies will be mapped and reported.

The Odom ES3 or Reson Seabat 8101 multibeam echosounders consist of a transducer array that emits a swath of sound. The seafloor coverage swath of the multibeam sonar depends on water depth, but is usually equal to two to four times the water depth. This sonar operates at frequencies of 120 or 240 kHz. Either system emits approximately 15 pulses/sec, with each pulse duration lasting 21 msec to 225 msec for a swath that can cover up to 500 m (1,640 ft) in width. The multibeam system requires additional non-acoustic equipment including a motion sensor (on vessel) to measure heave, roll, and pitch; a gyrocompass (on vessel); and a sound velocity probe (lowered from the vessel when the vessel is stationary). A TSS DMS-05 Dynamic Motion Sensor, Hemisphere VS1 10 Global Positioning System (GPS)/Heading System Odom Digibar Pro will provide these data. The resulting multibeam data will provide a three dimensional (3D) view of the seafloor in the measured area.

High-resolution Seismic Profiling

An integral part of the shallow hazards and site clearance surveys is high-resolution seismic profiling using three different acoustic source systems. Seismic systems operate on the principal that an acoustic impulse will reflect part of its energy upon encountering a density interface. This will be accomplished through the use of a high-frequency subbottom profiler, an intermediate-frequency seismic profiling system, and a multichannel seismic system. The high-resolution profiling systems, which use smaller acoustic sources, will be utilized as opposed to low-resolution systems or deep exploration seismic systems. The planned surveys are geared toward providing detail of the surficial and shallow subsurface geology and not toward hydrocarbon exploration. The planned high-resolution profiles will provide the detailed information that is not resolved in the deep seismic profiles. The following equipment will be utilized for the high resolution seismic profiling portion of the marine surveys.

High Resolution Subbottom Profiler

A subbottom profiler is a high-frequency seismic system that will be used to map geologic features in the proposed survey areas. Many of the modern subbottom profilers are "chirp" systems which are frequency or pulse-rate modulated. This allows the energy, amplitude, and phase characteristics of the acoustic pulse to be precisely controlled. The 500 Hz to 13 kHz frequency in conjunction with the 10-watt to 4-kilowatt (kW) power output generally achieves 25 to 250 msec, or approximately 20 to 200 m (65 to 656 ft) of bottom penetration, detailing the near-surface strata and density layers with a resolution of 6 to 20 centimeters (cm) (2 to 8 inches). The two-way travel time of the acoustic signal, from firing to receiving, is recorded and travel time measurements are subsequently applied to water column velocity information, system delays, and appropriate tow depth corrections to calculate water depths and/or depths to subsurface events. The degree of ocean bottom penetration is variable depending on properties of the bottom and near-surface materials, the output power, and carrier frequency. The subbottom profiler is often used to supplement higher energy seismic systems or coring data to obtain accurate profiles of large areas. Either subbottom profiler has a source level at approximately 214 dB re 1µPa@1m. The 160, 180, and 190 dB re 1µPa@1m radii, in the beam below the transducer, would be 501m, 50m, and 16m, respectively, for either subbottom profiler, assuming spherical spreading. The frequencies of the profilers fall within the hearing ranges of pinnipeds and odontocete, but they are largely above the hearing range of baleen whales (Richardson et al. 1995). However, odontocetes are most sensitive to sounds above 10 kHz, which is above the frequencies of one profiler and near the upper range of the other profiler (Richardson et al. 1995). Baleen whales hear sounds with dominant components in the 50 to 500 Hz range, which is at the lower range for one profiler and outside of the range for the other profiler (Richardson et al. 1995). Consequently, marine mammal hearing would be potentially most sensitive to the GeoChirp profiler, but the area ensonified by the sounds would be quite close to the vessel, which would be further reduced by the directional orientation of the sounds as discussed below.

One of the following subbottom profiler systems or equivalent will be used in the proposed marine surveys:

- Knudsen 320 BR sub-bottom profiling system: The sub-bottom profiler will be used in the 3.5 to 12 kHz frequency range. The transmission pulse length is programmable sweeps or user defined pings. A typical pulse width is 28 – 36 msec. The pulse repetition rate is 4 pulses/sec - 12 pulses/sec.

- GeoAcoustics/GeoPulse sub-bottom profiling system: The subbottom profiler will be used in the 3.5 to 5 kHz frequency range. Pulse cycles range from 1 to 32 cycles of the selected frequency. During the survey, 3.5 kHz will likely be used, possibly up to 5 kHz, depending on the geology of the seafloor.

- GeoAcoustics GeoChirp II subbottom profiling system: The subbottom profiler has a frequency range of 0.5 to 13 kHz, which is programmable. The transmission pulse length is typically 32 msec programmable sweeps or user defined pings. The pulse repetition rate is 4 pulses/sec (at maximum) for a 32 msec chirp sweep or 10 pulses/sec for pinger waveforms.

The corresponding distances for an animal in the horizontal direction of these transducers would be much smaller due to the direct downward beam pattern of the subbottom profilers. Therefore, the horizontal received levels of 180 and 190 dB re 1 microPa (rms) would be within much smaller radii than 50 m (164 ft) and 16 m (52 ft) when using the GeoAcoustics subbottom profilers, which have the highest downward source level, respectively. In addition, the pulse duration of these subbottom profilers is extremely short, in the order of tens to hundreds of msec, and the survey is constantly moving. Therefore, for a marine mammal to receive prolonged exposure, the animal has to stay in a very small zone of ensonification and keep with the vessel's speed, which is very unlikely. Moreover, the any effects would be less for baleen whales due to the frequency range of the profilers. Therefore, the potential effects from the sub-bottom profilers to marine mammals would be negligible.

Intermediate Frequency Seismic Profiling System

One intermediate-frequency seismic system is referred to as a “Boomer.” The Boomer transducer is a mechanical means of generating enough sound energy to penetrate the subsurface sediments. Signals are reflected from the various bedding planes (density/velocity interfaces) and received by a single-channel hydrophone streamer. The sound reflections are converted into electrical impulses, filtered, and sent to a graphic recorder. The Boomer can effectively detail the upper 40 to 600 m (131 to 1,969 ft) of subbottom, outlining the fine strata and density layers that represent foundation formations for seafloor-based structures. The depth of seismic penetration obtained with this system is determined by the sediment type and the amount of initial discharged energy. In many instances, the presence of organic gas will attenuate the signal and mask any deeper reflections. The “Boomer” systems will consist one of the following:

- An Applied Acoustics Squid 2000 mini sparker “Boomer” The maximum energy input ranges from 600 - 2500 Joules (J) per shot with a maximum power input of 2500 J per shot. The maximum energy will be determined once penetration has been assessed in the field. A pulse length range of 1 -5 msec is typical. The peak in the source level beam reaches 222 dB re 1 µPa-m at 600 J with a frequency range of 0.5 to 300 kHz.

- An Applied Acoustics Model AA300 Boomer plate with housing. The maximum energy input is 350 Joules (J) per shot with a maximum power input of 1,000 J per shot. The maximum energy that would be used for these surveys is 300 J. The pulse length ranges from 150 to 400 msec with a reverberation of less than 1/10 of the initial pulse. The peak in the source level beam reaches 218 dB re 1 µPa-m at 300 J with a frequency range of 0.5 to 300 kHz. A Datasonics Model SPR-1200 seismic profiling system also known as a "bubble pulser." It has an electromagnetic source. The frequency of the system is 400 Hz in a narrow band. The peak in the source-level beam reaches 200 dB re 1 µPa@1m.

Power is supplied by:

- Applied Acoustics CSP-D 1200 Seismic Energy Source. This is a broadband width source, so the frequencies will range from 500 Hz to 3 kHz. The source can output 2,500 to 4,000 volts (V) in a solid-state semi-conductor discharge method. The output energy is variable and ranges from 50 J to 12 kJ. CPAI will use the lowest input rate possible to collect the data we need to meet the MMS requirements. The charging rate for the source is 1,500 J per sec for continuous operation. The repetition rate is 6 pings per sec at the maximum, and during surveys, the rate will likely be 2 pings per sec.
- Datasonics Model BPS-530 power supply. It has a maximum repetition rate of 1/8 a second. The signal is received by a single channel or selected near channels on the hydrophone streamer cable.

Multichannel Seismic System

The multichannel seismic system sources will consist of an:

- Geo-Spark 1600 "Sparker". The "Sparker" much like the "Boomer" is a mechanical means of generating enough sound energy to penetrate the subsurface sediments. The "Sparker" has eight electrode modules which are evenly spaced which make up an array with a physical dimension of 1.6 x 2m. The number of electrodes used is user defined which give the Geo-Spark 1600 the capability of operating at 6 – 16Kj. It is expected that the sparker will be operated in a range of 10- 16Kj. The sparker is towed behind the vessel approximately 75 feet on a catamaran style floatation system. The towed unit is connected to a Geo-Spark 16Kj power supply located on the deck which can emit power output of 4000 – 16000 Joules Signals from the "Sparker" are reflected from the various bedding planes (density/velocity interfaces) and received by a multi-channel hydrophone streamer. These signals "data" is then recorded on disc or tape. The "Sparker" can effectively detail the upper 1 sec of sub bottom at a peak output of 212 dB, The depth of seismic penetration obtained with this system is determined by the sediment type and the amount of discharged energy.

- Ultra Shallow Water (USW) array composed of a 40-cubic-inch (cu inch) seismic sound source with four 10-cu-inch Input/Output (I/O) sleeve guns. If desired, the power can also be reduced to 20 cu. inches. The reflected energy will be received by a multi channel marine digital recording streamer system with 48 hydrophone channels located at intervals of 3.125 - 12.5 m along the length of the streamer. The sound source is expected to provide 1.5 to 3 sec of data, two-way travel time with a resolution of 10 msec. It operates at a frequency range of 20 to 200 Hz and a peak sound output of 196 dB for all four guns combined. The frequency range that will be used in the proposed surveys will be between 20 Hz and 200 Hz, nominal. This tool is useful in finding shallow faults and amplitude anomalies.

  The power is provided though an Ingersoll BVR-51 high-pressure air compressor unit. The air pressure can deliver 33 standard cubic feet per minute (scfm) per compressor. The air compressor package delivers ±33 scfm air volume for shots at 5 sec and 6.25 m (21 ft) intervals (boat speed equals 3.5 to 4 knots). The pressure signature is 6.27 peak-to-peak (PP) bar meters with a primary bubble ratio (P/B) of 8.4. A "Hot Shot Controller will be used to time and synchronization the source array and the Sentinel Recording system which will collect data from the streamer.

The Multi Channel Streamer which receives the signals generated by the Boomer, Sparker or Air Gun array is described below"

- The solid core multi channel seismic streamer and lead in will be deployed and retrieved by small streamer reel/winch attached mid ship on the stern of the vessel. Leveling for the steamer will be accomplished with several I/O 5011 leveling/compass birds distributed at predefined intervals along the cable. A tail buoy may be towed from the rear cable section to better position the streamer. Total length of the streamer is expected to be no more than 600m

Equipment Potentially Affecting Marine Mammals

While the sonar equipment proposed to be used for this project generates high sound energy, the equipment operates at frequencies (>100 kHz) beyond the effective hearing range of the marine mammals likely be encountered (Richardson et al. 1995). However, the equipment proposed for the seismic profiling operate at a frequency range and sound level that could affect marine mammal behavior if they occur within a relatively close distance to the sound source (Richardson et al. 1995). JASCO modeled the sound levels of different configurations of seismic profilers (10kj and 16kj sparkers, 10in³ and 20 in³ 2-gun arrays, 40 cu³ single gun, and 10 in³ 4-gun array) and found the 4-gun array produced the highest sound levels (Appendix I). Therefore, take estimates of marine mammals are calculated for the 4-gun array in this IHA, which reaches the 160 dB sound level at 1.665 km from the source, the 180 dB level at 115 m, and the 190 dB level at 20 m (See section 6 and 11 of application). CPAI may use any one of the profilers during the survey, but none will exceed the sound levels of the 4-gun array.

2. The Date(s) and Duration of Such Activity and the Specific Geographical Region where it will occur.

CPAI seeks incidental take authorization for a period of five months (1 July to no later than 30 November) for site clearance and shallow hazard surveys in the east central Chukchi Sea. Mobilization of operations will occur in early to mid-July out of Seward, and the surveys are proposed to begin in August and end by November in the Chukchi Sea depending on weather and ice conditions. Open water operations are ordinarily confined to no more than this five-month period because of the timing of ice melt and formation, which occur closer to four months in a typical year. While CPAI anticipates completing the actual survey work in 30-45 days, the longer period is required to compensate for poor weather conditions.

The geographic region of activity includes two areas spaced about 60 km apart and a path (dashed line on map) for sampling conditions along a potential pipeline route, (Figure 1). Each area is about 2,000 km^2 with dimensions about 72 km by 62 km. The two areas are over 111 km (60 nmi) off the Alaska coast, generally west from the village of Wainwright. The more southern area overlaps the Klondike prospect and the other area overlaps the Burger prospect. Activities along the potential pipeline route will include using side-scan sonar, multi-bean sonar, and echosounder to map the seafloor and taking core samples (using a small dredge deployed/recovered with a winch), but these activities are not anticipated to affect marine mammals given the instrumentation characteristics (e.g., narrow downward-directed beam, very high frequency, low power). Data on the pipeline route will be incidentally collected during transits to and from the mainland to change out crews and re-supply the vessel. No site clearance or shallow hazard surveys will be done along the potential pipeline route.

The approximate corner boundaries for the two areas are: N 71 00 57.82507, W 164 48 06.08531; N 70 35 08.43840, W 164 48 21.31038; N 70 34 59.52902, W 165 58 13.14520; N 71 00 48.69817, W 165 59 29.24948 for the southernmost area and N 71 25 48.26752, W 162 30 03.77569; N 71 05 09.97047, W 162 32 41.54596; N 71 05 55.80486, W 163 52 17.22985; N 71 26 35.01356, W 163 51 04.63566 for the northern most area. Water depths in the project area are typically less than 50 m.

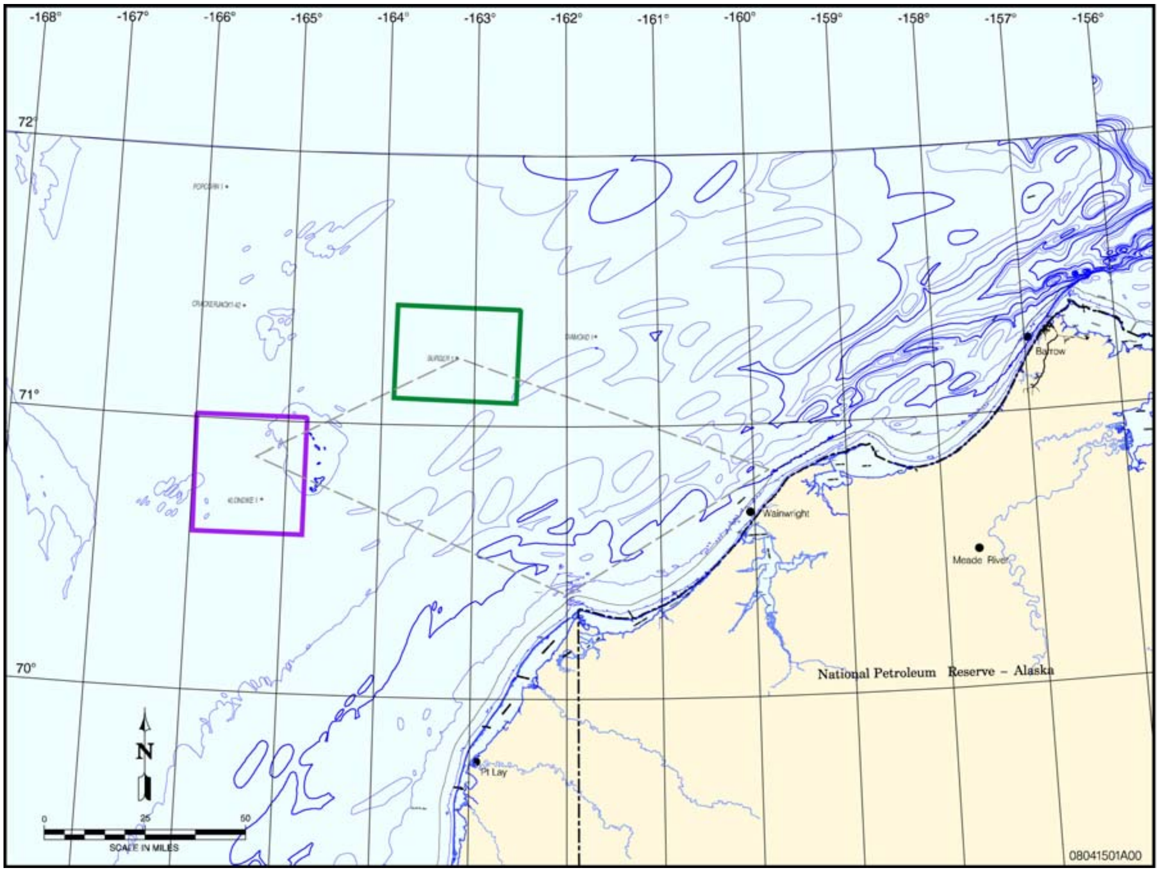

Figure 1 Project area showing two geophysical survey areas (green and purple) and the potential pipeline route (--- lines).

3. Species and Numbers of Marine Mammals Likely to be Found within the Activity Area

A total of seven cetacean, one porpoise, and four pinniped species are known to occur in the project area. Three species, the bowhead, humpback, and fin whale, are listed as Endangered under the Endangered Species Act (ESA). However, the humpback and fin rarely occur in the Chukchi Sea since it is at the extreme northern edge of its geographic range (Angliss and Outlaw 2005). Polar bears and the Pacific walrus also occur in the project area, but they are not addressed in this application. The U.S. Fish and Wildlife Service manage both of these species.

The table below summarizes the estimated abundance and ESA status of each species, which is more fully described in question number 3 to minimize redundancy in the application. Many of the estimates are for the entire geographic region occupied by the stocks, which are much higher than the numbers inhabiting the Chukchi Sea for certain species (fin, humpback, gray, and killer whales, and harbor porpoise). Furthermore, there are no estimates for some stocks (minke whale and ribbon seal).

Table 1. Estimated abundances of marine mammals inhabiting the Chukchi Sea

Species	Estimated Abundance	ESA Status
Bowhead Whale	10,545	Endangered
Beluga Whale (Beaufort Sea)	39,258	-
Beluga Whale (E. Chukchi Sea)	3,710	
Gray Whale	18,813	-
Fin Whale	5,703	Endangered
Killer Whale	≈ 100	-
Humpback Whale	961	Endangered
Minke Whale	No est. available	-
Harbor Porpoise	47,365	-
Ringed Seal	> 249,000	-
Bearded Seal	250,000-300,000	-
Spotted Seal	59,214	-
Ribbon Seal	No est. available	-

4. Description of the Status, Distribution, and Seasonal Distribution (When Applicable) of the Affected Species or Stocks or Marine Mammals Likely to be Affected by such Activities.

The information developed for the technical elements of the application was derived from published and unpublished literature, personal communications with marine mammal scientists, published IHA applications, and CPAI.

Bowhead whale: Bowhead whales only occur at high latitudes in the northern hemisphere and have a disjunct circumpolar distribution (Reeves 1980). They are one of only three whale species (beluga and narwhal) that spend their entire lives in the Arctic. Bowhead whales occur in the western Arctic (Bering, Chukchi, and Beaufort Seas), the Canadian Arctic and West Greenland (Baffin Bay, Davis Strait, and Hudson Bay), the Okhotsk Sea (eastern Russia), and the Northeast Atlantic from Spitzbergen westward to eastern Greenland. The proposed activity will only occur within the range of the Bering-Chukchi-Beaufort Sea (BCB) stock, which is the largest of the four stocks. The stock is classified as endangered under the Endangered Species Act (ESA) and depleted under the Marine Mammal Protection Act (MMPA).

The Bering-Chukchi-Beaufort stock of bowhead whales was estimated at 10,400 to 23,000 animals in 1848, before commercial whaling decreased the stock to between 1,000 and 3,000 animals by 1914 (Woodby and Botkin,1993). This stock has slowly increased since 1921 when commercial whaling ended, and now numbers at least 10,545 whales with an estimated 3.4 to 3.5% (>350 animals/year) annual rate of increase (Brandon and Wade 2004, George et al. 2004a,b, Zeh and Punt 2004, and Angliss and Outlaw 2005). The most recent published count of 121 calves during the 2001 census was the highest recorded for the population (George et al. 2004a). The high calf count is reflected in a high pregnancy rate and low length at sexual maturity, which is characteristic of an increasing and healthy population (George et al. 2004b). The actual population size is likely higher, since the most recent estimate was derived from data collected in 2001. The current population could be over 12,000 bowheads given an annual growth rate (3.4 - 3.5%). Shelden et al. (2001) suggested that the Bering-Chukchi-Beaufort stock should be delisted under the ESA, since its population is within the range of its pre-commercial exploitation size. George et al. (2004a) concluded that the recovery of the BCB Seas bowhead whale population is likely attributable to low anthropogenic mortality, relatively pristine habitat, and well-managed subsistence harvest.

The Bering–Chukchi–Beaufort stock winters in the central and western Bering Sea and largely summers in the Canadian Beaufort Sea (Moore and Reeves 1993, Brueggeman 1982). Spring migration from the Bering Sea follows the eastern coast of the Chukchi Sea to Point Barrow in nearshore leads from mid March to mid June before continuing through the Western Beaufort Sea through offshore ice leads (Braham et al. 1984; Moore and Reeves 1993). Some bowheads arrive in coastal areas of the eastern Canadian Beaufort Sea and Amundsen Gulf in late May and June but most may remain among the offshore pack ice of the Beaufort Sea until mid summer. After leaving the Canadian Beaufort Sea, bowheads migrate westward from late August or September through mid- or late October. A recently (2006) satellite-tagged whale left Canadian waters in early October to begin the fall migration (ADFG, Lori Quackenbush). Fall migration into Alaskan waters is primarily during September and October. However, in recent years a small number of bowheads have been seen or heard offshore from the Prudhoe Bay region during the last week of August (Treacy 1993; LGL and Greeneridge 1996; Greene 1997; Greene et al. 1999; Blackwell et al. 2004). Consistent with this, Nuiqsut whalers have stated that a small number of the earliest arriving bowheads have apparently reached the Cross Island area earlier (late August) than in past years (C. George, personal communication, 2006).

The Minerals Management Service (MMS) has conducted or funded late-summer/autumn aerial surveys for bowhead whales in the Alaska Beaufort Sea since 1979 (e.g., Ljungblad et al. 1986, 1987; Moore et al. 1989; Treacy 1988-1998, 2000, 2002a,b). Bowheads tend to migrate west in deeper water (farther offshore) during years with higher-than average ice coverage than in years with less ice (Moore 2000, Treacy et al. 2006). In addition, the sighting rate tends to be lower in heavy ice years and more widespread in light ice years (Treacy 1997:67; Treacy et al. 2006). During fall migration, most bowheads migrate west in waters ranging from 15 to 200 m deep (Miller et al. 2002 in Richardson and Thomson 2002); some individuals enter shallower water, particularly in light ice years, but very few whales are ever seen shoreward of the barrier islands. Survey coverage far offshore in deep water is usually limited, and offshore movements may have been underestimated. However, the main migration corridor is over the continental shelf.

Bowhead whales typically reach the Pt. Barrow area during their westward migration from the feeding grounds in the Canadian Beaufort Sea in mid-September to late October. Recent studies conducted in conjunction with the 2006 and 2007 seismic programs operated by Shell and CPAI reported no bowhead whales in the Chukchi Sea until after September in 2007 and a few in September in 2006 (LGL et al. 2008). Over the years, local residents report having seen small numbers of bowhead whales feeding off Barrow or in the pack ice off Barrow during summer (Craig George, personal communication). A few bowheads were reported in the Chukchi Sea during July of 2006 during the Shell and CPAI surveys, but it was unclear if these animals were summering or late migrants traveling to the Beaufort Sea feeding ground (LGL et al. 2008). Bowhead whales may feed opportunistically where food is available as they migrate through the Alaskan Beaufort Sea. Recent carbon-isotope analysis of bowhead whale baleen suggests the Chukchi and Bering seas may be the predominant feeding areas for adult and juvenile bowhead whales (Schell et al. 1987; Schell and Saupe 1993, Lee et al. 2005), but this suggestion has been questioned by the scientific community. Examination of stomach contents from whales taken in the Iñupiat subsistence harvest indicates that bowhead whales feed on a variety of invertebrates and small fishes (Lowry 1993). Bowhead whales complete their annual cycle by migrating across the Chukchi Sea in a westerly direction past Wrangel Island and then down the western coast of the Chukchi Sea to the Bering Sea (Miller et al., 1985). This pattern was recently confirmed by observations of movements of a satellite-tagged bowhead whale tracked from the summering grounds in the Beaufort Sea to the wintering grounds in the Bering Sea (ttp://www.wc.adfg.state.ak.us/index.cfm?adfg= marinemammals.bowheadMate).

Beluga Whale: In Alaska, beluga whales comprise five distinct stocks: Beaufort Sea, eastern Chukchi Sea, eastern Bering Sea, Bristol Bay, and Cook Inlet (O'Corry-Crowe et al. 1997). For the proposed project, only the Beaufort Sea stock and eastern Chukchi Sea stock will be encountered. Some eastern Chukchi Sea animals enter the Beaufort Sea in late summer (Suydam et al. 2001). Beluga whales from the eastern Chukchi Sea stock are an important subsistence resource for residents of the village of Point Lay, adjacent to Kasegaluk Lagoon, and other villages in Arctic Alaska.

The Beaufort Sea population is estimated to be in excess of 39,258 whales (Angliss and Outlaw, 2005). An estimated 2,500-3,000 beluga whales summer in the northwestern Beaufort and Chukchi seas, with some using coastal areas such as Peard Bay and Kasegaluk Lagoon (Frost et al. 1988, 1993 *cited in* USDI MMS 2003). This eastern Chukchi Sea stock was estimated at a minimum of about 3,710 whales (Angliss and Outlaw 2005). This population is not considered by NMFS to be a strategic stock, and it is believed to be stable or increasing (DeMaster 1995).

The Beaufort stock of beluga whales winter in the Bering Sea, summer in the eastern Beaufort Sea, and migrate around western and northern Alaska (Angliss and Lodge 2002). Most of these belugas 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. 1995). Much of this stock enters the Mackenzie River estuary during July–August to molt, but they spend most of the summer in offshore waters of the eastern Beaufort Sea and Amundsen Gulf (Davis and Evans 1982; Harwood et al. 1996; Richard et al. 2001). Belugas are rarely seen in the central Alaskan Beaufort Sea during summer. During late summer and autumn, most belugas migrate far offshore near the pack ice front (Frost et al. 1988; Hazard 1988. However, during the westward migration in late summer and autumn, small numbers of belugas are sometimes seen near the north coast of Alaska (e.g., Johnson 1979). Nonetheless, the main fall migration corridor of beluga whales is ~100+ km north of the coast. Satellite-linked telemetry data show that some belugas migrate west considerably farther offshore, as far north as 76ºN to 78ºN latitude (Richard et al. 1997, 2001).

The eastern Chukchi Sea stock seasonally inhabits the coastal areas off Alaska. Belugas have been predictably sighted near the Kasegaluk Lagoon from late June through mid to late July, after which they move north and east before returning to the Chukchi Sea in fall and then to the Bering Sea to winter (Lowry et al. 1999 in Lowry 2001; Suydam et al. 2001, Suydam et al. 2005, LGL et al. 2008). Suydam et al. (2005) satellite-tagged 23 belugas in Kasegaluk Lagoon in June/July 1998-2002, and found they moved north and east into the northern Chukchi Sea and western Beaufort Sea during July to September. Male belugas moved north of 75º N, with adult males moving farther north (beyond 79º N or > 1100 km north of the Alaska coast), using deeper water, and remaining there for the summer. Early in the northward migration adult males traveled in heavy ice (>90 % ice cover in pack ice) to reach 79-80º N by late July/early August. Belugas of all ages and both sexes most often occurred in water deeper than 200m along and beyond the continental shelf break, but some adult and immature females remained at or near the shelf break throughout summer and early fall. Brueggeman et al. (1990, 1991, 1992) recorded as many as 1,276 sightings of beluga whales west and southwest of Point Barrow during more than 1173 hr of vessel survey and over 40 flights in summer to early fall (July to October) of five oil and gas prospects in the Chukchi Sea; over 90% of the belugas were in a single group at Kasegaluk Lagoon on July 1. These data suggest the eastern Chukchi stock ranges over a broad area during summer and fall, primarily near and considerably beyond the continental shelf break regardless of ice cover.

Gray Whale:

There are two gray whale populations in the North Pacific based on geographic separation and an increase in the size of one population but not the other (Swartz et al. 2000). The small western North Pacific Ocean population, which summers near Sakhalin Island off Asia, is very far from the proposed project area. The larger eastern North Pacific Ocean population summers in the Bering, Chukchi, and western extreme of the Beaufort Sea and largely winters in the lagoons off Mexico. The population is currently estimated at 18,813 whales based on the mean of the 2000/01 and 2001/02 estimates derived by Rugh et al. (2005). Based on the current population trend and estimates, Rugh et al. (2005) and Wade and Perryman (2002) stated that the population is near or at carrying capacity. The eastern North Pacific stock is not listed under ESA or considered by NMFS to be a strategic stock.

Most summering gray whales congregate in the northern Bering Sea, particularly off St. Lawrence Island and in the Chirikov Basin (Moore et al. 2000), and in the southern Chukchi Sea. More recently, Moore et al. (2003) suggested that gray whale use of Chirikov Basin has decreased, likely from the combined effects of changing currents resulting in altered secondary productivity dominated by lower quality food. The northeastern-most of the recurring feeding areas is in the northeastern Chukchi Sea southwest and west of Pt. Barrow (Clarke et al. 1989, Brueggeman et al. 1992). Brueggeman et al. (1992) reported 258 gray whale sightings within the pack ice west and southwest of Barrow in the Chukchi Sea during aerial and vessel surveys in 1991. More recently, gray whales were encountered relatively frequently in this region in the nearshore waters from Point Hope to Point Barrow during aerial surveys conducted in conjunction with the 2006 and 2007 seismic programs operated by Shell and CPAI (LGL et al. 2008). The increased frequency of gray whale sightings in this region is likely a reflection of recovery of the population to pre-exploitation level and the need to exploit more distant summer feeding areas.

Only a small number of gray whales enter the Beaufort Sea east of Pt Barrow from the Chukchi Sea (Angliss and Outlaw 2005). Hunters at Cross Island (near Prudhoe Bay) took a single gray whale in 1933 (Maher 1960). Only one gray whale was sighted in the central Alaskan Beaufort Sea during the extensive aerial survey programs funded by MMS and industry from 1979 to 1997. However, during September 1998, small numbers of gray whales were sighted on several occasions in the central Alaskan Beaufort (Miller et al. 1999; Treacy 2000). More recently, a single sighting of a gray whale was made on 1 August 2001 near the Northstar production island (Williams and Coltrane 2002). Several single gray whales have been seen farther east in the Beaufort Sea (Rugh and Fraker 1981; LGL Ltd., unpubl. data), indicating that small numbers must travel through the region during some summers. In recent years, ice conditions were lighter near Barrow, and gray whales may have become more common. In the springs of 2003 and 2004, a few tens of gray whales were seen near Barrow by early-to-mid June (LGL Ltd and NSBDWM, unpubl. data). In addition, four gray whales were encountered each year during aerial and vessel surveys associated with Shell's 2006 and 2007 seismic program in the Beaufort Sea (LGL et al 2008). Consequently, the northeastern Chukchi Sea is a feeding area and also a transition area for small number of gray whales inhabiting the Beaufort Sea in summer.

Killer Whale: Killer whales are known to inhabit almost all coastal waters of Alaska, extending from the Chukchi and Bering seas into the Beaufort Sea. Killer whales appear to prefer coastal areas, but are also known to occur in deep water (Dahlheim and Heyning 1999). Killer whales are uncommon in the Chukchi and Beaufort seas based on the paucity of sightings by researchers. Brueggeman et al. (1992) reported a pod of 12 killer whales southwest of Barrow in Peard Bay during aerial surveys conducted in 1991. There have been sightings of killer whales off Point Barrow, Point Lay, Peard Bay, and Point Hope by natives but none in the last ten years, suggesting they are occasionally present but uncommon in the project area (George and Suydam 1998). More recently, one to two killer whales were recorded in the Chukchi Sea during the Shell and CPAI seismic program in 2006 and 2007 (LGL et al. 2008). While there is no current population estimate for the project area, ADFG (1994) provided an estimate of about 100 killer whales in the Bering Sea in the early 1990s.

Minke Whales:

Very little is known about minke whale use of the Chukchi Sea, and they would not be expected to occur in the Beaufort Sea. Sightings are infrequently reported during the open water season in the Chukchi Sea. Brueggeman et al. (1990) reported one minke whale in the northeastern Chukchi Sea during extensive vessel and aerial surveys from 1989 through 1991. More recently, vessel surveys conducted by Shell and CPAI in 2006 and 2007 encountered a few minke whales (3 whales/year)in the Chukchi Sea (LGL et al 2008). There are no estimates for minke whales in the Chukchi Sea, but numbers are clearly very low because it is the northern extreme of its range.

Other Cetaceans:

Very small numbers of other cetaceans could occur in the project area including fin and humpback whales and harbor porpoise. Fin and humpback whales are endangered and several have been recently observed in the Chukchi Sea (LGL et al. 2008). The Chukchi Sea is the northern most extreme of their range and no more than a few whales would be expected in the central to northern Chukchi Sea during summer (Angliss and Outlaw 2005, LGL et al. 2008). Humpbacks inhabit coastal areas would not be expected to occur offshore in the vicinity of the project area. Small numbers of harbor porpoises have been observed in the Chukchi Sea during summer, but it is unclear if these whales were nearshore or offshore (LGL et al. 2008). Harbor porpoises typically occur nearshore in bays and inlets where they travel as single animals (Angliss and Outlaw 2005). There are no population estimates for harbor porpoise in Alaska, and the estimate for fin whales (5,703 whales) and humpback whales (961) are for northeast and central Pacific Ocean, respectively (Angliss and Outlaw 2005).

Ringed Seals:

Ringed seals have a circumpolar distribution, which is closely associated with sea ice. Ringed seals are found throughout the Bering, Chukchi, and Beaufort Seas (Angliss and Outlaw 2005). They are the most abundant and widely distributed seal in the Chukchi and Beaufort Seas (King 1983).

Although there are no recent population estimates for the Alaska arctic, Bengtson et al. (2005) estimated ringed seal abundance from Barrow south to Shismaref in the Chukchi Sea to be 252,488 (SE=47,204) for 1999 and 208,857 (SE=25,502) in 2000 for an average of 230,673 seals. Frost et al (2002) estimated a density of 0.98 km^2 seals for 18,000 km^2 surveyed in the Beaufort Sea, which Angliss and Outlaw (2005) combined with the average estimate from Bengston et al. (in review) for a total minimum estimate of 249,000 ringed seals in the Beaufort and Chukchi seas. This is a minimum estimate, since Frost et al (2002) and Bengston et al (2005) surveyed a small part of the ringed seal habitat in the Beaufort and Chukchi Seas, and Frost et al. (2002) did not correct for missed seals. Consequently, estimates are likely much higher than reported, and they could be as high or approach past estimates of 1-3.6 millions ringed seals in the Alaska stock (Frost 1985; Frost and Lowry 1988; Frost et al. 1988).

Results from surveys by Bengston et al (2005) in May and June of 1999 and 2000 indicated ringed seal densities are higher in nearshore fast ice and pack ice, and lower in offshore pack ice, which is less stable and extensive. However, in some areas where there is limited fast ice but wide expanses of pack ice, the total numbers of ringed seals on pack ice may exceed those on shorefast ice (Burns 1970; Stirling et al. 1982; Finley et al. 1983). Frost et al. (2004) reported slightly higher ringed seal densities in the pack ice (0.92-1.33 seals/km^2) than in the shorefast ice (0.57-1.14 seals/km^2) in the central Beaufort Sea during late May and early June of 1996-1999, when seals are most commonly hauled out on the ice. Wiig et al., (1999) found highest seal densities on stable landfast ice, but significant numbers of ringed seals also occur in pack ice. During summer, high densities of ringed seals are associated with ice remnants (Burns et al. 1980 *cited in* USDI MMS 2003). Brueggeman et al. (1990, 1991, 1992) recorded as many as 668 sightings of ringed seals west and southwest of Point Barrow during more than 1173 hr of vessel survey and over 40 flights in summer to early fall (July to October) of five oil and gas prospects in the Chukchi Sea; ringed seals were over three times more often sighted than bearded seals, the next most common seal. These results suggest that ringed seal use is widespread in the sea ice but somewhat higher in nearshore that offshore ice during spring after which they use ice remnants during summer. Sea ice use depends on a variety of seasonal, environmental, and seal behavioral conditions, but appears to be relatively similar between the Chukchi and Beaufort Seas. Some ringed seals also occur in open water during summer south of the pack ice (LGL et al. 2008).

Ringed seals are a polygamous species. When sexually mature, they establish territories during the fall and maintain them during the pupping season. Pups are born in late March and April in lairs that seals excavate in snowdrifts and pressure ridges. During the breeding and pupping season, adults on shorefast ice (floating fast-ice zone) usually move less than individuals in other habitats; they depend on a relatively small number of holes and cracks in the ice for breathing and foraging. During nursing (4 to 6 weeks), pups usually stay in the birth lair. Alternate snow lairs provide physical and thermal protection when the pups are being pursued by their primary predator, polar bears and Arctic foxes (Smith et al. 1991 *cited in* USDI MMS 2003). The primary prey of ringed seals is Arctic cod, saffron cod, shrimps, amphipods, and euphausiids (Kelly 1988; and Reeves et al. 1992 *cited in* USDI MMS 2003). Ringed seals are a major resource that subsistence hunters harvest in Alaska (USDI MMS 2003).

Bearded Seals:

Bearded seals, the second most common seal in the arctic, are associated with sea ice and have a circumpolar distribution (Burns 1981). During the open-water period, bearded seals occur mainly in relatively shallow areas, because they are predominantly benthic feeders (Burns 1981). They prefer areas no deeper than 200 m (e.g., Harwood et al. 2005).

Bearded seals occur over the continental shelves of the Bering, Chukchi, and to a lesser extend the Beaufort Sea (Burns 1981). Reliable estimates of bearded seal abundance in Alaska waters are unavailable (Angliss and Outlaw 2005). However, Bengtson et al. (2005) estimated the average density for the eastern Chukchi Sea to be 0.07-0.14 seals/km² between Barrow and Shismaref from surveys conducted in 1999 and 2000. While he did not adjust the density for haul out behavior to estimate abundance, he did state that actual densities could be of a magnitude 12.5 times higher or 0.87-1.75 seals/km². Extrapolating these densities to abundance would put the number below but close to the estimate of ringed seals (230,000) in the Chukchi Sea. While there are no current estimates for bearded seals in the rest of their range off Alaska, early estimates of the entire Alaska stock ranged from 250,000-300,000 seals (Angliss and Outlaw 2005, Popov 1976, Burns 1981), which may be reasonable if not low given the estimate suggested by Bengtson et al. (2005) for a small part of their range. The Alaska stock of bearded seals is not classified by NMFS as a strategic stock.

Seasonal movements of bearded seals are directly related to the advance and retreat of sea ice and to water depth (Kelly 1988). During winter, most bearded seals are in the Bering Sea. In the Chukchi and Beaufort seas, favorable conditions are more limited, and consequently, bearded seals are scarce there during winter. From mid-April to June, as the ice recedes, some of the bearded seals over-wintering in the Bering Sea migrate northward through the Bering Strait. During summer they occur near the widely fragmented margin of multi-year ice covering the continental shelf of the Chukchi Sea and in nearshore areas of the central and western Beaufort Sea (LGL et al. 2008). Brueggeman et al. (1990, 1991, 1992) recorded as many as 258 sightings of bearded seals west and southwest of Point Barrow during over 1173 hr of vessel survey and more than 40 flights in July to October of five oil and gas prospects in the Chukchi Sea.

In some areas, bearded seals are associated with the ice year-round; however, they usually move shoreward into open water areas when the pack ice retreats to areas with water depths >200 m. During summer, when the Bering Sea is ice-free, the most favorable bearded seal habitat is found in the central or northern Chukchi Sea along the margin of the pack ice. Suitable habitat is more limited in the Beaufort Sea where the continental shelf is narrower and the pack ice edge frequently occurs seaward of the shelf and over water too deep for benthic feeding.

Pupping takes place on top of the ice less than 1 meter from open water from late March through May mainly in the Bering and Chukchi seas, although some takes place in the Beaufort Sea (Kovacs et al. 1996 *cited in* USDI MMS 2003). These seals do not form herds but sometimes do form loose groups. Bearded seals feed on a variety of primarily benthic prey, decapod crustaceans (crabs and shrimp) and mollusks (clams), and other food organisms, including Arctic and saffron cod, flounders, sculpins, and octopuses (Kelly 1988; and Reeves et al. 1992 *cited in* USDI MMS 2003).

Spotted Seal

Spotted seals (also known as largha seals) seasonally occur in the Beaufort, Chukchi, and Bering seas (Shaughnessy and Fay 1977). Spotted seals occur in large numbers along the Chukchi Sea coast from June to October (USDI MMS 1990, LGL et al. 2008) and in lower numbers along the Beaufort coast, hauling out on beaches, barrier islands, and remote sandbars on the river deltas (USDI MMS 2003). Haulouts within Kasegaluk Lagoon in the Chukchi Sea contain among the largest spotted seal concentrations in Alaska (Frost et al. 1993). Spotted seals migrate from the Chukchi or Beaufort Seas in the fall to the Bering Sea where they winter.

A reliable estimate of spotted seals is currently not available. However, surveys conducted by Rugh et al. (1993) in the Bering Sea and at known haul out sites resulted in maximum counts of 4,145 in 1992 and 2,591 in 1993. Using the maximum count with a correction factor for missed seals, Angliss and Outlaw (2005) developed an estimate of 59,214 spotted seals. This represents a minimum estimate, since a substantial portion of their range was not included in the survey.

During spring when pupping, breeding, and molting occur, spotted seals are along the southern edge of the sea ice in the Bering Sea (Quakenbush 1988; Rugh et al. 1997). In late April and early May, adult spotted seals are often seen on the ice in female-pup or male-female pairs, or in male-female-pup triads. Subadults may be seen in larger groups of up to two hundred animals. During summer, spotted seals are primarily in the Bering and Chukchi seas, but some range into the Beaufort Sea (Rugh et al. 1997; Lowry et al. 1998) from July until September. At this time of year, spotted seals haul out on land part of the time, but also spend extended periods at sea. The seals are commonly seen in bays, lagoons and estuaries, but also range far offshore as far north as 69–72ºN. In summer, they are rarely seen on the pack ice, except when the ice is very near to shore. Brueggeman et al. (1990, 1991, 1992) recorded 50 or fewer sightings of spotted seals west and southwest of Point Barrow during over 1173 hr of vessel survey and more than 40 flights in summer to early fall (July to October) of five oil and gas prospects in the Chukchi Sea; considerably fewer spotted seals were observed than ringed or bearded seals. Spotted seals leave the Chukchi and Beaufort seas as ice cover thickens with the onset of winter and move into the Bering Sea (Lowry et al. 1998). Important prey includes pelagic fishes, octopus, and crustaceans.

Ribbon Seal

Ribbon seals seasonally inhabit the Bering, Chukchi, and western Beaufort Sea (Angliss and Outlaw, 2005). They winter in the Bering Sea and follow the retreat and advance of the pack ice into the Chukchi and eastern Beaufort Seas during spring and fall. Little is known about the movements or abundance of ribbon seals during summer but sightings suggest they are relatively uncommon in the eastern Chukchi and Beaufort Seas. Extensive aerial and vessel surveys conducted in the eastern Chukchi Sea west of Icy Cape and Pt. Barrow during summer and fall of 1989, 1990, and 1991 documented one ribbon seal (Brueggeman et al. 1990, 1991, 1992). More recent aerial and vessel surveys conducted by CPAI and Shell in summer and fall of 2006 and 2007 from Point Hope to Point Barrow and considerably westward in the eastern Chukchi Sea reported one ribbon seal in 2006 but none in 2007 (LGL et al. 2008). Ribbon seals do not show up in the limited subsistence harvest data available for villages from Point Hope northward along the Alaska coast (Fuller and George 1997). These results collectively indicate that ribbon seals are extremely uncommon in the proposed survey area.

5. The Type of Incidental Taking Authorization that is being Requested (i.e., Takes by Harassment Only; Takes by Harassment, Injury and/or Death) and the Method of Incidental Taking.

CPAI is requesting authorization for incidental taking by harassment (Level B as defined in 50 CFR 216.3) of small numbers of marine mammals during its planned site clearance/shallow hazard survey in the northeastern Chukchi Sea from July to the end of November depending on ice conditions. The operations outlined in § 1 and 2 have the potential to take marine mammals by harassment. As discussed in Section 1 JASCO modeled the sound levels of different configurations of seismic profilers and found the 4, 10 in³-gun array produced the highest sound levels. Therefore, take estimates of marine mammals are calculated for the 4-gun array in this IHA, General vessel noise from the seismic vessel will typically be masked by airgun operations.

"Takes" by harassment will potentially result when marine mammals near the site clearance/shallow hazard survey are exposed to the pulsed sounds generated by the airguns. The effects will depend on the species of cetacean or pinniped, the behavior of the animal at the time of reception of the stimulus, as well as the distance and received level of the sound (see § 7). Temporary disturbance reactions are likely amongst some of the marine mammals in the general vicinity of the tracklines of the source vessel. No take by serious injury is anticipated, given the nature of the planned operations and the planned mitigation measures (see § 11, "MITIGATION MEASURES"). No intentional or lethal takes are expected.

6. By Age, Sex, and Reproductive Condition (if Possible), the Number of Marine Mammals (By Species) that May be Taken by Each Type of Taking, and the Number of Times such Takings by Each Type of Taking are Likely to Occur.

All anticipated takes would be "takes by harassment", involving short term, temporary changes in behavior. The mitigation measures to be applied will minimize the possibility of injurious takes. However, there is no specific information demonstrating that injurious "takes" would occur even in the absence of the planned mitigation measures. Nor are we aware of any evidence of seismic operations in general much less site clearance/shallow hazard surveys causing a decline of a marine mammal population (see NMFS stock assessment reports since 1995 (http://www.nmfs.noaa.gov/pr/sars/species.htm). Consequently, any take would be limited to Level B harassment.

In the sections below, we present the most current marine mammal density estimates obtained from the literature and present estimates of the numbers of marine mammals that might be affected during the proposed survey. The density estimates are taken from the published report of marine mammal surveys conducted during the Shell and CPAI seismic program in the Chukchi Sea during 2007 (LGL et al. 2008). Vessel-based estimates are reported for summer and fall in the offshore areas, which is in the general vicinity of the two areas of the project area. Since these are the most recent density estimates for the region, they were used to calculate take for the proposed project. There are no density estimates for ribbon seals, beluga, humpback whales or fin whales, which rarely occur in the region of the project area.

Take was calculated for the two areas of the study area using vessel-based density estimates (Table 2). Few bowheads and no belugas were observed during the vessel surveys conducted in the Chukchi Sea by LGL et al. (2008), although the surveys used multiple vessels achieving substantial effort and coverage from early July to mid November. This result is generally consistent with the historic information, which shows that bowheads generally migrated through the Chukchi Sea to the Beaufort Sea by mid-late June, and don't return until about late October and November, probably reaching the region of the project area no earlier than late October (LGL et al. 2008). Similarly, most belugas migrate to the northern Chukchi Sea and westward into the Beaufort Sea by mid to late July and return to the region of the project area in late October and November (Suydam et al. 2005). Although LGL et al. (2008) did not observe belugas offshore in 2006 or 2007, they did encounter belugas along the coast in decreasing numbers from July to Oct/Nov during aerial surveys. LGL et al. (2008) also observed bowheads in the fall near Barrow during nearshore aerial surveys, suggesting the whales had not moved very far into Chukchi Sea at that time. While these data and the historic information suggest the take calculations are reasonable for belugas and bowheads, we have adjusted the take to 10 animals for each species to account for the possible occurrence of more animals than estimated in the project area during operations due to an early freeze-up or other unanticipated changes in the environment. This adjustment is generally consistent with estimates based on less current densities used in past IHAs for bowhead ($0.0011/km^2$) and beluga ($0.0034/km^2$) whales for late fall.

The vessel-based density estimates for ringed and spotted seals were reported in the LGL et al. (2008) study as a combined estimate for the two species, since observers were not able to distinguish the two species in the open water. Therefore, take was calculated for the two species in combination. It is likely ringed seals comprise the greatest proportion of the estimated take given almost 95% (1,379 seals) of the combined ringed/spotted seal (668/40) sightings recorded during surveys in offshore waters of the Chukchi Sea during 1989-1991 were ringed seals (Brueggeman et al.1990, 1991, 1992). The take for killer, fin, and humpback whales and ribbon seals was collectively estimated at ten animals, since there species rarely occur in the project area and lack or have extremely low (killer whale) density estimates.

The estimated take of marine mammals is presented in Table 3 based on the density estimates in Table 2 and noise transmission loss estimates in Table 4. Disturbance (Level B) was assumed to occur at and above the 160 dB level for all marine mammal species based on NOAA guidelines. Estimated distances at received levels were based on a four gun (10 in^3 /gun) array derived from data provided by JASCO; the distances from this sound source to the 160 dB, 180 dB, and 190 dB level were greatest for this configuration (see JASCO report in Appendix). Other sound sources from the vessel were assumed to be overwhelmed by the airguns, and therefore were not incorporated in the take estimates.

Table 2. Estimated density (#/km²) of marine mammals in the Chukchi Sea used to calculate take for the 2008 geophysical survey[1]

Species	Average Offshore Density Estimate (Summer)	Average Offshore Density Estimate (Fall)
Ringed/Spotted Seal	0.0405	0.1101
Bearded Seal	0.009	0.0294
Bowhead Whale	0.0002	0.0001
Gray Whale	0.0035	0.0011
Beluga Whale	0.00	0.00
Killer Whale	0.00004	0.0
Minke Whale	0.0006	0.0
Harbor Porpoise	0.0028	0.0021

[1] Densities were based on 2007 vessel surveys of the Chukchi Sea in the region of the project area (LGL et al. 2008). Summer corresponds to June, July, and August, and fall corresponds to September, October, and November.

Table 3. Estimated take of marine mammals for 2008 geophysical survey in the Chukchi Sea.[1]

Month	Track Planned (km)	Bowhead	Gray	Beluga	Minke	Harbor Porpoise	Ringed/ Spotted	Bearded	Other[2]
Aug	2,120	1	25	0	4	20	286	64	-
Sept	2,120	1	8	0	0	15	777	208	-
Oct	1,060	1	4	0	0	7	389	104	-
Estimated Take	**5,300**	**10**	**37**	**10**	**4**	**42**	**1452**	**376**	**10**

[1]The total estimated take was adjusted to 10 animals each for bowheads, belugas, and the species in the other category to account for any underestimation of the take due to changing environmental conditions. This adjustment is consistent with estimates based on densities used in past IHAs for bowheads (0.001/km²) and beluga (0.0034/km²) whales for the late fall.
[2]Other equals ribbon seals, and humpback, fin, and killer whales
Take = (A) x (2B) x (C), where A = km of track shot with the 4 gun array (Table 2). B = transmission loss distance (km) to 160dB for the 4 gun array for all species (Table 4), C = average density (Table 1).
Take Calculation Example: 2120 km x 3.3 km x 0.0002 (density) =1 bowhead for the 4 gun array for August.

Take was not calculated for the other instruments on board the vessel, since their influence on marine mammals is less than for the airgun configurations. It is assumed that, during simultaneous operations of those additional sound sources and the airgun(s), any marine mammals close enough to be affected by the other instrumentation would already be affected by the airgun(s). However, whether or not the airgun(s) is operating simultaneously with the other sound sources, marine mammals are expected to exhibit no more than short-term and inconsequential responses to them given the instrumentation characteristics (e.g., narrow downward-directed beam, very high frequency, low power) and other considerations described in this document. Such reactions are not considered to constitute "taking" (NMFS 2001). Therefore, no additional allowance is included for animals that might be affected by the sound sources other than the airgun(s).

7. The Anticipated Impact of the Activity on the Species or Stock

This section includes a description of the impact of geophysical survey on marine mammals. The impacts are expected to be no more than negligible given the site clearance/shallow hazard survey will involve a relatively low volume of the energy source compared to typical seismic operations.

Potential Effects of Airgun Sounds.

The effects of sounds from airguns on marine mammals might include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, and at least in theory, temporary or permanent hearing impairment, or non-auditory physical effects (Richardson et al. 1995). Because of the small size of the airgun and the mitigation procedures it is unlikely there would be any temporary or especially permanent hearing impairment, or non-auditory physical effects. Also, behavioral disturbance is expected to be short term and limited to relatively short distances from the noise source. Consequently, the geophysical surveys are not expected to impact any marine mammal stocks.

Tolerance

Studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers. Numerous studies have shown that marine mammals at distances over a few kilometers from operating seismic vessels often show no apparent response. That is often true even when pulsed 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 airgun pulses under some conditions, at other times they have shown no overt reactions. In general, pinnipeds and small odontocetes seem more tolerant of exposure to airgun pulses than baleen whales.

Masking

Masking of marine mammal calls and other natural sounds are expected to be limited, although there are very few specific data of relevance. Some whales are known to continue calling in the presence of seismic pulses. Their calls can be heard between seismic pulses (e.g., Richardson et al. 1986; McDonald et al. 1995; Greene et al. 1999; Nieukirk et al. 2004). Masking effects of seismic pulses are expected to be negligible in the case of the smaller odontocete cetaceans, given the intermittent nature of seismic pulses. Also, the sounds important to small odontocetes are predominantly at much higher frequencies (> 1 kHz) than are airgun sounds (<1 kHz).

Disturbance Reactions

Disturbance includes a variety of effects, including subtle changes in behavior, more conspicuous changes in activities, and displacement. Based on NMFS (2001, p. 9293), we assume that simple exposure to sound, or brief reactions that do not disrupt behavioral patterns in a potentially significant manner, do not constitute harassment or "taking". By potentially significant, we mean "in a manner that might have deleterious effects to the well-being of individual marine mammals or their populations".

Reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, and many other factors. If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a short distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or the species as a whole. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on the animals could be significant. Given the many uncertainties in predicting the quantity and types of impacts of noise on marine mammals, it is common practice to estimate how many mammals were present within a particular distance of industrial activities, or exposed to a particular level of industrial sound. That likely overestimates the numbers of marine mammals that are affected in some biologically important manner.

The sound criteria used to estimate how many marine mammals might be disturbed to some biologically important degree by a geophysical program are based on behavioral observations during studies of several species. However, information is lacking for many species. Detailed studies have been done on gray, bowhead whales, and ringed seals, where the scientific literature shows that seismic sounds from large arrays have not had a biologically significant effect on these populations. The small size of the proposed program would have even less affect on marine mammals.

Baleen Whales. — Baleen whales generally avoid operating airguns, but avoidance radii are quite variable (Malme et al. 1984, 1985, 1988; Richardson et al. 1986, 1995, 1999; Ljungblad et al. 1988; Richardson and Malme 1993; McCauley et al. 1998, 2000a; Miller et al. 1999; Gordon et al. 2004). Whales often show no overt reactions to pulses from large arrays of airguns at distances beyond a few kilometers, even when airgun pulses remain well above ambient noise levels for longer distances. However, baleen whales exposed to strong noise pulses from airguns may react by deviating from their normal migration route around the sound source and/or interrupting their feeding and moving away. However, the observed changes in behavior of migrating bowhead and gray whales appeared to be of little or no biological consequence to the animals. They simply avoided the sound source by adjusting their track within the natural boundaries of the migration corridors. The relatively low volume of the airguns used for the proposed program should not disrupt the migratory behavior of marine mammals.

Studies of gray and bowhead whales have shown 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. Seismic pulses from large airgun arrays often diminish to those levels out to distances ranging from 4.5 to 14.5 km from the source. Bowhead whales on their summering grounds in the Canadian Beaufort Sea showed no obvious reactions to pulses from seismic vessels at distances of 6 to 99 km (3–53 nm.) and received sound levels of 107–158 dB on an approximate rms basis (Richardson et al. 1986); their general activities were indistinguishable from those of a control group. However, subtle but statistically significant changes in surfacing–respiration–dive cycles were evident upon statistical analysis. Bowheads usually did show strong avoidance responses when seismic vessels approached within a few kilometers (~3–7 km or 1.6–3.8 n.mi.) and when received levels of airgun sounds were 152–178 dB (Richardson et al. 1986, 1995; Ljungblad et al. 1988). In one case, bowheads engaged in near-bottom feeding began to turn away from a 30-airgun array with a source level of 248 dB re 1 µPa · m at a distance of 7.5 km (4 n.mi.), and swam away when it came within about 2 km (1.1 n.mi.). Some whales continued feeding until the vessel was 3 km (1.6 n.mi.) away. This work and a more recent study by Miller et al. (2005), show that feeding bowhead whales tend to tolerate higher sound levels than possibly migrating whales before showing an overt change in behavior. The feeding whales may be affected by the sounds, but the need to feed may reduce the tendency to move away. Reaction distances would be considerably shorter during the present project than the larger arrays, as a small energy source will be used.

Bowhead whales migrating west across the Alaskan Beaufort Sea in autumn may react more often to seismic operations than during other activities. Richardson (1999) suggested migrating bowheads reacted to seismic sounds out to distances of 20–30 km from a medium-sized airgun source (Miller et al. 1999; Richardson 1999). In 1996–98, a partially-controlled study of the effect of Ocean

Bottom Cable (OBC) seismic surveys on westward-migrating bowheads was conducted in late summer and autumn in the Alaskan Beaufort Sea (Miller et al. 1999; Richardson et al. 1999). Aerial surveys suggested that some westward-migrating whales may have avoided an active seismic survey vessel by 20–30 km (10.8–16.2 n.mi.), and that few bowheads approached within 20 km (10.8 n.mi.). Received sound levels at those distances were only 116–135 dB re 1 μPa (rms). Some whales may have begun to deflect from their migration path when as much as 35 km (19 n.mi.) away from the airguns according to Richardson (1999). Deflection, however, was less in 1997 than in 1998 for reasons not explained by Richardson. Moreover, avoidance of the area of seismic operations did not persist beyond 12–24 h after seismic shooting stopped. While we believe Richardson's interpretation of the data is questionable based on the sample size, absence of corroborating behavioral observations recorded during the study, and the literature on bowhead response to seismic sounds, the energy levels from the proposed project will be much smaller and travel shorter distances than the larger arrays, and highly unlikely to cause any change in the migration path of bowhead whales.

Malme et al. (1986, 1988) found that 50% of a group of gray whales ceased feeding at an average received pressure level of 173 dB re 1 μPa on an (approximate) rms basis to pulses from a single 100 in³ airgun off St. Lawrence Island in the northern Bering Sea. In addition, 10% of whales interrupted feeding at received levels of 163 dB. Malme at al. (1986) estimated that an average pressure level of 173 dB occurred at a range of 2.6 to 2.8 km (1.4–1.5 n.mi.) from an airgun array with a source level of 250 dB (0-pk) in the northern Bering Sea. There was no indication that western gray whales exposed to seismic noise were displaced from their overall feeding grounds near Sakhalin Island during seismic programs in 1997 (Würsig et al. 1999) and in 2001. However, there were indications of subtle behavioral effects and (in 2001) localized avoidance by some individuals (Johnson 2002; Weller et al. 2002). The smaller volume of the energy source for the proposed project will achieved sound levels over 160 dB at a much smaller radius than the airguns discussed above, resulting in few if any affects on feeding gray whales.

Experiments were conducted on larger numbers of gray whales migrating along the California coast. Malme and Miles (1985) concluded that, during migration, changes in swimming pattern occurred for received levels of about 160 dB re 1 μPa and higher, on an approximate rms basis. The 50% probability of avoidance was estimated to occur at a closest point of approach distance of 2.5 km (1.3 n.mi.) from a 4000-in³ array operating off central California. This would occur at an average received sound level of about 170 dB (rms). Some slight behavioral changes were noted at received sound levels of 140 to 160 dB (rms). Such sound levels from the proposed energy source would be found at only a few hundred meters from the source.

Seismic sounds have been hypothesized but not demonstrated or reported in the literature to reduce reproduction rates by causing cows to separate or abandon calf. All of the scientific evidence shows that seismic and other anthropogenic activities, including the most extreme activity, commercial whaling, have not caused the separation or abandonment of cow-calf pairs. The cow-calf maternal bond in bowhead and other species of whales is among the strongest found in nature. The relatively small energy of the proposed airgun system is unlikely to cause disruption of cow-calf pairs.

Data on short-term reactions (or lack of reactions) of cetaceans to impulsive noises do not necessarily provide information about long-term effects, however, cetaceans and other marine mammals have been exposed to seismic operations in the Chukchi and Beaufort Seas since the early 1980 with no apparent impact to the health or fitness of the populations. Seismic operations have been occurring in the Chukchi Sea every year since 1981 except during 1988, 1991, 1992, 1993, and 1995 to 2006. Seismic operations were most intense between 1981 and 1990 when five seismic vessels were operating during 1 year, four during 4 years, three during 3 years, and two during 2 years. All were conducting 2-d seismic surveys. A similar and at times greater level of seismic operations occurred in the Beaufort Sea during this time also using 2-d surveys, and more recently (1998-2004) 3-d surveys. During this time both the gray and bowhead whale populations have continued to use their historic summer and wintering grounds and migration routes, and have grown substantially to the point where gray whales are at or near carrying capacity and the bowhead population size is within the per-commercial exploitation levels. Consequently, single or multiple seismic operations have not been demonstrated to have had a biologically significant effect on the individuals or populations of bowhead whales, gray whales, or other marine mammals.

Toothed Whales. Little systematic information is available about reactions of beluga and killer whales to noise pulses. Beluga whales exhibit changes in behavior when exposed to strong, pulsed sounds similar in duration to those typically used in seismic surveys (Finneran et al. 2000, 2002). However, the animals tolerated high received levels of sound (pk–pk level >200 dB re 1 µPa) before exhibiting aversive behaviors. Belugas summering in the Eastern Beaufort Sea may have avoided the area of seismic operations (2 arrays with 24 airguns per array) by 10-20 km, although belugas occurred as close as 1540 m to the line seismic operations (Miller et al 2005). Observers stationed on seismic vessels operating off the United Kingdom from 1997–2000 have provided data on the occurrence and behavior of various toothed whales exposed to seismic pulses (Stone 2003; Gordon et al. 2004). Killer whales were found to be significantly farther from large airgun arrays during periods of shooting compared with periods of no shooting. The displacement of the median distance from the array was ~0.5 km (0.3 n.mi.) or more. Killer whales also appear to be more tolerant of seismic shooting in deeper water. The relatively low energy of the proposed airgun system should have no more than a negligible affect on belugas and other toothed whales. Moreover, hearing sensitivity of toothed whales normally occurs at frequencies much higher than those generated by airguns, which are normally below 1 kHz.

Pinnipeds. Monitoring studies in the Alaskan and Canadian Beaufort Sea during 1996–2002 provided considerable information regarding behavior of seals exposed to seismic pulses (Miller et al. 2005; Harris et al. 2001; Moulton and Lawson 2002). These seismic projects usually involved arrays of 6 to 16 with as many as 24 airguns with total volumes 560 to 1500 in3. 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 then when they were not (Moulton and Lawson 2002). However, these avoidance movements were relatively small, on the order of 100 m (328 ft) to (at most) a few hundred meters, and many seals remained within 100–200 m (328–656 ft) 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. Miller et al (2005) also reported higher sighting rates during non-seismic than during line seismic operations, but there was no difference for mean sighting distances during the two conditions nor was there evidence ringed or bearded seals were displaced from the area by the operations.

The operation of the airgun array had minor and variable effects on the behavior of seals visible at the surface within a few hundred meters of the array. The behavioral data from these studies indicated that some seals were more likely to swim away from the source vessel during periods of airgun operations and more likely to swim towards or parallel to the vessel during non-seismic periods. No consistent relationship was observed between exposure to airgun noise and proportions of seals engaged in other recognizable behaviors, e.g. “looked” and “dove”. Such a relationship might have occurred if seals seek to reduce exposure to strong seismic pulses, given the reduced airgun noise levels close to the surface where “looking” occurs (Miller et al. 2005; Moulton and Lawson 2002). Seals exposed to multiple seismic airguns in the Chukchi Sea during Shell and CPAI operations showed no more than localized movement, and there was no indication of displacement from seismic sounds (LGL et al. 2008).

Consequently, bearded, ringed, and probably spotted seals (least amount of data on reaction to seismic operations) and ribbon seals (no data on reaction to seismic operations) are not likely to show a strong avoidance reaction to the proposed airgun source. Pinnipeds frequently do not avoid the area within a few hundred meters of operating airgun arrays, even for large airgun arrays (e.g**.,** Harris et al. 2001). Reactions are expected to be very localized and confined to relatively small distances and durations, with no long-term effects on individuals or populations.

Hearing Impairment and Other Physical Effects

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

NMFS policy regarding exposure of marine mammals to high-level sounds is that cetaceans and pinnipeds should not be exposed to impulsive sounds =180 and 190 dB re 1 µPa (rms), respectively (NMFS 2000). Those criteria have been used in defining the safety (=shutdown) radii planned for the proposed seismic survey. However, those criteria were established before there were any data on the minimum received levels of sounds necessary to cause temporary auditory impairment in marine mammals. As summarized below

> •The 180-dB criterion for cetaceans is probably quite precautionary, i.e., lower than necessary to avoid temporary threshold shift (TTS), let alone permanent auditory injury.
>
> • The minimum sound level necessary to cause permanent hearing impairment is higher, by a variable and generally unknown amount, than the level that induces barely-detectable TTS.
>
> •The level associated with the onset of TTS is often considered to be a level below which there is no danger of permanent damage.

NMFS is presently developing new noise exposure criteria for marine mammals that take account of the now-available data on TTS and other relevant factors in marine and terrestrial mammals (NMFS 2005; D. Wieting in ttp://mmc.gov/sound/plenary2/pdf/plenary2summaryfinal.pdf**).**

Because of the planned monitoring and mitigation measures, there is little likelihood any marine mammals will be exposed to sounds sufficiently strong to cause even the mildest (and reversible) form of hearing impairment. Several aspects of the planned monitoring and mitigation measures for this project are designed to detect marine mammals occurring near the airgun(s), and to avoid exposing them to sound pulses that might (at least in theory) cause hearing impairment [see § XI, "MITIGATION MEASURES"]. In addition, many cetaceans are likely to show some avoidance of the small area with high received levels of airgun sound. In those cases, the avoidance responses of the animals themselves will reduce or (most likely) avoid any possibility of hearing impairment.

Temporary Threshold Shift (TTS) TTS is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter 1985). While experiencing TTS, the hearing threshold rises and a sound must be stronger in order to be heard. TTS can last from minutes or hours to (in cases of strong TTS) days. For sound exposures at or somewhat above the TTS threshold, hearing sensitivity recovers rapidly after exposure to the noise ends. There is limited data on sound levels and durations necessary to elicit mild TTS for marine mammals**,** and <u>none</u> of the published data concern TTS elicited by exposure to multiple pulses of sound.

For toothed whales (beluga, killer whales, etc.) exposed to single short pulses, the TTS threshold appears to be, at first approximation, a function of the energy content of the pulse (Finneran et al. 2002). Given the available data, the received level of a single seismic pulse might need to be ~210 dB re 1 µPa rms (~221-226 dB pk-pk) in order to produce brief, mild TTS. Exposure to several seismic pulses at received levels near 200-205 dB (rms) might result in slight TTS in a small odontocete (e.g., beluga whale), assuming the TTS threshold is (to a first approximation) a function of the total received pulse energy. Seismic pulses with received levels of 200-205 dB or more are usually restricted to a radius of no more than 100 m around a seismic vessel operating a large array of airguns. Such levels would be limited to distances within a few meters of the low-energy airgun sources to be used in this project.
For baleen whales, there are no data, direct or indirect, on levels or properties of sound that are required to induce TTS. However, no cases of TTS are expected given the strong likelihood that baleen whales (e.g., bowhead/gray) would avoid the approaching airgun(s), or vessel, before being exposed to levels high enough for any possibility of TTS.

In pinnipeds (e.g., ringed, bearded, spotted seals), TTS thresholds associated with exposure to brief pulses (single or multiple) of underwater sound have not been measured. Initial evidence from prolonged exposures suggested that some pinnipeds may incur TTS at somewhat lower received levels than do small odontocetes exposed for similar durations (Kastak et al. 1999**;** Ketten et al. 2001**;** cf. Au et al. 2000**).** However, more recent indications are that TTS onset in the most sensitive pinniped species studied (harbor seal, which don't occur in project area) may occur at a similar sound exposure level as in odontocetes (Kastak et al. 2004).

A marine mammal within a radius of 100 m (=328 ft) around a typical large array of operating airguns might be exposed to a few seismic pulses with levels of 205 dB, and possibly more pulses if the mammal moved with the seismic vessel. (As noted above, most cetacean species tend to avoid operating airguns, although not all individuals do so.). However, several of the considerations that are relevant in assessing the impact of typical seismic surveys with arrays of airguns are not directly applicable here because:

- The planned airgun sources involve low energy airguns, with correspondingly smaller radii greatly reducing concern. In addition, the vessel is constantly moving thereby avoiding any chance of prolonged exposure of marine mammals to noise.

- Even with a large airgun array, it is unlikely that cetaceans would be exposed to airgun pulses at a sufficiently high level for a sufficiently long period to cause more than mild TTS, given the relative movement of the vessel and the marine mammal.

• With a large array of airguns, TTS would be most likely in any odontocetes that linger near the active airguns, which would be unusual and not expected based on their behavior. In the proposed project anticipated 180 dB distances are only 115 m from the vessel.

NMFS (1995, 2000) concluded that cetaceans and pinnipeds should not be exposed to pulsed underwater noise at received levels exceeding, respectively, 180 and 190 dB re 1 µPa (rms). The 180 and 190 dB distances for the airguns operated by CPAI are estimated to be only 115 m and 20 m for the 4-gun array (Table 4). These sound levels are not considered to be high enough levels to cause TTS. Rather, they are the received levels above which, in the view of a panel of bioacoustics specialists convened by NMFS before TTS measurements for marine mammals started to become available, one could not be certain that there would be no injurious effects, auditory or otherwise, to marine mammals. TTS data that are now available imply that, at least for dolphins (none occur in project area), TTS is unlikely to occur unless the dolphins are exposed to airgun pulses much stronger than 180 dB re 1 µPa rms.

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

There is no specific evidence that exposure to pulses of airgun sound can cause PTS in any marine mammal, even with large arrays of airguns. However, given the possibility that mammals close to an airgun array might incur TTS, there has been further speculation about the possibility that some individuals occurring very close to airguns might incur PTS. Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage in terrestrial mammals. Relationships between TTS and PTS thresholds have not been studied in marine mammals, but are only assumed to be similar to those in humans and other terrestrial mammals. PTS might occur at a received sound level 20 dB or more above that inducing mild TTS if the animal were exposed to the strong sound for an extended period, or to a strong sound with very rapid rise time.

In the proposed project, marine mammals are unlikely to be exposed to received levels of seismic pulses strong enough to cause TTS, unless they are within 20 m of an airgun. Given the higher level of sound necessary to cause PTS, it is even less likely that PTS could occur. Baleen whales generally avoid the immediate area around operating seismic vessels. The planned monitoring and mitigation measures, including visual monitoring and shut downs of the airguns when mammals are seen within the "safety radii", will minimize the already-minimal probability of exposure of marine mammals to sounds strong enough to induce PTS.

Non-auditory Physiological Effects Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to strong underwater sound include stress, neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage. *There is no evidence in the literature that any of these effects occur in marine mammals exposed to sound from airgun arrays.* There have been no direct studies of the potential for airgun pulses to elicit any of those effects. 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 seismic sounds for sufficiently long that significant physiological stress would develop. That is especially so in the case of the present project which will deploy only 4, relatively low energy airguns, and the ship is moving 3-4 knots.

Gas-filled structures in marine animals have an inherent fundamental resonance frequency. If stimulated at that frequency, the ensuing resonance could cause damage to the animal. A workshop (Gentry [ed.] 2002) was held to discuss whether the stranding of beaked whales in the Bahamas in 2000, which don't occur in the project area (Balcomb and Claridge 2001; NOAA and USN 2001), might have been related to air cavity resonance or bubble formation in tissues caused by exposure to noise from naval sonar not seismic operations. A panel of experts concluded that resonance in air-filled structures was not likely to have caused the stranding. Opinions were less conclusive about the possible role of gas (nitrogen) bubble formation/growth in the Bahamas stranding of beaked whales.

Until recently, it was assumed that diving marine mammals are not subject to the bends or air embolisms. However, a recent article documents the probability of the bends manifested in sperm whale skeletons, which is a species that doesn't occur in the project area (Moore and Early 2004). Skeletal pitting and erosion, hypothesized to be the result of nitrogen emboli, was discovered in 16 sperm whale skeletons spanning a period of 111 years. Larger sperm whale skeletons exhibited the most damage, indicating a chronic pathology. Another short paper concerning beaked whales stranded in the Canary Islands in 2002 suggests that cetaceans might be subject to decompression injury in some situations (Jepson et al. 2003). If so, that might occur if they ascend unusually quickly when exposed to aversive sounds. However, the interpretation that the effect was related to decompression injury is unproven (Piantadosi and Thalmann 2004; Fernández et al. 2004). Even if that effect can occur during exposure to mid-frequency sonar, *there is no evidence that that type of effect occurs in response to airgun sounds.* It is especially unlikely in the case of the proposed survey, involving low energy sounds that will operate in any one location only briefly as the vessel constantly moves.

In general, little is known about the potential for seismic survey sounds to cause auditory impairment or other physical effects in marine mammals. The available data do not allow for meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. Marine mammals that show behavioral avoidance of seismic vessels, including most baleen whales, some odontocetes, and some pinnipeds, are especially unlikely to incur auditory impairment or other physical effects. Also, the planned monitoring and mitigation measures include shut downs of the airguns, which will reduce any such effects that might otherwise occur.

Strandings and Mortality

There is no evidence in the scientific literature that airgun pulses cause serious injury, death, or stranding even in the case of large airgun arrays (see mortality section of stock assessment reports prepared by the NMFS). While strandings have been associated with military mid-frequency sonar pulses, CPAI does not plan to use any sonar systems during the 2007 seismic program other than standard ship equipment for navigation and bathymetric measurements which operate at very low power and high frequency (55-200 kHz). Seismic pulses and military mid-frequency sonar pulses are quite different. Sounds produced by airgun arrays are broadband with most of the energy below 1 kHz. Typical military mid-frequency sonars operate at frequencies of 2-10 kHz, generally with a relatively narrow bandwidth at any one time. Thus, it is not appropriate to assume that there is a direct connection between the effects of military sonar and seismic surveys on marine mammals.

NMFS (2001) has concluded that momentary behavioral reactions "do not rise to the level of taking". Thus, brief exposure of cetaceans or pinnipeds to small numbers of signals from the sonar systems to be used on the proposed project would not result in a "take" by harassment.

8. The Anticipated Impact of the Activity on the Availability of the Species or Stocks of Marine Mammals for Subsistence Uses

Marine mammals are of key importance in the subsistence economies of the communities bordering the project area, including Barrow, Wainwright, Point Lay, and Point Hope. 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

Bowhead whales are important for subsistence at all of the villages bordering the project area except Point Lay, which does not hunt bowhead whales. The harvest is based on a quota, established by the IWC and regulated by agreement between AEWC and NMFS, according to the cultural and nutritional needs of Alaska Eskimos as well as on estimates of the size and growth of the stock of bowhead whales (Suydam and George 2004). Under a preferred alternative of an EIS prepared by NMFS (2008), the AEWC could be granted an annual strike quota of 67 bowhead whale, not to exceed 255 total landed whales over the five year period 2008 through 2012, with no more than 15 unused strikes from the previous year added to the annual strike quota. The most recent published data available show the 35, 49, 37, 35, and 36 whales were landed in 2000-2004 for a total of 192 whales (Suydam and George 2004, Suydam et al. 2005, Angliss and Outlaw 2005). Between 30 and 44 (35 = average) whales were taken at Point Hope, Wainwright, and Barrow, Nuiqsut, and Kaktovik during these years, with most (16-27 whales or 50-73%) taken by Barrow each year among these five villages. The size of the quota combined with the success of the harvest show that subsistence has been no more than negligibly affected by oil and gas operations.

Villages retain the ability to hunt bowheads during either the spring and/or fall migrations. Recent history shows that Point Hope and Wainwright only hunt during the spring migration (Suydam et al. 2005, Suydam and George 2004). The village of Barrow hunts during the spring and fall migrations, taking most bowheads during the spring migration (Table 3). The spring bowhead hunt occurs after leads open due to the deterioration of pack ice, which typically occurs from early April until the first week of June. Because of the timing, the spring hunt by Point Hope, Wainwright, and Barrow should not be affected by the geophysical operations, since the hunt will be completed well before the start of seismic operations in August.

Table 4. Number of whales landed during the spring/fall at Barrow, 1995-2004. The first number for each year is total landed in a given year and the second number is number landed in fall.

Yr	**95**	**96**	**97**	**98**	**99**	**00**	**01**	**02**	**03**	**04**	**05**
No	19/11	24/19	30/21	25/16	24/6	18/13	27/7	22/17	16/6	21/15	N/A

Source; Suydam and George, 2004 and Suydam et al. 2005.

The fall hunt occurs in open water from late August through October by Barrow. The autumn hunt at Barrow occurs from mid September through October. Barrow whalers hunt mainly in the waters east and northeast of Point Barrow in the Beaufort Sea. The whales have usually moved out of the Beaufort Sea by late October to mid November (Treacy 2002a,b). The location of the fall hunt depends on ice conditions, which can influence distance of whales from shore (Brower 1996). Hunters prefer to take bowheads close to shore to avoid a long tow during which the meat can spoil, but Braund and Moorehead (1995) report that crews may (rarely) pursue whales as far as 80 km, and in 2004 hunters harvested a whale up to 50 km northeast of Barrow (Suydam et al. 2005). Geophysical operations in the Chukchi Sea should not affect the fall hunt, since the hunt will occur a considerable distance east of the operations.

Beluga whales are hunted for subsistence at Barrow, Wainwright, Point Lay, and Point Hope, with the most taken by Point Lay (Fuller and George 1997). Point Lay harvests belugas primarily during the first half of summer in Kasegaluk Lagoon, where they averaged 40 belugas per year over a 10-year period (Fuller and George 1997). Compared to Point Lay, small numbers of belugas are harvested by Barrow with intermediate numbers harvested by Point Hope and Wainwright. Harvest at all of these villages generally occurs between April and July with most taken in April and May when pack-ice conditions deteriorate and leads open up. Hunters usually wait until after the bowhead whale hunt to hunt belugas. The Alaska Beluga Whale Committee recorded 23 beluga whales harvested by Barrow hunters from 1987 to 2002, ranging from 0 in 1987, 1988 and 1995 to the high of 8 in 1997 (Fuller and George 1999; Alaska Beluga Whale Committee 2002 in USDI/BLM 2005). The timing of the project (August start) will not overlap hunts at Point Hope, Wainwright, or Barrow. Point Lay villagers hunt in Kasegaluk Lagoon during late June to mid-July. The lagoon will be beyond (> 90 km) the influence of the project activities. Furthermore, the lagoon is shallow and close to shore, which would greatly reduces any underwater seismic sound, in the unlikely event some sounds reached the lagoon.

Ringed, bearded, and spotted seals are hunted by all of the villages bordering the project area (Fuller and George 1997). Ringed seals comprise the largest part of the subsistence hunt and spotted seal the least. At Barrow, spotted seals are primarily hunted nearshore in Admiralty Bay, which is about 60 km east of Barrow. The largest concentrations of spotted seals in Alaska are in Kasegaluk Lagoon, where Point Lay hunters harvest them (Frost et al. 1993). Braund et al. (1993) found that the majority of bearded seals taken by Barrow hunters are within ~24 km off shore. Ringed and bearded seals are hunted throughout the year, but most are taken in May, June, and July when ice breaks up and there is open water instead of the more difficult hunting of seals at holes and lairs. The timing slightly varies among villages, with peak hunting occurring incrementally later going from Point Hope to Barrow. Spotted seals are only hunted in spring through summer, since they winter in the Bering Sea (Fuller and George 1997). The seismic operation in the Chukchi Sea should have little to no affect on subsistence hunting, since the seismic survey will no more than minimally overlap the end of primary period when seals are harvested, and most hunting at the villages will be a considerable distance away from seismic operations, particularly at Point Lay (100 km).

The scheduling of this geophysical survey will be discussed with representatives of those concerned with the subsistence hunt, most notably the Alaska Eskimo Whaling Commission (AEWC), each respective village, the Barrow Whaling Captains' Association (BWCA), Alaska Beluga Whale Commission (ABWC), and the North Slope Borough Department of Wildlife Management (NSB WM), and science advisors to the AEWC. Geophysical operations will be managed to avoid or minimize any overlap in or near the location and timing of subsistence activities.

9. The Anticipated Impact of the Activity upon the Habitat of the Marine Mammal Populations, and the Likelihood of Restoration of the Affected Habitat.

The proposed seismic survey will not cause any permanent impact on habitats and the prey used by marine mammals as described in earlier responses and restated below regarding prey.

There is a relative lack of knowledge about the potential physical (pathological and physiological) effects of seismic energy on marine fish and invertebrates. Available data suggest that there may be physical impacts on eggs and on, larval, juvenile, and adult stages at very close range to seismic energy sources. Considering typical source levels associated with airgun arrays, close proximity to the source would result in exposure to very high energy levels. Whereas egg and larval stages are not able to escape such exposures, juveniles and adults most likely would avoid them. In the cases of eggs and larvae, it is likely that the numbers adversely affected by such exposure would be small in relation to natural mortality. Limited data regarding physiological impacts on fish and invertebrates indicate that these impacts are short-term and are most apparent after exposure at very close range (McCauley et al. 2000a,b**,** Dalen et al. 1996).

As in the case with physical effects of seismic on fish and invertebrates, available information on behavioral effects is relatively scant and often contradictory. There have been well-documented observations of fish and invertebrates exhibiting behaviors that appeared to be responses to exposure to seismic energy (i.e., startle response, change in swimming direction and speed, and change in vertical distribution (Wardle et al. 2001, Pearson et al. 1992). Some studies indicate that such behavioral changes are very temporary, whereas others imply that fish might not resume pre-seismic behaviors or distributions for a number of days (Engås et al. (1996). The type of behavioral reaction (startle, alarm, and avoidance) appears to depend on many factors, including the type of behavior being exhibited before exposure, and proximity and energy level of the sound source. The ultimate importance of those behaviors is unclear, but they do appear to be local and temporary.

Only a small fraction of the available habitat would be impacted by noise at any given time during the seismic surveys, and the constant movement of the seismic vessel would prevent any area from sustaining high noise levels for extended periods of time. Disturbance to fish species would be short-term and temporary, returning to their pre-disturbance behavior once the seismic activity ceases. Similarly, concentrations of zooplankton consumed by bowheads would only respond to a seismic impulse very close to the source, where they may scatter before regrouping after the seismic vessel passes. Thus, the proposed activity is not expected to have any effects on habitat or prey that could cause permanent or long-term consequences for individual marine mammals or their populations, since operations will be limited in duration, location, timing, and intensity.

10. **The Anticipated Impact of the Loss or Modification of the Habitat on the Marine Mammal Populations Involved.**

The proposed seismic survey will not result in any permanent impact on habitats used by marine mammals, or to the food sources they utilize. The main issues are direct and indirect impacts to habitat. Direct impacts are physical destruction or alteration of habitat, which will not occur from the seismic surveys. Indirect impacts are primarily caused by ensonification of habitat from noise, which will be localized and short term, since the proposed seismic surveys will be of short duration in any particular area at any given time. Ensonification from seismic operations should have no more than a negligible effect on marine mammal habitat because:

- The geophysical vessel will be constantly moving thereby preventing any given area from sustaining a constant level of noise.
- No studies have demonstrated that seismic noise affects the life stages, condition, or amount of food resources (fish, invertebrates, eggs) comprising habitats used by marine mammals, except when exposed to within a few meters of the seismic source or in a few very isolated cases. Where fish or invertebrates did respond to seismic noise, the affects were of temporary and of short duration (See above). Consequently, disturbance to fish species would be short-term and fish would return to their pre-disturbance behavior once the seismic activity ceases. Thus, the proposed survey would have little, if any, impact on the abilities of marine mammals to feed in the area where geophysical work is planned.
- Migrating bowhead whales may feed in the Chukchi and Beaufort Seas during the fall (September/October/November). They feed on concentrations of zooplankon. A reaction by zooplankton to a seismic impulse would only be relevant to whales if it caused a concentration of zooplankton to scatter. Pressure changes of sufficient magnitude to cause that type of reaction would probably occur only very close to the source. Impacts on zooplankton behavior are predicted to be negligible, and that would translate into negligible impacts on feeding bowhead whales.
- The geophysical project area covers a small percentage (< 1%) of the available habitat used by marine mammals in the Chukchi and Beaufort Seas allowing them to move away from any noise to feed, rest, or migrate.

Thus, the proposed activity is not expected to have any habitat-related effects that could cause significant or long-term consequences for individual marine mammals or their populations, since operations at the various sites will be limited in duration.

11. The Availability and Feasibility (Economic and Technological) of Equipment, Methods, and Manner of Conducting Such Activity or means of Effecting the Least Practicable Adverse Impact upon the Affected Species or Stocks, Their Habitat, and on Their Availability for Subsistence Uses, Paying Particular Attention to Rookeries, Mating Grounds, and Areas of Similar Significance).

Various species of marine mammals will be present but widespread in low densities in the seismic survey area during different times of the operation. Gray whales will be feeding in the Chukchi Sea during July, August, September, and October. Bowheads will be migrating during September, October, and early November in the Beaufort Sea and late October and November in the Chukchi Sea from the summer feeding grounds. Seals and other marine mammals will be feeding or migrating in the geophysical survey area during operations. However, the number of individual animals expected to be closely approached during the proposed activity will be small relative to their population sizes. With the proposed low volume airguns, monitoring, and shut-down provisions described below, seismic surveys area expected to be no more than negligible impacts on the species and stocks. There are no rookeries, mating grounds, or areas of similar significance in the seismic survey area.

Marine Mammal Monitoring

Two observers will be on the vessel to monitor marine mammals near the seismic source vessel during all daytime airgun operations and during any nighttime startups of the airguns. These observations will provide the real-time data needed to implement some of the key mitigation measures. When marine mammals are observed within, or about to enter, designated safety zones (see below), airgun operations will be shut down) immediately.

During daylight, vessel-based observers will watch for marine mammals near the seismic vessel during all periods of shooting prior to the planned start of airgun operations after an extended shut down. CPAI proposes to also conduct nighttime and daytime operations (though there will be little night at the start of the cruise). Marine mammal observers will not be on duty during ongoing seismic operations at night. At night, bridge personnel will watch for marine mammals (insofar as practical at night) and will call for the airgun(s) to be shut down if marine mammals are observed in or about to enter the safety radii. If the airguns are started up at night, marine mammal observers will monitor marine mammals near the source vessel prior to start up of the airguns using night vision devices.

Proposed Safety Radii

Received sound levels for the 160, 180, and 190 dB re 1 µPa (rms) for calculating safety radii and take are provided in Table 5. Received sound levels for the Chukchi Sea were determined for the 4-gun configuration operating at 10 in^3 volume per gun for the 190, 180, and 160 dB re 1 µPa (rms) by JASCO using Marine Operation Noise Model to compute the radii as described in attached report.

Table 5. Estimated distances (m) sound levels ≥ 190, 180, and 160 dB RMS received from an array of 4, 10 in³ airguns used in the site clearance and shallow hazard survey in the Chukchi Sea.

Location	**190dB (Safety Criterion for Seals)**	**180dB (Safety Criterion for Whales)**	**160dB (Assumed Onset of Behavioral Harassment)**
Chukchi Sea	<20 m	<115 m	<1.665 km

RMS values referred to 1 μPa

Airguns will be shut down immediately when marine mammals are detected within or about to enter the appropriate radius: 180-dB (rms) for cetaceans, and 190-dB (rms) for pinnipeds. The 180 and 190 dB shutdown criteria are consistent with guidelines listed for cetaceans and pinnipeds, respectively, by NMFS (2000) and other guidance by NMFS. CPAI is aware that NMFS is developing new noise-exposure guidelines, but that they have not yet been finalized or approved for use. CPAI will be prepared to revise their procedures for estimating numbers of mammals "taken", safety radii, etc., as may be required at some future date by the new guidelines.

Mitigation During Operations

In addition to monitoring, mitigation measures that will include (1) speed or course alteration, provided that doing so will not compromise operational safety requirements, (2) shutdown procedures, and (3) no start up of airgun operations unless the full 180 dB safety zone is visible during day or night.

During nighttime operations, if the entire safety radius is visible using vessel lights and NVDs (as may be the case in deep waters), then start up of the array may occur. However, lights and NVDs may not be very effective as a basis for monitoring the safety radii around the airgun(s). Nighttime startups of the airguns from a shut-down condition may not be possible. If the airguns have been operational before nightfall, they can remain operational throughout the night, even though the entire safety radius may not be visible.

The mitigation and marine mammal monitoring measures listed and described below will be adopted during the proposed seismic program, provided that doing so will not compromise operational safety requirements:

1. Speed or course alteration;
2. Shut down procedures;

Speed or Course Alteration

If a marine mammal is detected outside the safety radius and, based on its position and the relative motion, is likely to enter the safety radius, the vessel's speed and/or direct course may, when practical and safe, be changed that also minimizes the effect on the seismic program. The marine mammal activities and movements relative to the seismic vessel will be closely monitored to ensure that the marine mammal does not approach within the safety radius. If the mammal appears likely to enter the safety radius, further mitigative actions will be taken, i.e., either further course alterations or shut down of the airgun(s).

Shut-down Procedures

The operating airgun(s) will be shut down completely if a marine mammal approaches or enters the then-applicable safety radius and a power down is not practical. The operating airgun(s) will also be shut down completely if a marine mammal approaches or enters the estimated safety radius. The shutdown procedure should be accomplished within several seconds (of a “one shot” period) of the determination that a marine mammal is within or about to enter the safety zone.

Airgun activity will not resume until the marine mammal has cleared the safety radius. The animal will be considered to have cleared the safety radius if it is visually observed to have left the safety radius, or if it has not been seen within the radius for 15 minutes.

12. Where the Proposed Activity Would Take Place in or Near a Traditional Arctic Subsistence Hunting Area and/or May Affect the Availability of a Species or Stock of Marine Mammal for Arctic Subsistence Uses, the Applicant Must Submit Either a Plan of Cooperation or Information that Identifies What Measures have Been Taken and/or Will be Taken to Minimize any Adverse Effect on the Availability of Marine Mammals for Subsistence Uses.

CPAI will meet with key native organizations responsible for managing marine mammals in the arctic. In accordance with 50 CFR 126.104(a)(12) CPAI will meet with the Alaska Eskimo Whaling Commission (AEWC) in the planning for the 2008 site clearance and shallow hazard survey and develop a Plan of Cooperation (POC). In addition, CPAI will consult subsistence committees and commissions as required by our OCS 193 Leases, and meet with the North Slope Borough (NSB) as necessary.   Meetings with other stakeholders will provide information on the time, location, and features of the seismic survey/operations, opportunities for involvement by local people, potential impacts to marine mammals, and mitigation measures to avoid or minimize impacts.

A number of actions will be taken by CPAI during the surveys to minimize any adverse effect on the availability of marine mammals for subsistence, which have been identified in this application. They include the following:

- Site clearance and shallow hazard surveys will be occur in areas considerably away from the villages during the hunting periods;
- Site clearance and shallow hazard surveys will follow procedures to avoid, shut down, within specific safety radii to minimize effects on the behavior of marine mammals and, therefore, opportunities for harvest by local communities;
- In the unlikely event that a hunter is encountered, operations will be managed to stay beyond any hunter encountered within 5 km of the vessel when shooting airguns;.

The combination of the low volume air guns, timing, location, mitigation measures, and input from local communities and organization will minimize the effect of the seismic surveys on availability of marine mammals for subsistence uses.

13. The Suggested Means of Accomplishing the Necessary Monitoring and Reporting that will Result in Increased Knowledge of the Species, the Level of Taking or Impacts on the Population of Marine Mammals That are Expected to be Present While Conducting Activities and Suggested Means of Minimizing Burdens By Coordinating Such Reporting Requirements with Other Schemes Already Applicable to Persons Conducting Such Activity. Monitoring Plans Should Include a Description of The Survey Techniques That Would Be Used to Determine the Movement and Activity of Marine Mammals Near The Activity Site(s) Including Migration and Other Habitat Uses, Such As Feeding.

CPAI's proposed Monitoring Plan is described below. CPAI understands that this Monitoring Plan will be subject to review by NMFS and others, including discussions at the open-water review meeting that NMFS plans to convene in the spring of 2008, and that refinements may be required.

The monitoring work described has been planned as a self-contained project independent of any other related monitoring projects occurring simultaneously in the same regions. CPAI is prepared to discuss coordination of its monitoring program with any related work be done by other groups insofar as this is practical and desirable.

Vessel-based Visual Monitoring

Vessel-based observers will monitor marine mammals near the geophysical vessel during (1) all daytime hours; (2) start ups, and (3) at night when marine mammals are suspected of either approaching or within the safety radii. When feasible, observations will also be made during daytime periods during transits and other operations when guns are inactive.

During geophysical operations observers will be based aboard the vessel. Marine mammal observers (MMOs) will be hired by CPAI, with NMFS consultation. Observers will alternate at 4-hour shifts to avoid fatigue. The vessel crew will also be instructed to assist in detecting marine mammals and implementing mitigation requirements (if practical). Before the start of a geophysical survey the crew will be given additional instruction on how to do so.

The geophysical vessel will be a suitable platform for marine mammal observations. During daytime, the MMO(s) will scan the area around the vessel systematically with reticule binoculars (e.g., 7 × 50 Bushnell or equivalent) and with the naked eye. Laser range finders (Laser Tech laser rangefinder or equivalent) will be available to assist with distance estimation. They are useful in training observers to estimate distances visually, but are generally not useful in measuring distances to animals directly. During darkness, NVDs (Night Vision Device) will be available (ATN NVG-7 or equivalent), if and when required.

When mammals are detected within or about to enter the designated safety radius, the airgun(s) will be shut down immediately. The observer(s) will continue to maintain watch to determine when the animal(s) are outside the safety radius. Airgun operations will not resume until the animal is outside the safety radius. The animal will be considered to have cleared the safety radius if it is visually observed to have left the safety radius, or if it has not been seen within the radius for 15 minutes.

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

Results from the vessel-based observations will provide

1. The basis for real-time mitigation (airgun shut down).
2. Information needed to estimate the number of marine mammals potentially taken by harassment, which must be reported to NMFS.
3. Data on the occurrence, distribution, and activities of marine mammals in the area where the seismic study is conducted.
4. Information to compare the distance and distribution of marine mammals relative to the source vessel at times with and without seismic activity.
5. Data on the behavior and movement patterns of marine mammals seen at times with and without seismic activity.

Reporting

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

14. Suggested Means of Learning of, Encouraging, and Coordinating Research Opportunities, Plans, and Activities Relating to Reducing such Incidental taking and Evaluating its Effects.

Seismic operations, much less site clearance and shallow hazard surveys, have been conducted in the Alaska Arctic region for over 25 years and, during this time there have been no noticeable adverse impacts on the marine mammal populations or their availability for subsistence uses. Bowhead whales, gray whales, and other marine mammal species have increased to a point where they may be approaching or at carrying capacity of the habitat. The bowhead whale harvest has been relatively consistent over the last fifteen years among the whaling villages, averaging about 40 whales landed per year, suggesting no decrease in their availability for harvest. While the status of the other stocks is uncertain due to a lack of current data, there is no firm information to suggest the populations are declining or less available for harvest. Consequently, Alaskan aboriginal harvest combined with the scientific literature indicate that the past single and multiple seismic activity in the Chukchi Sea and the Beaufort Sea has had no more than a negligible affect on the health and fitness of the marine mammal populations.

Given that past geophysical activities have not had a noticeable effect on marine mammals, CPAI acknowledges that the implementation of monitoring and mitigation procedures will ensure that these mammals continue to remain healthy. CPAI will continue to cooperate with the NMFS, MMS, USFWS, other appropriate federal agencies, the State of Alaska, the North Slope Borough, AEWC, ABWC, EWC, the affected communities, and other monitoring programs as practicable, to coordinate research opportunities and assess all measures than can be taken to eliminate or minimize any impacts from our activities.

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