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November 16, 2005

Gordon Helm, Chief
Marine Mammal Division
Office of Protected Resources
National Marine Fisheries Service
1315 East - West Highway
Silver Spring, MD 20910-3226

Subject: Request for Approval, Incidental Harassment Authorization for Non-Lethal Taking of Whales and Seals in the Northern Chukchi Sea, Alaska During 2006

Dear Mr. Helm:

Shell Offshore, Inc. (Shell) and its geophysical (seismic) contractor WesternGeco propose to conduct a marine geophysical (deep seismic) survey program during open-water season as a pre-lease activity in U.S. Minerals Management Service (MMS)-administered Outer Continental Shelf (OCS) waters. This activity will occur in areas previously known as the Chukchi Sea MMS OCS Program Area in MMS Chukchi Sea Sale 193 (1989) and the proposed 2002-2007 Chukchi Sea Program Area in the Northern Chukchi Sea. Shell and WesternGeco request an Incidental Harassment Authorization (IHA) pursuant to Section 101 (a) (5) (D) of the Marine Mammal Protection Act (MMPA), 16 U.S.C. § 1371 (a) (5), to allow non-lethal takes of whales and seals incidental to offshore geophysical seismic operations.

The only type of incidental taking sought in this application is takes by noise harassment stemming from WesternGeco's deep seismic survey vessel M/V Gilavar.

The M/V Alex Gordon will serve as a resupply, fueling and chase vessel and is capable of assisting in ice management operations but will not deploy seismic acquisition gear. No site clearance or shallow hazards survey work will be performed.

The proposed Chukchi deep seismic survey will occur in two phases. Phase One will commence after June 15, 2006 as sea ice coverage conditions allow and will continue through July to early August 2006. Phase Two of the Chukchi Sea deep seismic survey will occur after mid-October and

continue until such time as sea ice and weather conditions preclude further work, probably sometime in mid- to late-November 2006.

Shell is presently negotiating the provisions of a Conflict Avoidance Agreement with the Alaska Eskimo Whaling Commission (AEWC) regarding times and areas to avoid any possible conflict with the bowhead subsistence whale hunts by Chukchi AEWC villages. Shell has participated in early consultation and coordination with Native entities that conduct subsistence activities in the area and conveyed a strong desire for avoiding potential conflicts.

Any impacts on the whale and seal populations of the Chukchi Sea from seismic activity are likely to be short term and transitory in temporary displacement of individuals or small groups that may be exposed to seismic sounds at the 160-190 decibels received levels. The seismic activities will not result in any permanent impact on habitats used by marine mammals or their prey sources. There should be no adverse impacts on the availability of the whale species for subsistence users.

Items presented pursuant to 50 C.F.R. § 216.104, "Submission of Requests", and § 216.107, "Incidental Harassment Authorization for Arctic Waters", are attached with the application and Marine Mammal Monitoring and Mitigation Measures Plan.

Please contact me at 985-543-1248 or Kent Satterlee at 985-902-5228 for further information.

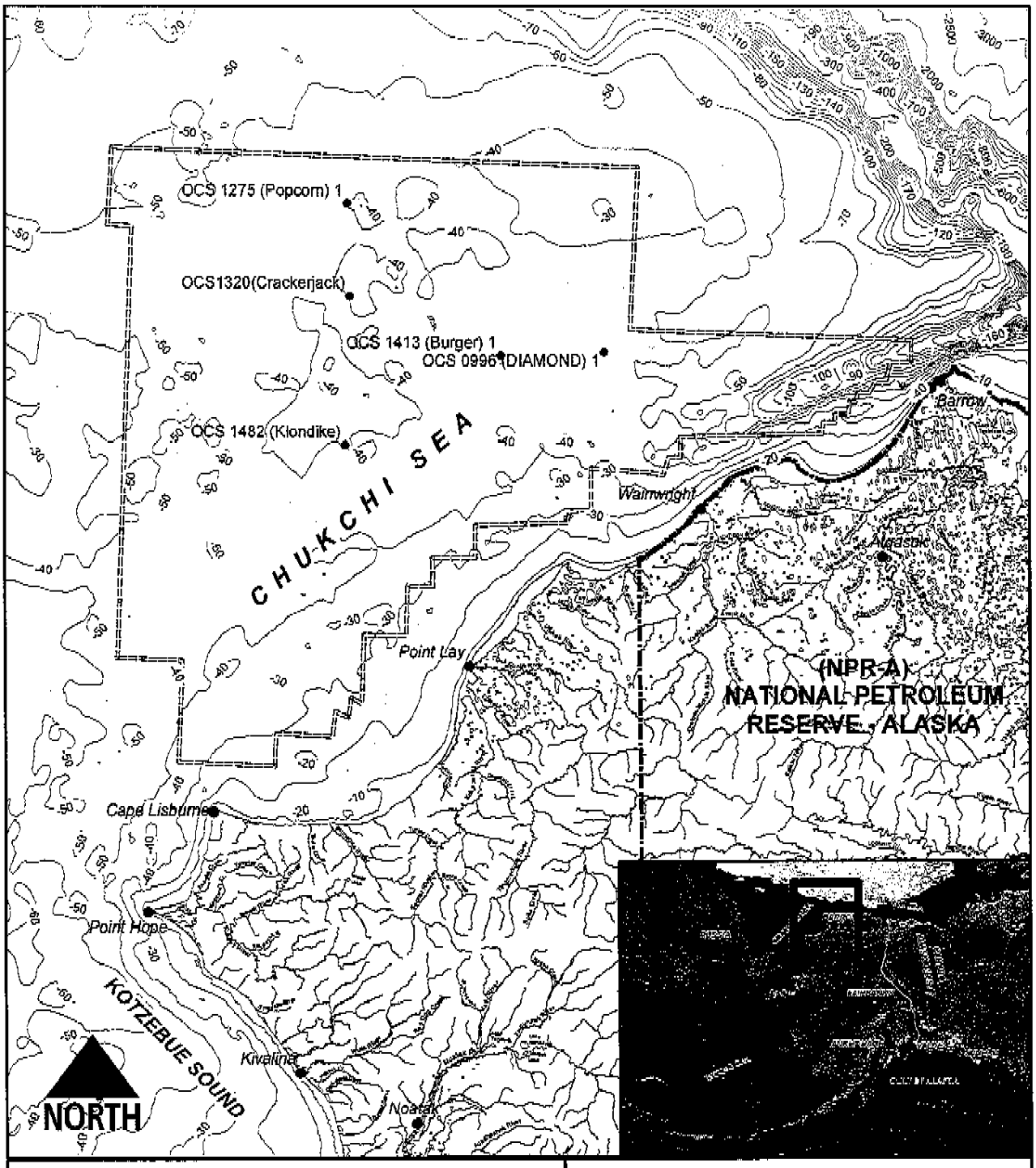
Sincerely,

Philip B. Smith
Manager, Regulatory Affairs and Incident Command

Attachments

cc: w/attachments

Maggie Ahmaogak, Alaska Eskimo Whaling Commission - Barrow, AK
Jessica LeFevre, Alaska Eskimo Whaling Commission – Washington, D.C.
Rance Wall, MMS Alaska Region
Doug DeMaster, NOAA Fisheries - Seattle, WA
Ken Hollingshead, NOAA Fisheries - Silver Spring, MD
Brad Smith, NOAA Fisheries - Anchorage, AK
Mark Stone - Shell
Gregg Nady - Shell
Chandler Wilhelm - Shell
Stacy Hutchinson - Shell
Arnold Brower, Jr. - ICAS



*Proposed Survey Area

National Petroleum Reserve - Alaska

Existing Oil & Gas Wells

Village

Bathymetric Contour (m)

DRAFT

*Note; Proposed survey boundaries are approximate

Projection Alaska Albers Equal Area Conic.
Bathymetry provided by the Mineral Management Service (MMS) and was derived from IBCAO Data Sources.

SHELL EXPLORATION & PRODUCTION CO.

PROPOSED AREA FOR MARINE GEOPHYSICAL SURVEY PROGRAM 2006 CHUKCHI SEA, ALASKA

SCALE: 0 25 50 100 Miles

FIGURE: 1-1

Lynx: 15067-003.mxd,11/07/05,R00

Application for Incidental Harassment Authorization for the Non-Lethal Taking of Whales and Seals in Conjunction with a Proposed Marine Geophysical (Seismic Acquisition) Program in the Northern Chukchi Sea, Alaska, During 2006

Submitted by Shell Offshore, Inc. and WesternGeco

November 2005

Shell Offshore, Inc and WesternGeco used the following guidance to prepare its request for Incidental Harassment Authorization (IHA).

50 CFR 216.104 "Submission of Requests"

(a) In order for the National Marine Fisheries Service (NMFS) to consider authorizing the taking by U.S. citizens of small numbers of marine mammals incidental to a specified activity (other than commercial fishing), or to make a finding that incidental take is unlikely to occur, a written request must be submitted to the Assistant Administrator. All requests must include the following information for their activity

1. A detailed description of the specific activity or class of activities that can be expected to result in incidental taking of marine mammals:

Information required by 50 CFR § 216.104 (a):

Shell Offshore, Inc. (Shell) and its geophysical (seismic) contractor WesternGeco propose to conduct a marine geophysical (deep seismic) survey program during open-water season on various U.S Minerals Management Service (MMS) Outer Continental Shelf (OCS) lease blocks in the Northern Chukchi Sea (See Figure 1-1). This seismic survey will consist of deep seismic surveys only conducted from WesternGeco's vessel M/V Gilavar. The M/V Alex Gordon will serve as a resupply, fueling and chase vessel. It also is capable of assisting in ice management operations but will not deploy seismic acquisition gear. The Chukchi Seismic work will not perform any site clearance or shallow hazard surveys.

Detailed specifications of the M/V Gilavar and its seismic acquisition arrays, and the M/V Alex Gordon as support vessel are included as Attachment A – Seismic Survey/Overview Description. These specifications include: (1) detailed descriptions of the number and lengths of the streamers which form the air gun and hydrophone arrays; (2) air gun size and sound propagation properties which need to be known to estimate the number of takes by noise harassment of marine mammals which may occur within ensonified zones (see Section 6 of this application); and (3)

additional detailed data on the M/V Gilavar's characteristics and capacities as a vessel. The M/V Gilavar and M/V Alex Gordon vessels will operate in accordance with the provisions of a Conflict Avoidance Agreement (CAA) being negotiated with the Alaska Eskimo Whaling Commission (AEWC) regarding times and areas to avoid any possible conflict with the bowhead whale migration and subsistence hunts. Specifications for the resupply and ice management vessel M/V Alex Gordon are contained in Attachment A.

2. The dates and duration of such activity and the specific geographic region where it will occur:

The proposed deep seismic survey will take place in two phases. Phase one will commence after June 15, 2006, as sea ice coverage conditions allow and will continue through July to early-August when the M/V Gilavar and M/V Alex Gordon will transit through the Beaufort Sea to start work on a deep seismic survey on Shell lease-holdings in the mid and eastern Beaufort. Shell is applying for a separate IHA for this proposed Beaufort Sea program. Phase two of the Chukchi Sea survey will occur after mid-October when sea ice conditions in the mid and eastern Beaufort Sea will make further survey work there impractical. The M/V Gilavar and M/V Alex Gordon will then transit to the Chukchi Sea and continue the deep seismic survey program until such time as sea ice and weather conditions preclude further work, probably sometime in mid- to late-November 2006. Obviously the dates indicated here represent what might occur under ideal conditions for performing marine seismic work whereas the actual dates will depend on sea ice and weather conditions as they occur in summer and mid-autumn of 2006. However, the proposed commencement date of June 15 will not occur earlier than that even if marine conditions allow since the timing is designed to ensure that there will be no conflict with the spring bowhead whale migration and the spring Chukchi subsistence hunt conducted by the Alaska Eskimo Whaling Commission's villages of Pt. Hope, Wainwright and Barrow.

The geographic region where the proposed deep seismic survey will occur is the Chukchi Sea MMS OCS Program Area designated as Chukchi Sea Sale 193 (1989) and the proposed 2002-2007 Chukchi Sea Program Area (See Figure 1-1, MMS Chukchi Sea Sale 193). Since the Chukchi deep seismic program is being conducted as a pre-lease activity, the exact locations where operations will occur remain confidential for business competitive reasons. That is, the seismic data acquired will be used by Shell to determine what leases it will bid on in a forth-coming competitive lease sale. In general, however, seismic acquisition will take place well offshore from the Alaska coast on OCS waters averaging greater than 40 meter (m) depths.

3. Species and numbers of marine mammals in area:

In general, the species of principal concern in the Chukchi Sea are the bowhead whale, gray whale, bearded, ringed and spotted seals, and to a lesser extent, killer whale and beluga whale. All of the above species fall under NMFS management authority.

The species and numbers of marine mammals likely to be found within the Chukchi Sea activity area and covered under this IHA are listed in Table 4-1.

A total of five cetacean species (bowhead, gray, beluga, and killer whale, and harbor porpoise), three species of pinnipeds (ringed, spotted, and bearded seal) are known to occur in or near the

proposed study area. Only the bowhead whale is listed as "Endangered" under the Endangered Species Act (ESA). Other ESA-listed species which are known to occur in the adjacent Bering Sea include Steller sea lion, sperm whale, humpback whale, fin whale, blue whale, and northern right whale, however, these species are considered to be extralimital in the Chukchi and Beaufort Seas. Due to the very remote chance of interaction or potential impact, these species are not discussed further under this IHA application.

The most numerous marine mammal seasonally occurring in the Chukchi Sea is the pinniped, Pacific walrus. The polar bear is also an important species found in the Chukchi Sea. These two marine mammal species fall under the management authority of the U.S. Fish and Wildlife Service (USFWS). A separate application for an IHA for walrus and polar bears is being made to USFWS for the Chukchi Sea program.

In an effort to reduce redundancy, we have included the required information about these species and abundance estimations (to the extent known) of these species in Section 4 below.

4. Status, distribution and seasonal distribution of affected species or stocks of marine mammals:

The following eight species of cetaceans and seals can be expected to occur in the region of the proposed seismic activity: bowhead, gray, beluga and killer whales, harbor porpoise, and ringed, spotted and bearded seals. These eight species are discussed in this section and are the species for which general regulations governing potential incidental takes of small numbers of marine mammals are sought. The geographic boundaries and distribution, primary habitats, and population trends and risks are discussed under each species.

Three species of marine mammals—the polar bear, Pacific walrus, and sea otter—are managed by the USFWS. Within the project seismic activity area in the Chukchi Sea, only the polar bear and Pacific walrus is known to occur and potential incidental take of these species will be dealt with under a separate IHA application for a Letter of Authorization from the USFWS, however, general status information on polar bear and Pacific walrus is included in Table 4-1 but not discussed further under the species discussions.

Table 4-1. List of species that may be encountered during seismic operations within the Chukchi Sea, their habitats, conservation status, and estimated abundance numbers

Species (Stock)	Habitat	Chukchi Sea Stock and/or ESA Status [1]	Estimated Abundance [2]
Cetaceans			
bowhead whale (*Balaena mysticetus*) (Western Arctic stock)	Pack ice and coastal	ESA listed as Endangered, listed as depleted under MMPA, and classified as a strategic stock	10,545
gray whale (*Eschrichtius robustus*) (eastern north Pacific)	Coastal, lagoons	Not listed under ESA, not listed as depleted under MMPA, and not classified as a strategic stock	18,813
beluga whale (*Delphinapterus leucas*) (eastern Chukchi Sea/Beaufort Sea)	Offshore, coastal, ice edges	Not listed under ESA, not listed as depleted under MMPA, and not classified as a strategic stock	3,710 / 39,258
killer whale (*Orcinus orca*) (eastern North Pacific Alaska resident stock)	Widely distributed	Not listed under ESA, not listed as depleted under MMPA, and not classified as a strategic stock	1,123
Harbor porpoise (*Phocoena phocoena*) (Bering Sea Stock)	Coastal, inland waters	Not listed under ESA, not listed as depleted under MMPA, and not classified as a strategic stock	47,356
Pinnipeds			
ringed seal (*Phoca hispida*) (Alaska)	Landfast ice and pack ice	Not listed under ESA, not listed as depleted under MMPA, and not classified as a strategic stock	Up to 3.6 million; Currently, no reliable abundance estimate is available for the Beaufort Sea, however, combined with surveys from the Chukchi Sea, approximately 249, 000 are estimated.
spotted seal (*Phoca largha*)	Pack ice	Not listed under ESA, not listed as depleted under MMPA, and not classified as a strategic stock	Several thousand and several tens of thousands. An estimate with correction using 1992 data =59,214 seals but is preliminary at best.
bearded seal (*Erignathus barbatus*)	Pack ice	Not listed under ESA, not listed as depleted under MMPA, and not classified as a strategic stock	Currently, no reliable abundance estimate is available for this stock. Early estimates of the Bering-Chukchi Seas ranged from 250,000 to 300,000.
Pacific walrus (*Odobenus rosmarus divergens*)	Pack ice	Not listed under ESA, not listed as depleted under MMPA, and not classified as a strategic stock	The current size of the Pacific walrus population is unknown, however, aerial surveys conducted jointly with the U.S. and Russia every 5 years between 1975 and 1990 produced population estimates ranging from 201,039 to 234,020.
Carnivora			
polar bear (*Ursus maritimus*) (Chukchi/Bering Seas Stock/ southern Beaufort Sea)	Coastal, ice	Not listed under ESA, not listed as depleted under MMPA, and not classified as a strategic stock	Estimated between 2,000 to 5,000 for the Chukchi/Bering Sea population. An estimate for the Southern Beaufort Sea population of northern Alaska is 2,272 bears.

1. ESA = Endangered Species Act. Stocks listed as depleted under the MMPA (Marine Mammal Protection Act) is described as any stock that falls below its optimum sustainable population (OSP)must be classified as "depleted," 16 U.S.C. § 1362(1)(A). The numeric threshold OSP has been interpreted by NMFS and USFWS as being above 0.6 K (i.e. greater than 60 percent of K, or carrying capacity). In other words, a stock that dropped in numbers to below 60 percent of K would qualify as "depleted" under the MMPA. The term "strategic stock" is defined as a marine mammal stock: (A) for which the level of direct human-caused mortality exceeds the Potential Biological Removal level; (B) which, based on the best available scientific information, is declining and is likely to be listed as a threatened species under the ESA of 1973 . . . within the foreseeable future; or (C) which is listed as a threatened species or endangered species under the ESA of 1973 . . ., or is designated as depleted under [the MMPA].
2. See text under individual species for population estimate sources.

Bowhead Whale (*Balaena mysticetus*)

The Western Arctic stock (discussed below) is distributed in seasonally ice-covered waters of the Arctic and near-arctic, generally between 60 and 75 degrees N latitudes in the western Arctic Basin (Moore and Reeves 1993). Currently, five bowhead whale stocks are recognized by the International Whaling Commission (IWC 1992). Small stocks occur in 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 (Zeh et al. 1993). The largest population is the Western Arctic stock, also know as the Bering, Chukchi, and Beaufort Sea stock (Rugh et al. 2003), and is the focus of this IHA.

In Alaskan waters, the majority of bowhead whales winter in the central and northwestern Bering Sea (November to March), migrate through the Chukchi Sea in the spring (March through June) following offshore ice leads around the coast of Alaska, and summer in the Canadian Beaufort Sea (mid-May through September) (Braham et al. 1980; Moore and Reeves 1993).

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). During fall migration, most bowheads migrate west in water ranging from 15 to 200 meters (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.

Bowhead whales typically reach the Barrow area during their westward migration from the feeding grounds in the Canadian Beaufort Sea in mid-September to late-October. Although, over the years, local residents report having seen a small number of bowhead whales feeding off Barrow or in the pack ice off Barrow during the summer, indicating that this area may be an important feeding area. Autumn bowhead whaling near Barrow normally begins in mid-September, but may begin as early as August if whales are observed and ice conditions are favorable (USDI/BLM 2005). Whaling can continue into October, depending on the quota and conditions.

The pre-exploitation population of bowhead whales in the Bering, Chukchi, and Beaufort seas is estimated to be 10,400-23,000 whales, and was reduced by commercial whaling to perhaps 3,000 (Woodby and Botkin 1993). Up to the early 1990s, the population size was believed to be increasing at a rate of about 3.2 percent per year (Zeh et al. 1996; Angliss and Lodge 2002) despite annual subsistence harvests of 14-74 bowheads from 1973 to 1997 (Suydam et al. 1995) and 42, 35, 49, 37, and 35 in 1999 through 2003, respectively (Suydam and George 2004). This is consistent with an annual population growth rate of 3.4 percent (95 percent CL 1.7-5 percent) from 1978 to 2001 reported by George et al. (2004) who estimated the population in 2001 at approximately 10,470 animals. Based on the most recent abundance estimates using 2001 data, approximately 10,545 bowheads whales make up the Western Arctic stock, with a minimum estimate [CV(N) = 0.128] of 9,472 whales (Angliss and Outlaw 2005).

The inclusion of the abundance estimate for 2001 results in a rate of increase of 3.5 percent (confidence intervals [CI] = 2.2 to 4.9 percent) (Brandon and Wade 2004 *cited in* Angliss and Outlaw 2005). Calve counts in 2001 was the highest recorded at 121 individuals, and lends building evidence of a growing population.

This bowhead population is currently listed as Endangered under the ESA and is classified as a strategic stock by NMFS (Angliss and Outlaw 2005).

Gray Whale (*Eschrichtius robustus*)

Gray whales originally inhabited both the North Atlantic and North Pacific oceans. The Atlantic populations are believed to have become extinct by the early 1700s. A relic population survives in the Western Pacific. The eastern Pacific or California gray whale population has recovered significantly from commercial whaling, and now numbers about 18,813, and is the focus stock under this IHA (revised Angliss and Outlaw 2005).

The eastern North Pacific population of the gray whale ranges from the Bering, Chukchi, and Beaufort seas (in summer) to the Gulf of California (in winter) (Rice 1998).Gray whales have also been documented foraging in waters off of Southeast Alaska, British Columbia, Washington, Oregon, and California (Rice and Wolman 1971; Berzin 1984; Darling 1984; Quan 2000; Calambokidis et al. 2002). Most of the eastern north Pacific population makes a round-trip annual migration of more than 8,000 km (5,000 miles) from Alaska waters to Baja California in Mexico. From late May to early October, the majority of the population concentrates in the northern and western Bering Sea and the Chukchi Sea.

Typically, gray whales are found primarily in shallow water, and usually remain closer to shore than any other large cetacean. Gray whales are considered common in the nearshore waters of the eastern Chukchi Sea, and occasionally are seen east of Point Barrow in late-spring and summer. On wintering grounds, mainly along the west coast of Baja California, gray whales utilize shallow, nearly land-locked lagoons and bays (Rice et al. 1981). From late February to June, the population migrates back to arctic and subarctic seas (Rice and Wolman 1971).

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 was reduced, likely as a result of 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 of Barrow (Clarke et al. 1989).

Gray whales have been counted as they migrate southward past Granite Canyon in central California each year since 1967. The most recent abundance estimates are from southbound migration counts in 1997/98, 2000/01, and 2001/02 periods with abundance estimates for the aforementioned periods of 29,758, 19,448, and 18,178, respectively [Rugh et al. (In press) *in* Angliss and Outlaw 2005].

Previous variations in estimates may be attributed to differences in the proportion of the gray whale stock migrating as far as the central California coast each year. The decline in abundance estimates between the 2000/01, and 2001/02 may be an indication that the abundance was responding to environmental limitations as the population approaches carrying capacity (Angliss and Outlaw 2005). The lower counts conducted in 2000/01 and 2001/02 may have been due to a large number of whales that did not migrate as far south as Granite Canyon, or possibly, abundance may have actually declined following high mortality rates documented in 1999 and 2000 (Rugh et al. (in press) *cited in* Angliss and Outlaw 2005; Gulland et al. 2005).

Using the mean of the 2000/01 and 2001/02 abundance estimates noted above is 18,813 animals (Angliss and Outlaw 2005). Gray whale numbers increased steadily until at least 1998, with an estimated annual growth rate of 3.3 percent between 1967 and 1988 (Buckland et al. 1993). More recent estimated growth rates from 1967/68 through 2001/02 indicate and annual growth rate of 1.9 percent (SE = 0.32 percent) [Rugh et al. (In press) *in* Angliss and Outlaw 2005]. In addition, Rugh et al. (in press) estimated carrying capacity of 26,290 (coefficient of variation [CV] = 0.059), indicating that recent reductions in abundance estimates may be a function of the population reaching its carrying capacity. The eastern Pacific stock was removed from the Endangered Species List in 1994 and is not considered by NMFS to be a strategic stock.

Beluga Whale (*Delphinapterus leucas*)

The beluga whale is an arctic and subarctic species that has several populations that occur in Alaska. 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, Angliss and Lodge 2004). For the proposed project, only the eastern Chukchi Sea and Beaufort Sea stocks will be discussed.

Satellite tagging efforts directed at the eastern Chukchi stock of beluga whales showed that whales tagged in the eastern Chukchi in summer traveled 1,100 km north of the Alaska coastline and to the Canadian Beaufort Sea within 3 months of tagging (Suydam et al. 2001), indicating significant stock overlap with the Beaufort Sea stock of beluga whales. During the winter, beluga whales occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers for molting (Finley 1982) and calving (Sergeant and Brodie 1969). Annual migrations may cover thousands of kilometers (Reeves 1990).

Beluga whales of the eastern Chukchi and Beaufort stocks winter in the Bering Sea, summer in the eastern Beaufort Sea, and migrate around western and northern Alaska (Angliss and Lodge 2002). The majority of belugas in the Beaufort stock migrate through the Chukchi 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).

During late summer and autumn, most belugas migrate far offshore near the pack ice front (Hazard 1988; Clarke et al. 1993; Miller et al. 1998) and may select deeper slope water independent of ice cover (Moore et al. 2000b). Small numbers of belugas, however, are sometimes observed near the north coast of Alaska during the westward migration in late summer and autumn (Johnson 1979) but the main fall migration corridor of beluga whales is greater than 100 km (62 miles) north of the coast. Aerial and vessel-based seismic monitoring programs conducted in the central Alaskan Beaufort Sea from 1996 through 2001 observed only a few beluga whales migrating along or near the coast (LGL and Greeneridge 1996; Miller et al. 1998, 1999). The vast majority of belugas seen during those projects were far offshore.

The abundance estimate considered the "most reliable" for the eastern Chukchi Sea beluga whale stock is 3,710, a result from 1989–1991 aerial surveys (Frost et al. 1993, Angliss and Lodge 2004). Additional surveys were conducted in 1998 (DeMaster et al. 1998) and again in July 2002 (Lowry and Frost 2002, cited in Angliss and Outlaw 2005), but both were partial surveys and therefore, a more recent abundance estimate for this stock is not available.

Small numbers of belugas may be encountered during the early (June/July) phase of the proposed seismic surveys in the eastern Chukchi Sea, however, the majority of the migration will have passed. The continuation of seismic acquisition from mid-October through November should not encounter belugas. This population is not considered by NMFS to be a strategic stock but the current population trend of the Beaufort Sea stock of beluga whales is unknown (Angliss and Outlaw 2005).

Killer Whale (*Orcinus orca*)

Killer whales are found throughout the world's oceans and seas, from tropical waters near the equator to the cooler waters in the high latitudes. They are most common in cooler coastal waters of both hemispheres, but appear in greatest numbers within 800 km from continental coasts (Mitchell 1975). Killer whales are found throughout the North Pacific and along the entire Alaskan coast, extending from the Bering and Chukchi Seas with small numbers possibly occurring in the Beaufort Sea. It is unclear which stock of killer whales may move into the waters of the Chukchi; however small numbers have been reported west of Point Barrow in the late spring and early summer, presumably following the bearded seal migration (pers comm., C.George, NMML, November 8, 2005).

Based on data regarding association patterns, acoustics, movements, and genetic differences, eight killer whale stocks are now recognized within the Pacific U.S.: 1) the Alaska Resident stock - occurring from southeastern Alaska to the Aleutian Islands and Bering Sea; 2) the Northern Resident stock - occurring from British Columbia through part of southeastern Alaska; 3) the Southern Resident stock - occurring mainly within the inland waters of Washington State and southern British Columbia, but also in coastal waters from British Columbia through California; 4) the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock - occurring mainly from Prince William Sound through the Aleutian Islands and Bering Sea; 5) the AT1 transient stock - occurring in Alaska from Prince William Sound through the Kenai Fjords; 6) the West Coast transient stock - occurring from California through southeastern Alaska; and 7) the Offshore stock - occurring from California through Alaska, and 8) the Hawaiian stock.

The Alaska resident stock is a transboundary stock, but is found from southeastern Alaska to the Aleutian Islands and Bering Sea (Angliss and Outlaw 2005). The NMML began killer whale studies in 2001 in Alaskan waters west of Kodiak Island, including the Aleutian Islands and Bering Sea. Line-transect surveys were conducted in July and August in 2001-2003. Based on these surveys an estimated abundance of resident killer whales was 991 (CV = 0.52), with 95 percent confidence interval of 380-2585 (Zerbini et al. in prep. *cited in* Angliss and Outlaw 2005). Because areas such as Prince William Sound and the Bering Sea were outside the line-transect survey area and movement of whales were known to move out of the survey area over the course of the 3-year study, counts of known 'resident' whales in these areas were combined, using photo identification, to produce a minimum number estimate of 1,123 killer whales belonging to the Alaska Resident stock (Angliss and Outlaw 2005). The eastern North Pacific Alaska resident stock of killer whales is not classified as a strategic stock.

Harbor Porpoise (*Phocoena phocoena*)

The harbor porpoise is the smallest cetacean, found in shallow, coastal waters from temperate to arctic zones of the northern hemisphere (Read 1999). In the eastern North Pacific Ocean, the

harbor porpoise ranges from Point Barrow, along the Alaska coast, and down the west coast of North America to Point Conception, California (Gaskin 1984). The Bering Sea stock of the harbor porpoise primarily frequents coastal waters, and in the Gulf of Alaska and Southeast Alaska, they occur most frequently in waters less than 100 m in depth (Waite and Hobbs, in review, *cited in* Angliss and Outlaw 2005).

The northern extent of the harbor porpoise's range is the Chukchi Sea near Point Barrow south through the Bering Sea, southeastern shore of Bristol Bay, and south to San Luis Obispo, California (Suydam and George 1992). There are extralimital records of harbor porpoise documented further east of Point Barrow near the mouth of the Mackenzie River in the Northwest Territories, Canada.

Aerial surveys conducted in June and July 1999 in the waters of Bristol Bay provide an abundance estimate (with correction) of 47,356 (CV = 0.223) (Angliss and Outlaw 2005).

The estimate for 1999 can be considered conservative, as the surveyed areas did not include known harbor porpoise range near either the Pribilof Islands or in the waters north of Cape Newenham, approximately 59 degrees N (Angliss and Outlaw 2005). This estimate is higher than the 1991 estimate of 10,946 (Dahlheim et al. 2000) but differences in survey techniques make direct comparisons of the surveys difficult.

Surveys conducted in 1999 were more extensive than during the 1991 surveys, and additional areas (Dahlheim et al. 2000). In addition, the use of a second correction factor for the 1999 estimate confounds direct comparison. The density of harbor porpoise resulting from the 1999 surveys was still substantially higher than that reported in Dahlheim et al. (2000), but it is unknown whether the increase in density is a result of a population increase or is a result of survey design.

Harbor porpoise is unlikely to occur within the seismic acquisition area as transects will occur well offshore in water depth averaging approximately 250 m in depth. Harbor porpoise are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the ESA. The Bering Sea stock of harbor porpoise is not classified as a strategic stock. Population trends and status of this stock relative to optimum sustainable population (OSP) are currently unknown.

Ringed Seal (*Phoca hispida*)

In the North Pacific, ringed seals are found in the southern Bering Sea and range as far south as the Seas of Okhotsk and Japan. Throughout their range, ringed seals have an affinity for ice-covered waters and are well adapted to occupying seasonal and permanent ice, and are year-round residents throughout the Beaufort, Chukchi, and Bering Seas, as far south as Bristol Bay in years of extensive ice coverage. They tend to prefer large floes (i.e., more than 48 m in diameter) and are often found in the interior ice pack where the sea ice coverage is greater than 90 percent (Simpkins et al. 2003), and remain in contact with ice most of the year and pup on the ice in late winter-early spring.

During winter, ringed seals occupy landfast ice and offshore pack ice of the Bering, Chukchi and Beaufort seas. Ringed seals maintain breathing holes in the ice and occupy lairs in accumulated snow (Smith and Stirling 1975). They give birth in lairs from mid-March through

April, nurse their pups in the lairs for 5–8 weeks, and mate in late April and May (Smith 1973; Hammill et al. 1991; Lydersen and Hammill 1993).

During late April through June, ringed seals are distributed throughout their range from the southern ice edge northward (Braham et al. 1984). Preliminary results from recent surveys conducted in the Chukchi Sea in May-June 1999 and 2000 indicate that ringed seal density is higher in nearshore fast and pack ice, and lower in offshore pack ice (Bengtson et al. (in review) *cited in* Angliss and Outlaw 2005). Frost and Lowry (1999) conducted surveys in May and results indicated that, in the Alaskan Beaufort Sea, the density of ringed seals in May-June is greater to the east of Flaxman Island than to the west.

No estimate for the size of the Alaska ringed seal stock is currently available (Angliss and Outlaw 2005). Past ringed seal population estimates in the Bering-Chukchi-Beaufort area ranged from 1-3.6 million (Frost et al. 1988). Frost and Lowry (1981) estimated 80,000 ringed seals in the Beaufort Sea during summer and 40,000 during winter.

Aerial surveys within 20 nautical miles (nm) of shore were conducted in May-June between 1986 and 1987 for a portion of the range of the ringed seal estimated 44,360 +/-9,130 (96 percent CI) (Frost et al. 1988). Spring density estimates in the same area from 1985-1987 ranged from 1.01 to 2.94 seals per square kilometers (/km^2) (Frost and Lowry 1988). Similar surveys for the Alaska Beaufort Sea between Kaktovik and Barrow occurred in the spring during several years in the 1990s with density estimates for all years ranging from 0.81-1.17 seals/km^2 with a mean of 0.98 seals/km^2 or approximately 18,000 hauled-out ringed seals in the survey area. Surveys conducted in 1999 and 2000 between Shishmaref to Barrow in the eastern Chukchi Sea estimated abundance of ringed seals at 252,488 (SE = 47,204) and 208,857 (SE = 25,502), respectively (Bengtson et al. (in review) *cited in* Angliss and Outlaw 2005). Combining this with the average abundance estimate of 230,673 seals from the eastern Chukchi Sea, results in a total of 249,000 seals.

It is not known whether the more recent lower densities correspond to an actual reduction in the population or are related to earlier survey dates in 1990s. At earlier dates, a higher proportion of the seals are still using their lairs and are unavailable to be counted by aerial surveyors (Kelly et al. 2004). Frost et al. (2002) reanalyzed the earlier estimates for 1985-87 and reported ringed seal densities surveyed between Oliktok Point and Flaxman Island ranged from 0.56 to 1.16 seals/km2 (about half the density originally reported) during the spring seasons of 1985 to 1987. Based on more recent surveys from 1996 through 1999, ringed seal density in fast ice areas between Oliktok Point and Flaxman Island ranged from 0.48 to 0.77 seals/km^2 (Frost et al. 2002).

BP's Northstar project, near Prudhoe Bay, developed a seal survey and monitoring program to establish a baseline prior to construction and to monitor during initial operations for comparison. Ringed seal densities reported by Moulton et al. (2002) ranged from 0.39 to 0.63 seals/km^2 prior to construction in the Northstar development area. Ringed seal densities close to Northstar in 2000, 2001, and 2002 were not reduced relative to those farther away or to those during the 1997 to 1999 pre-development period (Moulton et al. 2003 a, b), however because aerial surveys will underestimate actual seal densities, the above density figures should be used as minimum estimates.

During summer, ringed seals are found dispersed throughout open water areas, although in some regions they move into coastal areas (Smith 1987; Harwood and Stirling 1992). During the open-water period, ringed seals in the eastern Beaufort Sea are widely dispersed as single animals or small groups (Harwood and Stirling 1992). Marine mammal monitoring in the nearshore central Beaufort Sea confirms these generalities (Moulton and Lawson 2002; Williams et al. 2004, Green et al. 2005, in progress).

Large concentrations of ringed seals are not expected to be encountered near each of the proposed seismic activity areas in the northern Chukchi Sea during the summer and fall time period. The Alaska stock of ringed seals is not classified as a strategic stock by NMFS.

Spotted Seal (*Phoca largha*)

Spotted seals occur in the Beaufort, Chukchi, Bering and Okhotsk Seas, and south to the northern Yellow Sea and western Sea of Japan (Shaughnessy and Fay 1977). Based on satellite tagging studies, spotted seals migrate south from the Chukchi Sea in October and pass through the Bering Strait in November and overwinter in the Bering Sea along the ice edge (Lowry et al. 1998).

During spring when pupping, breeding, and molting occur, spotted seals tend to prefer small floes (less than 20 meters in diameter), and inhabit mainly the southern margin of the ice in the Okhotsk and Bering seas, with movement to coastal habitats after the retreat of the sea ice (Shaughnessy and Fay 1977; Quakenbush 1988; Rugh et al. 1997; Simpkins et al. 2003).

In summer, the majority of spotted seals are found in the Bering and Chukchi Seas, but do 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 most commonly seen in bays, lagoons and estuaries and are typically not associated with pack ice unless it is near to shore.

As the ice cover thickens with the onset of winter, spotted seals leave the northern portions of their range and move into the Bering Sea (Lowry et al. 1998).

A reliable abundance estimate for spotted seal is not currently available (Angliss and Outlaw 2005); however, early estimates of the size of the world population of spotted seals was 335,000–450,000 animals and the size of the Bering Sea population, including animals in Russian waters, was estimated to be 200,000–250,000 animals (Burns 1973 *cited in* Angliss and Lodge 2004). The total number of spotted seals in Alaskan waters is not known (Angliss and Lodge 2004), but the estimate is most likely between several thousand and several tens of thousands (Rugh et al. 1997). Using maximum counts at known haulouts from 1992 (4,135 seals), and a preliminary correction factor for missed seals developed by the Alaska Department of Fish and Game (Lowry et al. 1994), an abundance estimate of 59,214 was calculated for the Alaska stock (Angliss and Lodge 2004).

The activities associated with the proposed seismic work in the Chukchi Sea are expected to encounter few, if any, spotted seals. The Alaska stock of spotted seals is not classified as a strategic stock by NMFS.

Bearded Seal (*Erignathus barbatus*)

Bearded seals are associated with sea ice and have a circumpolar distribution (Burns 1981). Bearded seals are predominately benthic feeders, and prefer waters less than 200 meters in depth.

Seasonal movements of bearded seals are directly related to the advance and retreat of sea ice and to water depth (Kelly 1988). During winter they are most common in broken pack ice and in some areas also inhabit shorefast ice (Smith and Hammill 1981). In Alaska waters, bearded seals are distributed over the continental shelf of the Bering, Chukchi, and Beaufort Seas, but are more concentrated in the northern part of the Bering Sea from January to April (Burns 1981).

During winter, most bearded seals in Alaskan waters are found in the Bering Sea. In the Chukchi and Beaufort seas, favorable conditions are more limited, and consequently, bearded seals are less abundant there during winter. From mid- to late-April to June, as the ice recedes, some of the bearded seals migrate northward through the Bering Strait and spend the summer along the ice edge in the Chukchi Sea (Burns 1967, Burns 1981).

Recent spring surveys along the Alaskan coast indicate that bearded seals tend to prefer areas of between 70 percent and 90 percent sea ice coverage, and are typically more abundant greater than 20 nm of shore, with the exception of high concentrations nearshore to the south of Kivalina in the Chukchi Sea (Bengtson et al. 2000; Simpkins et al. 2003).

During the summer in the Chukchi Sea, bearded seals are most associated with the pack ice edge near the continental shelf. The nearshore areas of the central and western Beaufort Sea provide somewhat more limited habitat because the continental shelf is narrower and the pack ice edge frequently occurs seaward of the shelf and over waters greater than 200 m in depth.

A reliable abundance estimate for the Alaska stock of bearded seals is not available. The most recent surveys occurred in May-June of 1999 and 2000 between Shismaref and Barrow with average densities of 0.07 seals per km^2 and 0.14 seals per km^2, respectively, however, there is no correction factor available for these data. Early estimates of the Bering-Chukchi Sea population ranged from 250,000 to 300,000 (Burns 1981).

Aerial surveys conducted by MMS in fall 2000 and 2001 sighted a total of 46 bearded seals during survey flights conducted between September and October (Treacy 2002 a, b), with all but two sightings recorded east of 147 degrees W and all sightings were within 40 nm of shore. Aerial surveys conducted from 1997 to 2002 in the vicinity of Northstar Island also reported small numbers of bearded seals, ranging from none to 15 seals (Moulton et al. 2003c).

The proposed seismic activity areas may encounter bearded seals during the open-water season, however, the number of bearded seals is expected to be small. The Alaska stock of bearded seals is not classified by NMFS as a strategic stock.

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:

The only type of incidental taking sought in this application is that of takes by noise harassment. The only sources of harassment will be those stemming from marine noises produced by operation of the vessels M/V Gilavar and M/V Alex Gordon and noise produced by the operation of the seismic air guns arrayed from the M/V Gilavar.

6. Numbers of marine mammals that may potentially be taken:

Shell seeks authorization for potential "taking" of small numbers of marine mammals under the jurisdiction of the NMFS in the proposed region of activity. Species for which authorization is sought are bowhead, gray, killer and beluga whales, harbor porpoise, and ringed, spotted, and bearded seals. Polar Bear and Pacific walrus will be covered in a separate IHA with USFWS.

The only anticipated impacts to marine mammals associated with noise propagation from vessel movement, seismic acquisition operations, and seabed profiling work would be temporary and short term displacement of seals and whales from within ensonified zones produced by such noise sources.

The proposed area of seismic acquisition for the Chukchi Sea proposed by Shell is not expected to "take" more than small numbers of marine mammals, or have more than a negligible effect on their populations.

Basis for Estimating Numbers of Marine Mammals that Might be "Taken by Harassment"

Taking into account the small total volume and relatively-low sound output of the airgun sources, and mitigation measures that are planned, effects on cetaceans and pinnipeds are generally expected to be limited to avoidance of a small area (ensonification zone) around the seismic operation and short-term changes in behavior, falling within the MMPA definition of "Level B harassment".

The methods to estimate "take by harassment" and present estimates of the numbers of marine mammals that might be affected during the proposed seismic acquisition area in the Chukchi Sea are described below. The density estimates for the species covered under this IHA are based on the estimates developed by LGL (2005) University of Alaska IHA and used here for consistency. Density estimates are based on the data from Moore et al. (2000) on summering bowhead, gray, and beluga whales in the Beaufort and Chukchi Seas, and relevant studies on ringed seal estimates including Stirling et al. (1982), Kingsley (1986).

This section provides estimates of the number of potential "exposures" to sound levels greater than 160 decibels (dB) re 1 μPa (rms) and greater than 170 dB. The greater than 160 dB criterion is applied for all species of cetaceans and pinnipeds; the criterion is applied for delphinids and pinnipeds. The 170 dB criterion is considered appropriate for those two groups, which tend to be less responsive, whereas the 160 dB criterion is considered appropriate for other cetaceans (LGL 2005).

The following estimates are based on a consideration of the number of marine mammals that might be disturbed by approximately 5,556 km of seismic surveys in the geographic region of the Chukchi Sea MMS OCS Program Area designated as Chukchi Sea Sale 193 (1989) and the proposed 2002-2007 Chukchi Sea Program Area.

Source arrays are composed of identically tuned Bolt gun sub-arrays operating at 2000 psi, air pressure. In general, the signature produced by an array composed of multiple sub-arrays has the same shape as that produced by a single sub-array while the overall acoustic output of the array is determined by the number of sub-arrays employed. The gun arrangement for the 1,049 cubic inches (in^3) sub-array is detailed below and is comprised of three subarrays comprising a total 3,147 in^3 sound source. There will be no site clearance work performed for these seismic activities, therefore, potential taking estimates only include noise disturbance from the use of airguns.

The specifications of the equipment to be used and areas of ensonification are described more fully in Section 1.

Cetaceans

For whales, Moore et al. (2000) likely offer the most current data to estimate densities of belugas, bowheads and gray whales during summer in the Beaufort and Chukchi seas, however, densities of beluga and gray whales are likely overestimated due to the fact that most beluga and gray whales are found west of the three seismic survey areas. Density estimates for bowhead whale were conducted by air during the bowhead migration and, while likely accurate for the area proposed for seismic activities within the Chukchi Sea, will overestimate the numbers of "take by harassment" (noise disturbance) because activities will occur in late June through early August, and again in early- to mid-October through November when bowhead whales are widely distributed and would be expected to occur in very low numbers within the seismic activity area.

Killer whale and harbor porpoise are known to occur at least occasionally in the Chukchi Sea, however, densities are very low or zero. In those cases, the "Requested Take Authorization" figures include upward adjustment for these two species for small numbers that might be encountered during seismic activities.

Table 6-1 gives the average and maximum densities for each cetacean species likely to occur within the project areas based on the density estimates developed and corrected as needed by LGL for the Beaufort and Chukchi Seas (LGL 2005), and these estimates were based on surveys of offshore waters (greater than 100 m in depth). All seismic activities are estimated to occur in waters 40-60 m in depth.

The estimated numbers of potential exposures presented in Table 6-1 are based on the 160 dB re 1 μPa (rms) criteria for most cetaceans, because this range is assumed to be the sound source level at which marine mammals may change their behavior sufficiently to be considered "taken by harassment."

Pinnipeds

Ringed, spotted, and bearded seals are associated with sea ice, and most census methods used to determine density estimates for pinnipeds are associated with counting the number of seals hauled out on ice.

Table 6-1. Expected densities of marine mammals during open-water seismic surveys proposed for offshore areas of the Chukchi and Beaufort Seas.

Species	Average Density (#/km^2) [1]	Maximum Density (#/km^2) [1]
Cetaceans		
bowhead whale	0.0064	0.0256
gray whale	0.0045	0.0179
beluga whale	0.0034	0.0135
killer whale	0.0000	0.0000
harbor porpoise	0.0000	0.0002
Pinnipeds		
ringed seal	0.251	0.444
spotted seal	0.0001	0.0005
bearded seal	0.0128	0.0226

[1] These estimates are calculated from various sources including Moore et al. 2000, Stirling et al. 1982, Kingsley 1986, and presented in LGL 2005, Table 4.

Correction factors have been developed for most pinniped species that address biases associated with detectability and availability of a particular species. Although extensive surveys of ringed and bearded seals have been conducted in the Beaufort Sea, the majority of the surveys have been conducted over the landfast ice and few seal surveys have been in open water. The most comprehensive survey dataset on ringed seals (and bearded seal) from the central and eastern Beaufort Sea was conducted on offshore pack ice in late spring (Kingsley 1986). It is important to note that all proposed activities will be conducted during the open-water season and density estimates used here were based on counts of seals on ice. Therefore, densities and potential take numbers will overestimate the numbers of seals that would likely be encountered and/or exposed because only the animals in the water would be exposed to the seismic and clearance activity sound sources.

Although the estimated numbers of potential exposures presented in Table 6-2 are based two sound source ranges (i.e., >160 dB and >170 dB re 1 µPa (rms)), for most pinnipeds, the 170 dB threshold should be used to determine "take by harassment" because this range is assumed to be the sound source level at which most pinnipeds may change their behavior in reaction to increased sound exposure.

Exposure Calculations for Cetaceans and Pinnipeds

The number of exposures of a particular species to sound levels between 160 dB and 180 dB re 1 µPa (rms) was calculated by multiplying:

- the expected species density (i.e., average and maximum), taken from LGL (2005) and shown in Table 6-1,
- the anticipated total line-kilometers of operations with the three 1,049 in^3 subarrays (i.e.5,556 kilometers),
- the cross-track distances within which received sound levels are predicted to be between ≥160 dB to 169 dB and >170 to 179 dB (Figure 6-1 and Table 6-3).

Table 6-2. Estimates of possible numbers of marine mammals exposures to 160 dB and >170 dB during Shell's proposed seismic acquisition program in the Chukchi Sea.

Species	Avg Density at greater than 160 dB	Max Density at greater than 160 dB	Avg Density at greater than 170 dB	Max Density at greater than 170 dB	Requested Take Authorization
Cetaceans					
bowhead whale	46	185	30	121	**185**
gray whale	33	129	21	85	**129**
beluga whale	25	98	16	64	**98**
killer whale	0	0	0	0	**5**
harbor porpoise	0	1	0	1	**5**
Pinnipeds					
ringed seal	1,813	3,207	1,185	2,097	**2,097**
spotted seal	1	4	0	2	**2**
bearded seal	92	163	60	107	**107**
Total	**2,009**	**3,786**	**1,314**	**2,476**	

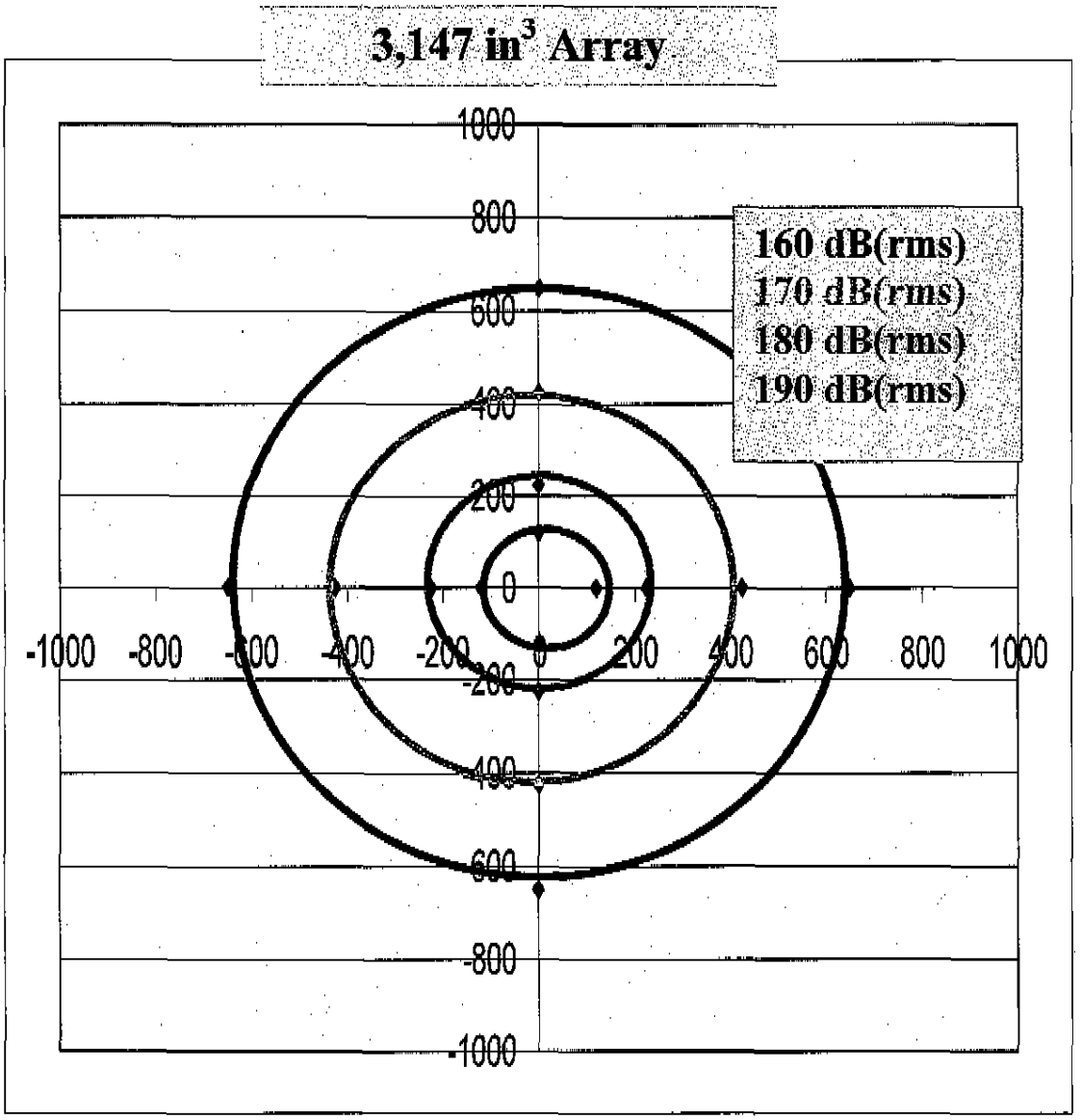
The last column of Table 6-2 also shows the shows the numbers of animals for which "harassment take authorization" is requested. No other cetacean or pinniped species are suspected to occur within the Chukchi Sea and are not included under this IHA because of the unlikely event of an encounter. The results and estimated request for take authorization is displayed in Table 6-2.

Applying the method described above, and multiplying the distance times 2 (Table 6-3), approximately 7,223 km^2 and 4,723 km^2 would be within the greater than 160 dB and greater than 170 dB ensonification zones, respectively. Based on this method, the "average" and "maximum" estimates of the numbers of marine mammal exposures to the proposed seismic arrays with received levels between ≥160 and <180 dB re 1 µPa (rms) were obtained using the "average" and "maximum" densities from Tables 6-1.

Table 6-3. Sound level and distance from sound sources based on the proposed 3,147 cubic inch array at a depth of six meters

Sound Level	Distance from Source	Area of Ensonification (Distance x 2)
160 dB (rms) 169 dB (Peak-Peak) $2.8X10^{-3}$ Bar	< 650 meters	1,300 meters
170 dB (rms) 179 dB (Peak-Peak) $8.9X10^{-3}$ Bar	< 425 meters	850 meters
180 dB (rms) 189 dB (Peak-Peak) $2.8X10^{-2}$ Bar	< 225 meters	450 meters
190 dB (rms) 199 dB (Peak-Peak) $8.9X10^{-2}$ Bar	< 120 meters	240 meters

Figure 6-1. Estimated Radii of rms Sound Level output from simulation of 3,147 cubic inch source array.



Estimates for the ESA-listed bowhead whale may be exposed to noise levels of 160 dB; however, as stated earlier, proposed activities would occur when bowheads are widely distributed and would be expected to occur in very low numbers within the seismic activity area. The estimated average and maximum numbers for bowhead whales are 46 and 185, respectively (Table 6-2).

Gray and beluga whales also have the potential for exposure, particularly near Area 3. The average and maximum estimates of the number of exposures for gray whales are 33 and 129, 25 and 98 for beluga whales, 0 and 0 for killer whale, and 0 and 1 for harbor porpoise, however, exposure estimates for the killer whale and harbor porpoise were rounded up to five each to cover the slight possibility of encounter (Table 6-2).

As stated earlier, density information for pinnipeds stems from on-ice surveys and likely overestimates the number of seals that may actually receive higher sound sources from seismic (airgun) activities.

Ringed seals would be the most prevalent marine mammal species encountered at each of the three proposed seismic acquisition areas, and would account for over 80 or 84 percent of the marine mammals that might be exposed to seismic sounds equal to or greater than 170 dB or 160 dB, respectively. Pinnipeds are not likely to react to seismic sounds unless they are greater than 170 dB re 1 μPa (rms), and Moulton and Lawson (2002) indicated that most pinnipeds exposed to 170 dB do not visibly react. Under this IHA, the requested take authorization for all pinnipeds uses the maximum density of greater than 170 dB instead of the 160 dB threshold. This decision to use the lower estimated number is based on the theory that surveys for pinnipeds within the Chukchi Sea, and elsewhere, are based on on-ice counts which will overestimate the number of potential exposures (i.e., only a portion of the animals are in the water, and therefore, could be exposed).

Spotted and bearded seals may be encountered in much small numbers than ringed seals, but also have the potential for exposure. The average and maximum estimates of the number of exposures for spotted seals are 0 and 2, and 60 and 107 for bearded seals (Table 6-2).

Summary

The proposed survey area in the Chukchi Sea will involve towing three subarray airgun configurations that introduce pulsed sounds into the ocean. No site clearance work is proposed for the seismic acquisition activities. Routine vessel operations, other than the proposed operations by the airgun(s), are conventionally assumed not to affect marine mammals sufficiently to constitute "taking." Taking into account the small total volume and relatively low sound output of the airgun sources, and mitigation measures that are planned, effects on cetaceans and pinnipeds are generally expected to be limited to avoidance of a small area around the seismic operation and short-term changes in behavior, falling within the MMPA definition of "Level B harassment". The requested "take authorization" for each species is based on the estimated *maximum number of exposures* to greater than 160 dB re 1 μPa (rms) for all cetaceans and greater than 170 dB re 1 μPa (rms) for pinnipeds (i.e., the highest of the various estimates where a behavioral change may be expected). In addition, the estimated numbers of animals potentially exposed to sound levels sufficient to cause appreciable disturbance are very low percentages of the population sizes ranging into the Chukchi and Beaufort Seas.

Based on the above threshold criterion, the number of ESA listed bowhead whales that may be exposed to sounds greater than 160 dB re 1 μPa (rms) represent approximately 1.7 percent of the estimated population within the Beaufort and Chukchi Seas (Table 4-1 in Section 4) however, seismic surveys conducted from mid-June through July and again from mid-October through November would occur when bowhead whales are widely distributed and would be expected to occur in very low numbers within the seismic activity area.

No reliable abundance numbers currently exist for ringed, spotted, and bearded seals for the Chukchi Sea, however, the potential number of exposures would be a very small fraction of earlier abundance estimates.

For both cetaceans and pinnipeds likely to be encountered within the activity areas, the short-term exposures to airgun sounds are not expected to result in any long-term negative consequences for the individuals or their populations. Furthermore, the estimated number of animals potentially exposed and requested under a "take" authorization, will be likely be much less for some species (e.g., bowhead whale) because of the period of seismic acquisition, and the survey and mitigation plan which contains efforts to further avoid take.

7. The anticipated impact of the activity on the species or stock:

The only anticipated impacts to marine mammals associated with noise propagation from vessel movement and seismic airgun operations would be the temporary and short term displacement of seals and whales from within ensonified zones produced by such noise sources. Any impacts on the whale and seal populations of the Chukchi Sea seismic acquisition activity area are likely to be short term and transitory arising from the temporary displacement of individuals or small groups from locations they may occupy at the times they are exposed to seismic sounds at the 160-190 db received levels. As noted in section 6, above, it is highly unlikely that animals will be exposed to sounds of such intensity and duration as to physically damage their auditory mechanisms.

8. The anticipated impact of the activity on the availability of the species or stocks of marine mammals for subsistence uses:

There should be no adverse impacts on the availability of the whale species for subsistence uses.

The only whale species normally taken by Inupiat hunters is the bowhead. Chukchi seismic operations will not begin until after 15 June 2006 at which time the majority of bowheads will have migrated to their summer feeding areas in Canada. In the event any bowheads remain in the northeastern Chukchi Sea after June 15, they are not normally hunted after this date until the return migration occurs around late September when a fall hunt by Barrow whalers takes place. Seismic operations for phase two of the Chukchi program will be timed and located so as to avoid any possible conflict with the Barrow fall hunt, and specific provisions governing the timing and location matters addressed here will be incorporated in the CAA established between Shell and WesternGeco, the AEWC, and the Barrow Whaling Captains Association.

Gray whales, which will be abundant in the northern Chukchi Sea from spring through autumn, are not taken by subsistence hunters.

The various pinniped species, including walrus, are all taken by subsistence hunters of the Chukchi villages (Barrow, Wainwright, Pt Lay, Pt Hope). The planned seismic operations will not adversely affect the usual open-water locations of these species and no haul-out areas will be encountered with the possible exception of the polar ice front used by walrus. However, most seismic operations will take place sufficiently distant from nearshore traditional seal and walrus hunting areas.

9. Anticipated impact on habitat:

The seismic activities proposed will not result in any permanent impact on habitats used by marine mammals, or to their prey sources. Seismic activities will occur during the time of year when bowhead whales are widely distributed and would be expected to occur in very low numbers within the seismic activity area (mid- to late-June through July and again from mid-October through November). The northeastern-most of the recurring feeding areas is in the northeastern Chukchi Sea southwest of Barrow. Important walrus feeding areas will be addressed in a separate IHA. Any effects would be temporary and of short duration at any one place. The primary potential impacts to marine mammals is associated with elevated sound levels from the proposed seismic (airguns) work, and discussed in detail earlier in Sections 6 and 7.

A broad discussion on the various types of potential effects of exposure to seismic on fish and invertebrates can be found in LGL (2005), and includes a summary of direct mortality (pathological/physiological) and indirect (behavioral) effects.

Mortality to fish, fish eggs and larvae from seismic energy sources would be expected within a few meters (0.5 to 3 meters) from the seismic source. Direct mortality has been observed in cod and plaice within 48 hours that were subjected to seismic pulses two meters from the source (Matishov 1992), however other studies did not report any fish kills from seismic source exposure (La Bella et al. 1996, IMG 2002, Hassel et al. 2003). To date, fish mortalities associated with normal seismic operations are thought to be slight. Saetre and Ona (1996) modeled a worst-case mathematical approach on the effects of seismic energy on fish eggs and larvae, and concluded that mortality rates caused by exposure to seismic are so low compared to natural mortality that issues relating to stock recruitment should be regarded as insignificant.

Limited studies on physiological effects on marine fish and invertebrates to acoustic stress have been conducted. No significant increases in physiological stress from seismic energy were detected for various fish, squid, and cuttlefish (McCauley et al. 2000) or in male snow crabs (Christian et al. 2003). Behavioral changes in fish associated with seismic exposures are expected to be minor at best. Because only a small portion of the available foraging habitat would be subjected to seismic pulses at a given time, fish would be expected to return to the area of disturbance anywhere from 15-30 minutes (McCauley et al. 2000) to several days (Engas et al. 1996).

Available data indicates that mortality and behavioral changes do occur within very close range to the seismic source, however, the proposed seismic acquisition activities in the Chukchi Sea is predicted to have a negligible effect to the prey resource of the various life stages of fish and invertebrates available to marine mammals occurring during the project's 60- day duration which will cover approximately 5,556 km.

10. Anticipated impact of habitat loss or modification:

The total footprint of the proposed seismic survey area covers approximately 378,000 acres. The effects of the planned seismic activity at each of the three locations on marine mammal habitats and food resources are expected to be negligible, as described in Section 9. It is estimated that only a small portion of the animals utilizing the areas of the proposed activities would be temporarily displaced.

During the period of seismic acquisition (mid-June through July, and again in early- to mid-October through November, 2006), most marine mammals would be dispersed throughout the area. The peak of the bowhead whale migration through the Chukchi Sea typically occurs in October, and efforts to reduce potential impacts during this time will be addressed with the actual start of the migration and with the whaling communities. The timing of seismic activities in the Chukchi Sea will take place when the whales are widely distributed and would be expected to occur in very low numbers within the seismic activity area. Starting in late August bowheads may travel in proximity to the aforementioned activity area and hear sounds from vessel traffic and seismic activities, of which some might be displaced seaward by the planned activities. The numbers of cetaceans and pinnipeds subject to displacement of 0.6 to 1.2 km and 0.4 to 0.9 km (or more), respectively, are small in relation to abundance estimates for the mammals addressed under this IHA.

In addition, feeding does not appear to be an important activity by bowheads migrating through the Chukchi Sea in most years, however, sightings of bowhead whales do occur in the summer near Barrow (Moore and DeMaster 2000) and there are suggestions that certain areas near Barrow are important feeding grounds. In addition, a few bowheads can be found in the Chukchi and Bering Seas during the summer and Rugh et al. (2003) suggests that this may be an expansion of the western Arctic stock although more research is needed. In the absence of important feeding areas, the potential diversion of a small number of bowheads away from seismic activities is not expected to have any significant or long-term consequences for individual bowheads or their population. Bowheads, gray, beluga and killer whales, and harbor porpoise are not expected to be excluded from any habitat.

The proposed activities are not expected to have any habitat-related effects that would produce long-term affects to marine mammals or their habitat due to the limited extent of the acquisition areas and timing of the activities.

11. The availability and feasibility (economic and technological), methods, and manner of conducting such activity or means of effecting the least practicable impact upon affected species or stock, their habitat, and of their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance:

Six main mitigations are proposed: (1) the timing of seismic operations is scheduled so as to avoid those areas of the northern Chukchi where and when bowhead whales are likely to be present (late spring and mid autumn); (2) to confine marine operations to areas not commonly used by subsistence hunters; (3) curtailing active seismic work when the marine mammal observers visually sight (from shipboard) or aerially the presence of marine mammals within identified ensonified zones; (4) to configure the airguns in a manner that directs the energy

primarily downward thus decreasing the range or horizontal spreading of seismic noise; (5) using a seismic energy source which is as small as possible while still accomplishing the geophysical objectives; and (6) using the ramp-up and soft start methods of initiating seismic operations which is intended to alert any marine mammals either within or approaching an operating airgun array so that they may swim away from the source. Details of the proposed mitigations are discussed further in the Marine Mammal Monitoring and Mitigation Measures Plan that is included as Attachment B to this application.

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 or marine mammal for Arctic subsistence uses, the applicant must submit a plan of cooperation or information that identifies what measures have been taken and/or will be taken to minimize any adverse effects on the availability of marine mammals for subsistence uses. A plan must include the following:

i. A statement that the applicant has notified and provided the affected subsistence community with a draft plan of cooperation.

ii. A schedule for meeting with the affected subsistence communities to discuss proposed activities and to resolve potential conflicts regarding any aspects of either the operation or the plan of cooperation.

iii. A description of what measures the applicant has taken and/or will take to ensure that proposed activities will not interfere with subsistence whaling or sealing; and

iv. What plans the applicant has to continue to meet with the affected communities, both prior to and while conducting activity, to resolve conflicts and to notify the communities of any changes in the operation.

Negotiations were initiated beginning in summer 2005 with the AEWC to create a CAA between Shell and Western Geco for 2006 and the subsistence hunting communities of the North Slope. The CAA will cover both this proposed Chukchi Sea deep seismic program and the Beaufort Sea deep seismic, site clearance and shallow hazard survey programs which are being applied for in a separate IHA application. The most recent meeting occurred in October 2005 between representatives of the operator, the North Slope Borough, and AEWC in Fairbanks during the annual meeting of the Alaska Federation of Natives.

Shell and WesternGeco, at the suggestion of AEWC and the NSB, will schedule community meetings with the Chukchi villages of Barrow, Wainwright, Pt Lay and Pt Hope in early 2006.

The CAA will incorporate all appropriate measures and procedures regarding the timing and areas of the operators' planned activities (to wit: times and places where seismic operations will be curtailed or moved in order to avoid potential conflicts with active subsistence whaling and sealing); communications between operators' vessels and whaling or hunting crews (i.e., the communications center will function in Barrow for the Chukchi program); provision for marine mammal observers/Inupiat communicators aboard the M/V Gilavar and M/V Alex Gordon; conflict resolution procedures; and provisions for rendering emergency assistance to subsistence hunting crews.

If requested, post-season meetings will also be held to assess the effectiveness of the 2006 CAA, to address how well conflicts (if any) were resolved, and to receive recommendations on any changes (if any) might be needed in the implementation of future CAAs.

It is anticipated that a final draft of the 2006 CAA will be available for consideration and review by NMFS and the MMS by early spring.

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:

The proposed Marine Mammal Monitoring and Mitigation Measures Plan the deep seismic is included as Attachment B of this application. It should be noted that all sightings of polar bears and walrus acquired by shipboard or aerial observers will be recorded and reported to the USFWS.

14. Suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects:

Marine mammal studies in the Chukchi Sea may be undertaken by various agencies and programs during the course of the 2006 open water season. It is unclear if these studies might be relevant to Shell's proposed activities. Shell is prepared to share information obtained during implementation of our marine mammal monitoring program with a variety of groups who may find the data useful in their research. A suggested list of recipients includes:

- The North Slope Borough Department of Wildlife Management (C. George)
- The USFWS Office of Wildlife Management (C. Perham)
- The USGS Alaska Science Center Polar Bear Research Program (S. Amstrup)
- The MMS's Bowhead Whale Aerial Survey Program (C. Monnett)

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