Conservation Concerns for Cetaceans in the Bering Sea and Adjacent Waters: Offshore Oil Development and other Threats

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ABSTRACT

The North Aleutian Basin Planning Area (i.e. the Bristol Bay region) is situated in the eastern Bering Sea, which is known for its high biological productivity. There are a number of endangered whale populations utilizing the area as habitat; they include the North Pacific right whale, bowhead whale, blue whale, fin whale, sei whale, humpback whale and sperm whale. The Minerals Management Service, the federal regulatory agency responsible for leasing offshore federal lands for oil and gas resource development, proposes scheduling two lease sales in the North Aleutian Basin in 2010 and 2012. There are currently a variety of lethal and sublethal threats posed by climate change, commercial fishing, maritime commercial shipping, naval activities, pollution, and others. Compounding these threats would be those greater threats posed by offshore oil and gas exploration and production activities associated with leasing OCS lands in the North Aleutian Basin Planning Area (e.g., noise pollution, oil spills and other forms of chemical pollution, vessel collisions, entanglement with or ingestion of marine debris, trophic modifications resulting from the introduction of non-native species, burning of fossil fuels used to extract more sequestered hydrocarbons that subsequently are made available as energy and ultimately contributes to global climate warming and in turn modifies wildlife and human habitats). The synergistic interactions are vast and threatening to endangered whale populations attempting to rebuild from past human imprudence. The best available information holds that the loss or injury of any individuals of the eastern North Pacific right whale population (the most endangered large whale population) due directly or indirectly to offshore oil and gas leasing, exploration, or production is unacceptable, as is the degradation of their habitat, if conservation of this population and species is to succeed. Therefore, it is prudent and sagacious to forego leasing OCS lands in the North Aleutian Basin Planning Area until endangered whale populations, such as the eastern North Pacific right whale population, rebuild and are delisted.

KEYWORDS: RIGHT WHALE; NORTH PACIFIC; GRAY WHALE; HUMPBACK WHALE; BOWHEAD WHALE; SEI WHALE; FIN WHALE; CLIMATE CHANGE; REPRODUCTION; STRESS; FEEDING GROUNDS; ARCTIC; HABITAT; POLLUTANTS; DEBRIS; ICE; SHIP STRIKES; CONSERVATION; MORATORIUM; HEARING; BIRTH RATE; MORTALITY RATE; PREGNANCY RATE; SURVIVORSHIP;DISTRIBUTION; MIGRATION; MOVEMENTS; ACOUSTICS; PARTURITION; PREGNANCY

INTRODUCTION

The North Aleutian Basin Planning Area (i.e. the Bristol Bay region; see Figure II-4 in MMS, 2006) is situated in the eastern Bering Sea, which is known for its high biological productivity that is strongly seasonal (e.g., NRC 1996, Loughlin and Ohtani 1999, PICES 2004). The marine mammal fauna of the Bering Sea is particularly rich and includes north temperate, subarctic, and arctic species (NRC 1996). There are eight species of baleen whales and eight species of toothed whales that occur regularly or sporadically in the North Aleutian Basin Planning Area. Of these, the North Pacific right whale (*Eubalaena japonica*), bowhead whale (*Balaena mysticetus*), blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), sei whale (*Balaenoptera borealis*), humpback whale (*Megaptera novaeangliae*), and sperm whale (*Physeter macrocephalus*) are listed as 'endangered' under the U.S. Government's Endangered Species Act. The gray whale (*Eschrichtius robustus*) also utilizes the area; the gray whale was previously listed as 'endangered,' however its population has recovered

sufficiently such that it was delisted in 1994. Marine mammal species listed as 'endangered' are also classified as 'depleted' under the Marine Mammal Protection Act (MMPA). North Pacific right whale, sei whale, fin whale and blue whale are listed by IUCN as endangered, while the humpback and sperm whale are listed by IUCN as vulnerable.

The U.S. Congress established a moratorium on offshore oil and gas leasing in the Bristol Bay region of Alaska in 1989 following the *Exxon Valdez* oil spill. In 2003, Congress lifted their congressional moratorium for Bristol Bay. The leasing area, identified by the Department of the Interior as the North Aleutian Basin Planning Area, was also to be protected through 2012 by a presidential moratorium issued by President Bill Clinton. In January 2007, President George W. Bush lifted the presidential moratorium prohibiting the leasing of offshore federal lands in the North Aleutian Basin Planning Area for oil and gas exploration and development. As such, currently both the congressional and presidential moratoriums for leasing offshore federal lands (from state waters out 200 miles from shore) in the Bristol Bay region have been removed, and the North Aleutian Basin Planning Area may be leased to the offshore oil and gas industry for hydrocarbon exploration and production. The Minerals Management Service (MMS), the federal regulatory agency responsible for leasing offshore federal lands for oil and gas resource development, proposes scheduling two lease sales in the North Aleutian Basin in 2010 and 2012 (MMS, 2006a).

Offshore oil and gas exploration and production activities have the potential to modify whale habitats and harm marine wildlife, including marine mammal populations. The purpose of this paper is to identify the potential impacts of oil and gas exploration and production in the North Aleutian Basin on the conservation of select baleen whale species that are found in this area (North Pacific right, gray, and humpback).

SYNOPSIS OF SELECT WHALE SPECIES UTILIZING THE BRISTOL BAY AREA

Cetacean distribution and abundance in the Bering Sea is poorly described, with even the more recent reviews of cetaceans' role in the ecosystem reliant on data from historical whaling records (http://www.beringclimate.noaa.gov/essays_moore.html). For most species of Bering Sea marine mammals, seasonal distribution is known only in general terms and winter distributions are poorly understood (NRC, 1996).

Gray Whale

The gray whale currently inhabits the North Pacific, although in the past, it occurred in the North Atlantic. Based on available information, there are two geographically isolated populations inhabiting the North Pacific; the western North Pacific (Korean-Okhotsk) population, and the eastern North Pacific (California-Chukchi) population. Most of the eastern North Pacific population forages in summer in the northern Bering and Chukchi seas (Jones and Swartz, 2002; Angliss and Outlaw, 2007), although new sightings evidence show gray whales feeding year-round along the east side of the Kodiak Island archipelago (Moore *et al*., 2007). Most whales migrate in fall south along the coasts of Alaska, British Columbia, and the U.S. west coast to Baja California, Mexico where they winter chiefly along the west coast of the Baja in shallow lagoons and bays that serve as calving and mating areas (Jones and Swartz, 2002; Angliss and Outlaw, 2007). The spring migration north to the summer feeding areas in the northern Bering and Chukchi seas beings in mid-February, retraces the fall migration route, although whales departing from the winter areas do so in a staggered manner, with newly pregnant females departing first, returning soonest to summer feeding areas. Following them are anestrous females, adult males, and then immatures (Jones and Swartz, 2002). Cows and calves tend to travel extremely close to shore and are mostly alone or in pairs.

Whales migrate into the eastern Bering Sea in spring via Unimak Pass, Alaska (Rugh, 1984). Once having entered the Bering Sea, most continue to follow the coast along the north side of the Alaska Peninsula and elsewhere in Bristol Bay (Braham, 1984). When spring sea ice persists in Bristol Bay, some whales move offshore along or near the ice front. They generally do not move to the coast in northern Bristol Bay in early spring because shorefast and pack ice can be extensive. As Bristol Bay becomes clear of ice, the whales approach Egegik river and turn west toward Cape Constantine. Gray whales continue nearshore westward to Cape Newenham and then apparently move directly across outer Kuskokwim Bay to the southeast top of Numivak Island, then probably fan out around the island and on towards St. Lawrence Island (Braham, 1984). It is this segment of the migration in which whales shift from a strictly nearshore to an offshore distribution. Whales are not simply transiting through the North Aleutian Basin Planning Area; Braham (1984) observed feeding during the spring migration along the northside of the Alaska Peninsula and north coast of Bristol Bay in June and August and on the south side of Numivak Island in May. Further details of gray whale migration in the region are described by Rugh (1984) and Braham (1984).

Gray whales forage chiefly by suctioning small invertebrates and crustaceans from the benthos in shallow waters over the continental shelf (4-120msw) (Jones and Swartz, 2002), although they also occasionally feed by surface skimming or by engulfing zooplankton from the water column. However, zooplankton is only known to be

consumed beyond the principle feeding areas in the northern Bering Sea and Chukchi Sea (Jones and Swartz, 2002). Gray whales exhibit moderate flexibility in their foraging repertoire (i.e. benthic suction, engulfing, and skimming) and diets, relative to North Pacific right whales.

Gray whales were listed as 'endangered' under the ESA in 1969, however, the eastern North Pacific population has recovered sufficiently such that it was delisted in 1994. The latest abundance estimates for this population are 18, 246 (2000/01) and 16,848 (2001/02) whales (Rugh *et al.*, 2005). These estimates are well below the estimate in 1997/98 (27,958 whales), however, the low levels of the more recent estimates may have been caused by an unusual number of whales not migrating as far south as the surveys were conducted. Alternatively, abundance may have declined following high mortality rates observed in 1999 and 2000 (Rugh *et al*., 2005).

Synthesis Statement: The Bristol Bay area includes a migratory corridor utilized by gray whales of all ages to move between summer feeding areas in the northern Bering, Chukchi, and Alaskan Beaufort seas. During spring migrations, gray whales feed in the Bristol Bay area before moving north into their principle summer feeding areas.

Humpback Whale

The humpback whale occurs in the North Pacific but not in Arctic waters (Angliss and Outlaw, 2007). Humpbacks are highly migratory, spending spring through fall in summer feeding areas in mid- or high-latitude waters, and wintering in calving areas in the tropics where they do not feed (Clapham, 2002). Summer feeding areas utilized by North Pacific humpback whales include the Bristol Bay region, the broader Bering Sea, and much of the Gulf of Alaska (Angliss and Outlaw, 2007).

Humpbacks occurring in the Gulf of Alaska and the Bering Sea feed on euphausiids and small forage fishes. Fidelity to summer feeding areas may be strong, as demonstrated by North Atlantic humpback whales. Such fidelity to feeding areas is determined by where a calf was taken by its mother in the calf's natal year (Clapham, 2002).

The humpback whale was harvested by commercial whalers in centuries past to the point approaching extinction; it was subsequently protected but it is still listed as 'endangered' under the ESA. The IUCN lists the humpback as 'vulnerable.' Three populations of humpback whales are recognized in North Pacific waters of the U.S.; the eastern, central, and western North Pacific populations (Angliss and Outlaw, 2007). Humpback whales occur in the Bering Sea (Moore *et al*., 2002), and it is not known for certain whether these animals belong to the western or central North Pacific population, or are a separate, unnamed population (Angliss and Outlaw, 2007). Moore *et al.*, (2002) reported uncorrected abundance estimates of 102 humpback whales from surveys conducted in the eastern Bering Sea during the summers of 1999 and 2000.

Synthesis Statement: The Bristol Bay region functions as summer feeding habitat for humpback whales, possibly of all ages.

North Pacific Right Whale

The North Pacific right whale is one of the world's rarest cetaceans (Brownell *et al.*, 2001; Kenney, 2002; LeDuc *et al.*, 2001). The North Pacific right whale is listed as 'endangered' under the ESA and by the IUCN, and remains critically depleted even after more than six decades of international legal protection (Kenney, 2002).

Historically, North Pacific right whales occurred from Japan and northern Mexico north to the Sea of Okhotsk, the Bering Sea, and the Gulf of Alaska (Kenney, 2002). Presently, data support the distinction of two populations: the western Pacific (Sea of Okhotsk and adjacent waters) population and the eastern Pacific (Bering Sea, Aleutian Islands, and Gulf of Alaska) population (Angliss and Outlaw, 2007). There is no evidence of exchange between the two populations. Of these two populations, the eastern North Pacific right whale is the most endangered population of large whale (Tynan *et al.*, 2001) and the prognosis for continued survival is poor (Brownell *et al.*, 2001). The International Whaling Commission expressed considerable concern over the status of this population in its status report of right whales worldwide (IWC, 2001).

Presently, sightings of eastern North Pacific right whales are extremely rare, and primarily made in the eastern Bering Sea, near Unimak Pass, Alaska, and south of Kodiak Island in the Gulf of Alaska (Shelden *et al*., 2005). For example, in July of 1996, a group of four right whales were observed together in the Bristol Bay region (Goddard and Rugh, 1998). The sighting was unusual for two reasons, the first being that no group of more than two right whales had been reported in the region in more than 30 years; the second being that it was the first confirmed sighting of a North Pacific right whale calf in 150 years (Rugh, 1997). More recently, 7 female whales and 2 calves were identified as part of a small group of whales tracked along the western margin of the North Aleutian Basin Planning Area (Wade *et al*., 2007). These sightings are particularly significant, since there are no reliable estimates of abundance for either population (Angliss and Outlaw, 2007; Brownell, *et al*., 2001; Kenney, 2002; LeDuc *et al*., 2001). However the eastern North Pacific population is believed by some scientists

to be very small and probably number less than the North Atlantic right whale population (Brownell *et al*, 2001; Clapham *et al*., 2006) whose latest minimum population size was determined by Waring *et al*. (2007) to be 306 animals. The IWC (2001) recommended that studies designed to assess population trends for the eastern North Pacific population be implemented as a matter of urgency.

Right whales are generally migratory, with a northward movement to high latitudes in spring, and a similar southward movement in autumn (Clapham *et al*., 2004; Kenney, 2002 Shelden and Clapham, 2006). Temperate or high latitude areas utilized by whales in summer function as feeding areas; warmer waters utilized in colder months function as mating and/or calving areas and are not necessarily the same geographic sites (Kenney, 2002). Right whales in the North Atlantic and the Southern Hemisphere calve in coastal waters in winter months. However, in the eastern North Pacific, no such calving areas have been found (Brownell *et al*., 2001; Kenney, 2002). There is very little information on where right whales from the eastern North Pacific spend their winters (Brownell *et al*., 2001; Shelden *et al*., 2005; Shelden and Clapham, 2006). However, the Bristol Bay area is known to be a primary summer feeding area for eastern Pacific right whale adults and calves (Wade *et al*., 2006) and critical habitat has been designated within the eastern Bering Sea/Bristol Bay area (Fed. Reg., 2006). Approximately two-thirds of the critical habitat identified for right whales in the eastern Bering Sea occurs within the North Aleutian Basin Planning Area boundary.

Right whales have a relatively narrow feeding repertoire, and feed entirely on zooplankton, mainly calanoid copepods, but also on smaller copepods, krill, pteropods, and planktonic crustaceans (Kenney, 2002). Prey is consumed by skimming them from at or just below the sea surface, or at depth. Right whales apparently also feed close to the seafloor, as they have been observed to surface from extended dives with mud on their heads. Details concerning the prey of North Pacific right whales are described by Clapham *et al.* (2006) and Shelden *et al*. (2005).

Right whales mate and conceive in winter months; gestation is approximately one year which ideally culminates in the birth of one calf (Kenney, 2002). Calves remain with their mothers until weaning at approximately one year old. Growth of the calf is relatively rapid from birth to weaning, effectively doubling in birth size. Growth after the first year is likely to be dependent on feeding success. Circumstantial evidence indicates that learning is an important life skill for habitat selection in right whales (Kenney, 2002). Calves apparently learn the locations of summer feeding areas by accompanying their mothers during the first year of life and then return to these same habitats for the rest of their lives. This pattern, known as matrilineal habitat fidelity, appears common in other migratory whale species.

Synthesis Statement: The Bristol Bay area is utilized by eastern North Pacific right whales as a summer feeding area. More than 60 percent of right whale critical habitat delineated in the eastern Bering Sea occurs within the North Aleutian Basin Planning Area. Critical habitat areas where eastern North Pacific right whales winter, mate, and calve are unknown, as are migratory routes connecting them to summer feeding areas in the eastern Bering Sea. The prognosis for the eastern North Pacific population is poor (Brownell *et al.*, 2001). *Several factors concerning these whales make them particularly vulnerable to extinction. These include a very small current population, the fact that they are long lived, have delayed maturity, and a long reproductive cycle.*

CLIMATE CHANGE IN THE BERING SEA AND ADJACENT WATERS

The IPCC (2007a) states in part that: (1) Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level. (2) Most of the observed increase in globally averaged temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic greenhouse gas concentrations. Global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values. The global increases in carbon dioxide concentration are due primarily to fossil fuel use and land-use change, while those of methane and nitrous oxide are primarily due to agriculture. (3) Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would *very likely* be larger than those observed during the 20th century. (4) Sea ice is projected to shrink in both the Arctic and Antarctic under all IPCC Special Report emission scenarios. In some projections, Arctic late-summer sea ice disappears almost entirely by the latter part of the 21st century. And, (5) anthropogenic warming and sea level rise would continue for centuries due to the timescales associated with climate processes and feedbacks, even if greenhouse gas concentrations were to be stabilized. There is high confidence that observed changes in marine systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels and circulation, including shifts in ranges and changes in algal, plankton and fish abundance in high-latitude oceans (IPCC, 2007b). Future changes attributed to climatic warming in the polar regions (including Alaska, include reductions in thickness and extent of ice sheets, and changes in natural ecosystems with detrimental effects on migratory birds, mammals, and higher predators. In the Arctic,

additional impacts include reductions in the extent of se ice and permafrost and increased coastal erosion. Some large-scale climate events have the potential to cause very large impacts, especially after the 21st century (IPCC, 2007b).

Alaska and its surrounding marine ecosystems are warming (ACIA, 2005) due to global warming propelled by fossil fuel use and land-use exchange (IPCC, 2007a). There is evidence that the Chukchi and Bering seas are warming, undergoing ecosystem shifts. Large whales are altering their feeding areas within the Bering and Chukchi Seas (Moore *et al*., 2003; Overland and Stabeno, 2004; Schumacher *et al*., 2003; Tynan 1998, 1999; Tynan and DeMaster, 1997). Non-climate stresses can increase vulnerability to climate change by reducing resilience and can also reduce adaptive capacity because of resource deployment to competing needs (IPCC, 2007b). For example, current stresses of endangered whales in the eastern Bering Sea include recovery from commercial whaling, marine pollution, and entanglement in commercial fishing gear. Tynan and DeMaster (1997) describe observations of Arctic climate change and its potential effects on marine mammals. They noted that managers of marine resources in the Arctic should be aware of present observations and predictions of climate change; and that they should develop risk-averse management strategies that take into account possible adverse impacts of arctic climate change on the ecosystem. They also state that a warming Arctic could result in redistributions of animals that would reflect emigration or immigration, rather than underlying changes in the actual size of the population.

PRINCIPAL LAWS RELATING TO OFFSHORE OIL AND GAS EXPLORATION AND PRODUCTION

The Outer Continental Shelf Lands Act (OCSLA) defines the Outer Continental Shelf (OCS) as all submerged lands lying seaward of state coastal waters which are under U.S. jurisdiction. The OCSLA empowers the Secretary of the Interior to grant leases to the highest qualified responsible bidder and to formulate regulations as necessary to carry out the provisions of the OCSLA. In 1982, Congress passed the Federal Oil and Gas Royalty Management Act which mandates protection of the environment and conservation of federal lands in the course of building oil and gas facilities. The Secretary of the Interior designated the Minerals Management Service (MMS) as the administrative agency responsible for the mineral leasing of submerged OCS lands and for the supervision of offshore operations after lease issuance. The OCSLA has been amended several times, most recently by the Energy Policy Act of 2005. For more information regarding the OCSLA and the MMS, see www.mms.gov.

The MMS must comply with a variety of environmental laws, regulations, and executive orders to carry out its mission. Those laws most pertinent to the conservation of endangered large whales include the Clean Water Act (CWA), Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA), National Environmental Policy Act (NEPA), and the Oil Pollution Act (OPA).

Leasing OCS lands for offshore oil and gas exploration and production

Outer Continental Shelf (OCS) lands are leased by the federal government (i.e., Minerals Management Service, U.S. Dept. of the Interior) to oil and gas companies, that explore, develop and produce oil and natural gas (MMS, 2006b). The potential leasable area is the submerged land generally three geographical miles from a State's coast to a line about 200-300 miles offshore.

In general, all leasing blocks that may have hydrocarbon potential or otherwise may be of interest to the oil and gas industry are included in the geographical area identified for proposed leasing (MMS 2006b). The MMS attempts to develop leasing proposals that include as much acreage with leasing and hydrocarbon potential as allowed by the OCSLA as amended (MMS, 2006).

The National Environmental Policy Act (NEPA) requires that the MMS prepare an Environmental Impact Statement (EIS) before conducting any major Federal action that could significantly affect the quality of the human environment (such as conducting leasing of offshore federal lands) and specifies the basic information that the EIS shall include. Federal regulations for implementing the procedural provisions of NEPA include public scoping to obtain opinions of citizens about the proposed leasing, as well as focusing the environmental analysis in the EIS on significant issues and alternatives, thereby eliminating issues that are not significant. The MMS determines what is significant is what is insignificant. The analysis of possible effects on the environment includes risks of potential oil spills as estimated by the use of an oil spill risk analysis model. The environmental impacts analysis is strongly influenced by MMS's interpretation of significance and insignificance.

The lease sale process is described in MMS (2006b). When a high bid is deemed acceptable by the MMS as part of a lease sale and various official leasing forms are executed, the MMS issues a lease to the successful bidder.

Leases usually are effective the first day of the month following the date they are signed by the appropriate MMS official (MMS, 2006b).

The oil and natural gas mineral lease is a contract with the federal government granting the right to explore, develop, and produce oil and/or natural gas for a specific period and from a specific tract of OCS land. If a discovery is made within the initial period of the lease, the lease is extended for as long as oil and/or natural gas is produced in paying quantities or approved drilling operations are conducted (MMS, 2006b). The term of the lease may also be extended if a suspension of production or suspension of operations has been granted or directed (MMS, 2006b), as has occurred for some leases offshore of California. If oil and gas is produced as a result of a single lease sale, and additional oil and gas resources in the planning area are commercially viable, it is reasonable to expect the MMS to conduct additional lease sales in the planning area to lease additional blocks for hydrocarbon development, thereby expanding the oil and gas leasing activity in the planning area, as has occurred in the western and central planning areas of the Gulf of Mexico.

The MMS has held a lease sale in the Bristol Bay area in the past. The MMS conducted Lease Sale 92 in the North Aleutian Basin Planning Area in 1986, prior to the *Exxon Valdez* oil spill in Prince William Sound. Following the *Exxon Valdez* oil spill, the Congress established a moratorium on offshore oil and gas leasing activities in Bristol Bay and some other offshore federal areas. The lease sale was litigated, and subsequently, some offshore oil and gas companies with Bristol Bay leases sued the federal government for breach of contract and compensation. The litigation arose after several years of moratoria and other government actions preventing exploration and development in Bristol Bay and other areas. In 1995, the Department of the Interior announced buyback settlements with oil companies wherein they agreed to drop their claims and surrender all leases in Bristol Bay (USDOI, 1995).

POTENTIAL IMPACTS ON CETACEANS OF OFFSHORE OIL AND GAS INDUSTRY ACTIVITIES

Offshore oil and gas industry project activities may be sequentially characterized as (1) exploration, (2) production, and (3) decommissioning and abandonment. Exploration activities generally include conducting geophysical seismic surveys and exploratory drilling. Production activities include construction and operation of offshore and onshore structures, facilities, and pipelines for oil and gas production. Decommissioning and abandonment is the process of terminating oil and gas operations and returning the lease or pipeline right-of-way to a condition meeting the requirements of the federal regulations. It includes abandoning wells and pipelines, removing platforms and other facilities, and site clearance.

The MMS divides potential environmental impacts of offshore oil and gas leasing activities into two groups – those resulting from (1) routine OCS operations and (2) accidents (e.g., oil spills). Routine OCS operations in the North Aleutian Basin Planning Area that could affect cetaceans include offshore exploration, the construction and operation of offshore platforms and pipelines, the construction and operation of onshore processing facilities and pipelines, operational discharges and wastes, and OCS vessel and aircraft traffic (MMS, 2006a). Cetaceans may be affected by noise, discharges and wastes, human activities, and physical structures and equipment associated with leasing activities (MMS, 2006a).

Offshore Seismic Surveying and Exploratory Drilling

Seismic surveys may be conducted pre- and/or post-leasing of federal OCS lands. There are multiple types of seismic surveys, such as 2D, 3D, or vertical surface profiling. Depending upon the need, seismic surveys may be periodically conducted on or around a lease block over the lifetime of a lease (the MMS estimates the lifetime of a lease sale scenario involving two lease sales in the North Aleutian Basing to be 40 years). Blocks may be surveyed one season using 2D seismic, surveyed again later using 3D seismic, and surveyed again still later with vertical surface profiling.

Noise produced during offshore seismic surveys may physically harm and/or behaviourally affect cetaceans, depending upon their proximity and sensitivity to the survey sound source (typically an airgun array). Adverse effects may include physical harm to the ear and associated hearing loss, stress, discomfort, injury, masking of other important sounds, and behavioural responses (e.g., avoidance, cessation of vocalization, or change in diving and breathing activity). Scientific studies of the effects of anthropogenic noise on marine mammals have been and continue to be important; some general references on this topic include Richardson *et al*. (1995), and NRC reports (2000, 2003, 2005). The National Marine Fisheries Service is engaged in ocean noise science and maintains an online bibliography concerning marine mammal hearing and acoustic impacts (http://www.nmfs.noaa.gov/pr/acoustics/bibliography.htm). Moore and Clarke (2002) describe responses of gray whales to human activities offshore (including seismic surveys) and discuss potential impacts.

The MMS (2006a) notes that there is currently no evidence suggesting that routine seismic surveys result in population-level effects in marine mammals, and that it is not possible to predict the type or magnitude of responses to such surveys or to evaluate the potential effects on populations. It is known that baleen whales

respond to seismic surveys; responses include avoidance and deflection of travel (Malme and Miles, 1985; Richardson and Malme, 1993). Affected whales may be expected to leave the area and, if exposed to maximal sound levels, may incur short-term or long-term hearing loss (MMS, 2006a). Exposure to less than maximal sound levels could result in temporary masking effects to the affected individuals (MMS, 2006a, citing Ljungblad *et al*., 1988; Malme *et al*., 1989).

The drilling of exploration and delineation wells also generates noise that whales may respond to. Moore and Clarke (2002) summarize studies examining the response of gray whales to various offshore noise playback experiments, and cited Richardson *et al*.'s, (1995) conclusion that the 'noisiest' period of offshore oil and gas operations occurs during exploration and site establishment.

Exploratory drilling generates large volumes of drilling muds and cuttings that are discharged into the sea (MMS, 2006a). Heavier components of these cuttings and muds are expected to settle to the bottom, while lighter components may remain suspended, increasing turbidity, and causing cetaceans to avoid the area. The MMS reports that any increase in suspended solids associated with the discharge of drilling wastes would be rapidly be diluted and dispersed, and thus, not be expected to adversely affect cetaceans in the area. However, the rapid rate of dilution and dispersion is more an assumption given that drilling wastes released from drilling rigs in the northern Gulf of Mexico can extend for several miles as observable from aircraft.

Construction and Operation of Offshore Platforms and Pipelines and Onshore Structures

MMS (2006a) estimates 4-6 offshore platforms and up to 150 miles of offshore pipeline and 1-2 pipeline landfalls could be constructed in the North Aleutian Basin Planning Area under the proposed leasing action. Noise and human activity associated with construction and operations could disturb cetaceans that may be present in the immediate vicinity of these facilities. Construction activities in noncoastal areas could disturb feeding or social behaviours, mask calls from conspecifics or sounds produced by predators (e.g., the killer whale, *Orcinus orca*). No impacts from operational wastes to marine mammals would be expected under normal operations, since such wastes would be disposed of through down-hole injection into NPDES-permitted disposal wells (MMS, 2006a).

Cetaceans utilizing coastal waters (e.g., the gray whale) may be affected by the construction and operation of onshore facilities. MMS (2006a) estimates that up to 3 onshore facilities, 2 pipeline landfalls, and 1 dock/causeway facility could be constructed in onshore areas adjacent to the North Aleutian Basin Planning Area.

Vessel and Aircraft Traffic

Offshore exploration, construction, and production operations require vessel and aircraft support. For example, the MMS (2006a) estimates there could be up to 3 vessel trips per week and 3 helicopter trips per day to each offshore platform (4-6 platforms). Cetaceans may be affected by traffic either by disturbance from passing vessels or aircraft or by direct collisions with vessels. The current leasing action proposed by the MMS (2006a) includes all OCS lands within the North Aleutian Basin as being available for leasing for oil and gas exploration and production. Therefore, vessel and aircraft traffic can occur anywhere across the North Aleutian Planning Area, including within or proximate to critical habitat for North Pacific right whales, summer feeding areas of North Pacific right whales and humpback whales, and migratory pathways of gray whales.

Accidents

Accidental chemical spills (e.g., oil) are anticipated as a result of extracting offshore oil and gas resources; marine mammals may be exposed to spilled oil by direct contact, inhalation, and ingestion, resulting in a variety of lethal and sublethal effects (MMS, 2006a). Direct contact may result in sensitive tissues such as the eyes and lungs becoming temporarily insulted and/or permanently damaged. Inhalation of evaporates could damage or insult lung tissue. Moore and Clarke (2002) reviewed the effect of oil on gray whales. They noted that it is not clear whether gray whales can detect surface oil since gray whales were observed lying in or swimming through oil slicks from the 1989 *Exxon Valdez* oil spill along south-central Alaska. Geraci and St. Aubin (1985) experimented by contaminating gray whale baleen with oil and determined that oiling of baleen was slight and short term, but that oil could still contaminate food contacted by oiled baleen. Ingested oil is toxic to marine mammals (Engelhardt, 1983). Benthic prey of gray whales may become contaminated by sinking oil and dispersants (Neff, 1990; Würsig, 1990). Oil spills may be a greater threat to right whales than other baleen whales because their very fine baleen might be fouled more easily with oil (Kenney, 2002). Furthermore, North Pacific right whales may be particularly vulnerable to oiling of baleen and ingestion of oil, due to their feeding technique of skimming zooplankton occurring chiefly at or just beneath the sea surface.

The lease plan proposed by the MMS (2006a) assumes a number of spills occurring in the North Aleutian Basin Planning Area, ranging from less than 50 barrels to 4600 barrels of oil spilled. Contrary to the statement made

by the MMS (2006a), spills occurring in federal waters of the planning area can be expected to affect humpback, sei, fin, and North Pacific right whales, as well as designated critical habitat in the eastern Bering Sea.

CONSERVATION CONCERNS IN THE NORTH ALEUTIAN BASIN FROM THE PROPOSED OIL AND GAS INDUSTRY ACTIVITIES

The North Aleutian Basin Planning area functions as summer feeding habitat to North Pacific right whales and humpback whales, and the planning area is a migratory corridor and feeding area to eastern North Pacific gray whales. Among these whales are cows with calves, and pregnant cow whales. A list of conservation concerns associated with offshore oil and gas leasing activities in North Aleutian Basin Planning Area includes, but is not limited to:

1) Seismic survey activities may disrupt the feeding of, and/or increase the nutritional /physiological stress of pregnant cow whales, thereby increasing the potential for stress-induced abortion of the fetus or death in utero. Stress (acute or chronic) may result from harassment, pollution, disease, or other environmental factors. Stress interferes in the reproduction of mammals; it adversely influences implantation and fetal growth, and lends to abortion (Arck *et al*. 1995). Most reproductive-related problems (dystocia, stillbirth, weak calf, poor maternal care) occur in the first few hours after delivery (Robeck *et al*., 2001). By far the most frequent pathology associated with reproduction in captive marine mammals is stillbirth (Robeck *et al*., 2001). Pre-natal and natal mortality rates among many baleen whales, including North Pacific right, gray, and humpback whale populations are unknown; no studies are known to have examined the effects of exposing pregnant cow whales to seismic noise and their subsequent success of carrying a developing fetus to parturition unharmed. Termination of one or more pregnancies of North Pacific right whale cows may likely constitute a population-level effect that severely compromises their ability to recover from the threat of extinction given their apparently very low population numbers. Seismic surveys conducted in or proximate to designated critical habitat or near Unimak Pass are more likely to impact right whales that may be pregnant.

2) Seismic surveys may disturb cow-calf pairs such that nursing is disrupted frequently or for extended durations. Young, weaned whales may also experience feeding disruptions. Such disruptions can serve to stress and compromise the nutritional health of the calf or young whale. Recall that growth of a right whale calf is relatively rapid from birth to weaning, effectively doubling in birth size over their first year, and that growth after that first year is likely to be dependent on feeding success. Furthermore, premature weaning of calves or lengthy separation of a cow-calf pair may lead to starvation and death of the calf (i.e., right, gray, humpback). There are no studies known examining this scenario, however, it is a reasonable scenario and it poses a grave concern to the conservation and recovery of endangered whales, particularly for North Pacific right whales.

3) Seismic survey noise may prematurely separate a calf from its mother and disrupt learning needed to reinforce matrilineal habitat fidelity, responsible for aiding the aging calf in leaning the migratory route between winter and summer habitats. An affected calf may stray, and thus become lost to the population. This is of principal concern for North Pacific right, gray, and humpback whales.

4) Seismic vessels actively engaged in a seismic survey tow an airgun array and hydrophone arrays, restricting them in manoeuvrability. Right whales are prone to collisions with vessels as well as to entanglement in lines, nets, and other objects. Although slow moving, seismic vessels conducting surveys and restricted in manoeuvrability may pose risks to right whales of collision or entanglement in seismic array cables.

5) Baleen whales are sensitive to seismic surveys and exhibit avoidance and deflection of travel. There are several scenarios that may expose a large majority of a population to a seismic survey that disrupts or deflects whale migration in the Bristol Bay area. One scenario involves conducting seismic surveys at lease blocks in the vicinity of Unimak Pass, a migratory passage leading between the Bering Sea and the Gulf of Alaska. Whales (e.g., right, gray, humpback) occur near and/or migrate through Unimak Pass to reach winter and summer habitat areas. Timing of movement through Unimak Pass is poorly defined for many cetaceans. Timing of gray whale movements at Unimak Pass (Braham, 1984; Rugh, 1984) is perhaps outdated as climate change in North America is altering the timing of animal movements from what was observed twenty or more years ago.

6) Another scenario of concern is posed if a seismic survey is conducted in blocks proximate to the state waters of Bristol Bay during the gray whale migration. Seismic survey disturbances may cause whales to temporarily suspend migration along the coast or otherwise deflect their movements. Cow-calf pairs and pregnant females have high nutritional demands that are likely well synchronized with migratory behaviour. The energetic costs of delaying gray whale cow-calf pairs or pregnant cows on their

northward migration to summer feeding areas is unknown, but may be important. An unusual mortality event of eastern North Pacific gray whales occurred in 1999-2000; the emaciated state of many of the stranded whales supports the idea that starvation could be a significant contributing factor, though the underlying cause of starvation during this event was undetermined (Gulland *et al*., 2005).

7) Seismic surveys conducted within or in the general vicinity of North Pacific right whale critical habitat in the eastern Bering Sea may disturb feeding of North Pacific right whales and cause them to depart critical habitat thereby nutritionally stressing a majority of the very small population.

8) There may be multiple seismic surveys conducted in the North Aleutian Basin Planning Area in a year, some coincident with one another. Multiple permitted seismic surveys and their potential interaction with whales and their habitats are not dynamically modelled by the MMS, hence whales may be deflected from one area by a seismic survey only to become influenced and deflected by a different survey ongoing in a different block in the North Aleutian Basin Planning Area. Consequently, multiple surveys conducted over a summer may unintentionally but synergistically herd whales (e.g., North Pacific right) from critical habitat or other selected areas.

9) The North Pacific right whale exhibits a narrow feeding repertoire, skimming zooplankton at or just below the sea surface, or at depth. The delineation of critical habitat areas for the North Pacific right whale was developed in part upon the distribution of whales and their prey. The MMS (2006a) did not assess potential impacts of offshore exploration activities on North Pacific right whale critical habitat and their prey for the proposed leasing of OCS lands in the North Aleutian Basin Planning Area. Understanding the impacts of exploratory drilling and associated discharges on important prey species of the North Pacific right whale is of high concern, as is understanding the impacts of releasing drilling wastes into or in proximity of North Pacific right whale critical habitat.

10) Gray whales migrate along the coastline of the Bristol Bay area and have been observed feeding therein during their northerly migration. Gray whales exhibit three forms of feeding (benthic suction, engulfing, and skimming); it is not understood how gray whale feeding may be affected by drilling operations in lease areas along their migration route, but it is of concern particularly for cow-calf pairs and pregnant females.

11) It is important that critical habitat boundaries are accurately portrayed by the MMS and clearly delineated on permits issued to offshore lessees and operators.

12) The construction and operation of offshore platforms, pipelines and coastal infrastructure would generate additional anthropogenic noise beyond that already produced in the Bristol Bay area. Whales may become habituated to some degree to industrial noise, however, it is not understood at what cumulative threshold it might become biologically significant for some whale populations. Of specific concern is the potential impact of construction noise on North Pacific right whales.

Increasing vessel traffic (e.g., seismic vessels, support vessels, supply vessels, and barges) in the North Aleutian Basin Planning Area raises concern regarding vessel collisions with endangered whales. Recovery of endangered North Atlantic right whales has been severely hampered by collisions with vessels along the East Coast of the U.S.. Laist *et al*. (2001) found that right whales, humpback whales, sperm whales and gray whales are hit commonly. Vanderlaan and Taggart (2007) analyzed the influence of vessel speed relative to a lethal injury for a large whale when struck and found that the probability of a lethal injury drops below 50 percent at a vessel speed of 11.8 knots.

As noted earlier, the leasing plan proposed by the MMS (2006a) makes all OCS lands in the North Aleutian Basin Planning Area available for leasing, exploration, and production. Therefore, blocks within or proximate to designated critical habitat for North Pacific right whales may be leased and vessel traffic would be necessary to explore and produce oil and gas resources from those leases, greatly increasing the risk of vessel collision with endangered right whales. Also, North Pacific right whales are not restricted to critical habitat, and are documented occurring near Unimak Pass which is outside the areas delimited as critical habitat. Vessel traffic in the southern portion of the North Aleutian Basin Planning Area poses a lethal threat to North Pacific right whales, humpback, and gray whales.

13) Contrary to the conclusions of the MMS (2006a), increasing oil and gas industrial activity offshore and onshore in the North Aleutian Basin Planning Area is likely to contribute to the jetsam and flotsam occurring in the Bering Sea, regardless of whether the discharge or disposal of solid debris into offshore waters from OCS structures and vessels is prohibited. Entanglement in or ingestion of OCS-related trash and debris by cetaceans in the eastern Bering Sea should be expected as a result of routine operations (oil spills are illegal actions, but are nonetheless anticipated problems). Of principle concern is the entanglement and drowning of North Pacific right whales, bowhead whales, humpback whales,

and other endangered cetaceans. Ingestion of marine debris and associated harm is also a conservation concern for cetaceans.

14) Offshore exploration and production activities in the Alaska Region requires bringing rigs, platforms, and/or vessels to Alaska from such areas as the Gulf of Mexico, the West Coast, or foreign waters. These structures and vessels may be contaminated with species alien to Alaska (MMS, 2006a). Such species may be attached to the hull structure, hitch a ride on the vessel, or be transported via ballast water. Species contaminating a rig/vessel may subsequently disperse into Alaska's ecosystems (MMS, 2006a). The introduction of non-native species to Alaska poses potentially significant ecological and social impacts. All non-native species are potentially harmful unless it is shown that the risks involved are low or that the introduction of the species is beneficial (Gollasch 2002). Gollasch (Table II, 2002) categorizes the probability of colonization of non-native species according to matching climate (temperature) in donor and recipient regions. Alaska's marine waters are of the arctic and cold temperate regions, and accordingly, there is a medium to high probability of colonization of non-native species introduced from another warm temperate, cold temperate or arctic region. Bringing rigs, platforms, and/or vessels to Alaska from outside may introduce non-native lower trophic species to the Bristol Bay area; should these non-natives establish viable populations, they may restructure ecosystem dynamics that extend well beyond the lower trophic populations native to the Bristol Bay area. For example, the unintended introduction of a non-native zooplankton (e.g. copepod) may adversely affect native copepod populations that North Pacific right whales feed on.

15) Though their population is apparently very small, the North Pacific right whale is threatened by one or more anticipated, though accidental, oil spills associated with offshore oil and gas leasing activities in the North Aleutian Basin Planning Area. Likewise, critical habitat for the North Pacific right whale may be fouled by spilled oil. Baleen whales encountering oil in the water may have their baleen fouled leading to the ingestion of oil. Right whales appear more susceptible to oil fouling their baleen and ingestion of oil. Gray whales may consume benthic prey contaminated by oil or dispersants that sink and foul sea floor habitats. Baleen whales ingesting oil may die; the loss of cows or calves of small populations (e.g., North Pacific right whale) may have population level effects that significantly compromise their ability to recover from the threat of extinction.

16) Cleanup of larger oil spills would likely generate more extensive vessel traffic, increasing the potential of collisions with whales. Spill response chemicals are typically toxic and may have lethal or sublethal effects on cetaceans ingesting them.

17) The cumulative impacts of various natural and anthrogenic activities occurring in the past, present, and that are reasonably foreseeable in the future are extremely challenging to accurately assess for cetaceans in the eastern Bering Sea and linked ecosystems. It is clear that past commercial whaling devastated many whale populations, such as the bowhead, fin, sei, humpback, gray and North Pacific right whales. Only the eastern North Pacific gray whale population has recovered sufficiently so that it could be delisted. Other populations are in varying states of recovery, with the eastern North Pacific right whale population being the rarest of all the large whales. There are currently a variety of lethal and sublethal threats posed by climate change, commercial fishing, maritime commercial shipping, naval activities, pollution, and others. Compounding these threats would be those greater threats posed by offshore oil and gas exploration and production activities associated with leasing OCS lands in the North Aleutian Basin Planning Area (e.g., noise pollution, oil spills and other forms of chemical pollution, vessel collisions, entanglement with or ingestion of marine debris, trophic modifications resulting from the introduction of non-native species, burning of fossil fuels used to extract more sequestered hydrocarbons, that subsequently are to be made available as energy and contributes to global climate warming). The synergistic interactions are vast and threatening to endangered whale populations attempting to rebuild from past human imprudence.

As one example, consider the potential impacts of various contaminants that cow whales (e.g., bowhead, gray, humpback, North Pacific right) are exposed to during growth, maturation, pregnancy, and during lactation when synergistically interacting with threats posed by seismic surveys, vessel traffic, permitted discharges, oil spills, or other impacting factors associated with offshore oil and gas activity in the North Aleutian Basin Planning Area. Many anthropogenic compounds (see Vos *et al*. 2003, for information on the toxicology of marine mammals) may cause endocrine disruption, defined as the adverse effects of any artificial substance which assumes the same function as a hormone or alters the normal functioning of natural hormones or their significance (Fair and Becker, 2000). These effects range from decreased embryonic viability, altered embryonic development, altered sexual maturation, altered endocrine function, altered immune function, altered growth, and general health, altered reproductive behavior, neoplasia, to carciniogenesis. Furthermore, hormone disruption may

account for losses traditionally blamed on habitat loss or overexploitation and the degree that contaminants account for decreasing marine mammal populations is unknown (Fair and Becker, 2000). While many animals have shown reproductive problems that have been linked to contaminants, marine mammals such as whales, dolphins, seals, and polar bears may be in the most jeopardy (Fair and Becker, 2000). Animals that appear healthy and normal may actually have altered hormone ratios, dysfunctional sex organs, or other physical and metabolic damage (Fair and Becker, 2000). These animals may lose their ability to withstand otherwise tolerable stresses or their rebound capability after natural disasters (Fair and Becker, 2000). Given that the eastern North Pacific right whale population is likely very small, the mortality of one or more North Pacific right whales, particularly a cow or calf or both, resulting from some direct impact stemming from offshore oil and gas activity in the North Aleutian Basin Planning Area (e.g., mortality due a vessel collision or an oil spill) or indirectly because of synergistic effects (e.g., the greater sum of interactions between contaminant loads, harassment attributed to seismic surveys contributing to stress and possibly stress-induced abortion, sporadic oil spills, and habitat degradation) may jeopardize the existence of the very small population.

CONCLUSIONS

The Minerals Management Service (U.S. Dept. of the Interior) proposes leasing federal offshore lands in the Bristol Bay area (identified by the MMS as the North Aleutian Basin Planning Area), for the oil and gas exploration and production activities. Two lease sales would be conducted between 2007 and 2012. Once leased, lessees of OCS lands have contractual rights to explore and develop oil and gas resources therein, with limitations set forth in the OCSLA and associated federal regulations. The Bristol Bay area is utilized by a variety of endangered large whales as summer feeding habitat and as a migratory pathway to other important habitats. Offshore oil and gas exploration and production activities pose lethal and sublethal impacts to endangered whale populations utilizing the Bristol Bay area. The best available information holds that the loss or injury of any individuals of the eastern North Pacific right whale population due directly or indirectly to offshore oil and gas leasing, exploration, or production is unacceptable, as is the degradation of their habitat, if conservation of this population and species is to succeed. North Pacific right whales are so few in number that there can be no tolerance of incompetence, negligence, or accidents resulting in physical harm to a cow or calf. The death of one cow or calf likely constitutes a population level effect that severely compromises the population's recovery. Leasing of OCS lands in the North Aleutian Basin Planning Area is fraught with real hazards that may physically harm North Pacific right whales or their critical habitat. Although other endangered whale populations in the region are fairing better, they still have yet to be delisted and may be harmed by offshore oil and gas activities in the North Aleutian Basin. The best scientific information available shows that it is prudent to forego leasing OCS lands in the North Aleutian Basin Planning Area until endangered whale populations, such as the eastern North Pacific right whale population, rebuild and are delisted. Until such time, reinstatement of the presidential and congressional moratoriums prohibiting oil and gas leasing, exploration, and production in the eastern Bering Sea is prudent and sagacious.

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