OCS EIS/EA
MMS 2006-001

Environmental Assessment

Proposed OCS Lease Sale 202
Beaufort Sea Planning Area

Minerals Management Service
Alaska OCS Region

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Abbreviations, Acronyms, and Symbols

AAC	Alaska Administrative Code
ACIA	Arctic Climate Impact Assessment
ACMP	Alaska Coastal Management Plan
ACS	Alaska Clean Seas
ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
AEWC	Alaska Eskimo Whaling Commission
AMAP	Arctic Mapping and Assessment Program
ANCSA	Alaska Native Claims Settlement Act
ANIMIDA	Arctic Nearshore Impact Monitoring Development Area
ANWR	Arctic National Wildlife Refuge
AQCR	Air Quality Control Regions
bbl	barrel(s)
BCB Seas	Bering-Chukchi-Beaufort Seas stocks (bowhead whales)
BE	Biological Evaluation
Bbbl	billion barrels
BLM	Bureau of Land Management
BPXA	British Petroleum (Exploration) Alaska, Inc.
BWASP	Bowhead Whale Aerial Survey Program
CANIMIDA	Continuation of Arctic Nearshore Impact Monitoring in Development Area
CBC	Center for Biological Diversity
CBS	Central Beaufort Sea (polar bear population)
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
chl-a	chlorophyll-a
CIP	Capital Improvements Project(s)
CZMA	Coastal Zone Management Act
dB	decibel(s)
DCED	Department of Community and Economic Development (State of Alaska)
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
ERA	Environmental Resource Area
ESA	Endangered Species Act
FR	*Federal Register*
FWS	Fish and Wildlife Service (USDOI)
G&G	Geological and Geophysical (permit)
ICAS	Inupiat Community of the North Slope
IHA	Incidental Harassment Authority
in	inch(es)
in^3	cubic inch(es)
IPCC	Inrtergovernmental Panel on Climate Change
ITL	Information to Lessees
IUCN/SSG	World Conservation Union/Species Survival Commission
IWC	International Whaling Commission
km	kilometer(s)
km^2	square kilometer(s)
LS	land segment
m	meter(s)
mi^2	square mile(s)
MMbbl	million barrels (of oil)
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service

NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NPR-A	National Petroleum Reserve-Alaska
NSB	North Slope Borough
NSBCMP	North Slope Borough Coastal Management Plan
NSBCP	North Slope Borough Comprehensive Plan
NTL	Notice to Lessees
NWAB	Northwest Arctic Borough
OBC	ocean-bottom cable (seismic surveys)
OCRM	Office of Resource Management (USDOC, NOAA)
OCS	Outer Continental Shelf
OSRA	Oil-Spill-Risk Analysis
PAH	polycyclic aromatic hydrocarbons
PBR	Potential Biological Removal
PBSG	Polar Bear Specialist Group
PEA	Programmatic Environmental Assessment
PINC	Potential Incident of Noncompliance
ppb	parts per billion
PSD	Prevention of Significant Deterioration
SBS	Southern Beaufort Sea (polar bear population)
TSS	total suspended solids
U.S.C.	United States Code
USDOC	U.S. Department of Commerce
USDOI	U.S. Department of the Interior
USEPA	Environmental Protection Agency
USGS	U.S. Geological Survey
Y-K Delta	Yukon-Kuskokwim Delta
$<$	less than
$>$	greater than
$\leq$	less than or equal to
$\geq$	equal to or greater than
2D	two-dimensional (seismic survey)
3D	three-dimensional (seismic survey)

I. OBJECTIVES OF THE ENVIRONMENTAL ASSESSMENT

The Minerals Management Service (MMS) prepared this Environmental Assessment (EA) to update the potential environmental and sociocultural effects of proposed Beaufort Sea Oil and Gas Lease Sale 202. The update is a step in a long sequence of assessments for numerous Beaufort Sea lease sales over the past two decades. The effects of reoffering the area through three proposed leases sales—186, 195, and 202—were assessed individually and cumulatively in the multiple-sale final Environmental Impact Statement (EIS) (USDOI, MMS, 2003). The MMS responded to comments on the EIS and offered the area in Lease Sale 186 in September 2003. The potential effects of Sale 195 were updated with an EA, finding that there would be no new significant impact that was not already assessed in the multiple-sale EIS. The MMS responded to comments on the EA and reoffered the Beaufort Sea through Lease Sale 195 in March 2005. Partly because of the high price of oil, many tracts received bids, especially in the nearshore area.

This EA tiers from the two previous National Environmental Policy Act (NEPA) documents and updates the effects assessment for proposed Sale 202 (USDOI, MMS, 2003). This EA will be available for public comment during midsummer 2006, and the proposed lease sale is scheduled for March 2007. Sections of this EA summarize the Purpose and Need for the Proposal, the Description of the Proposed Action and Alternatives, and the updated impact analysis, including updated information on the affected environment and effects. If Sale 202 is held and results in the issuance of leases, the potential effects of any specific proposals for operations (e.g., seismic exploration, exploratory drilling, construction of development structures, and/or pipeline burial) would be reviewed to determine if further NEPA analysis is needed. Although leasing is the first step towards oil production, numerous outer continental shelf sales conducted in the Beaufort Sea since 1979 have resulted in only one offshore field (Northstar) that extends into Federal waters. It is not realistic to assume that leasing will automatically result in development.

II. PURPOSE AND NEED FOR THE PROPOSAL

As explained in the Beaufort Sea multiple-sale final environmental impact statement (EIS) (USDOI, MMS, 2003:Sec. I.A), the overall need for offshore oil and gas lease sales is identified in the Outer Continental Shelf Lands Act. It directs the Department of the Interior (USDOI) to make such resources available to meet the Nation's energy needs as rapidly as possible and to balance the orderly energy resource development with protection of the human, marine, and coastal environments. Seven lease sales have been held in the Beaufort Sea, and the current 5-year schedule of lease sales includes one more—Sale 202.

The effects of the three sales were assessed in a Beaufort Sea multiple-sale final EIS. Sale 202 would help to reduce U.S. dependence on foreign petroleum sources. It would help also to moderate the rising price of oil and its negative effect on the economy. Further, the USDOI has proposed additional lease sales in both the Beaufort Sea and Chukchi Sea Planning Areas under the proposed 2007-2012, 5-year oil and gas leasing program; thus, additional leases in the Beaufort Sea might help to moderate the high cost of exploring and/or developing prospects in the proposed lease-sale area.

III. PROPOSED ACTION AND ALTERNATIVES

This section includes a summary of the Proposed Action, a scenario of operations that reasonably might be expected to occur as a result of the Proposal, the mitigation measures and Information to Lessees (ITL's) that would help to moderate the potential effects, the proposed leasing incentives to stimulate industry interest in the Beaufort Sea, and alternatives to the Proposed Action (Fig. 1).

III.A. Proposed Action – Alternative VII.

The MMS identifies Alternative VII as the Proposed Action for Sale 202; the alternative would defer leasing within areas in which Barrow and Kaktovik residents conduct subsistence whaling. The Minerals

Management Service (MMS) received several comments in response to the Request for Information that was published in the *Federal Register* on October 28, 2005. Some of the comments expressed interest in leases within the whole Area of Call. That area, shown in Figure 1, includes 1,877 whole or partial blocks that encompass 9,770,000 acres (about 3,954,000 hectares). The MMS also received letters about the potential effects of operations in subsistence-whaling areas (Appendix A). The subareas that would not be offered for lease by Alternative VII consist of 54 whole or partial blocks, equaling approximately 259,000 acres, or 3% of the whole Area of Call. The deferrals were conceived as a way to reduce conflicts between subsistence whalers and outer continental shelf (OCS) operations. The deferral areas were discussed during public hearings on the North Slope and were the subject of comment letters on the multiple-sale final environmental impact statement (EIS) and Sale 195 Environmental Assessment. The deferrals were addressed recently in a letter about Sale 202 from the Alaska Eskimo Whaling Commission (AEWC) and about the 5-year program from U.S. Senator Murkowski. As explained in the AEWC letter (Appendix A), the Barrow and Kaktovik whalers hunt within areas larger than the deferrals. The MMS believes that conflicts between subsistence whalers and OCS operations within that larger area (and within the subsistence-whaling areas for Nuiqsut) can be moderated through mitigation measures.

III.B. Potential Scenario.

We assume that the Proposed Action would result in the production of 340-570 million barrels (MMbbl) of oil. For purposes of analysis, we use a single production estimate of 460 MMbbl of oil. The market price for oil is higher than when the multiple-sale EIS was completed. A future oil price range of $18-$30 per barrel was considered when determining an appropriate level of oil resources for analysis of the possible environmental consequences of a leasing program. Oil is a volatile commodity, and prices easily could drop in the future. Companies are very aware of the price volatility and, because development projects span several decades, they base their investment decisions on long-term average prices. The price for Alaska North Slope crude oil from 1996-2005 has averaged $26.81 per barrel (*Anchorage Daily News*, 2006). Because scenarios are estimates of industry activities, it is realistic to base our analysis on long-term averages that better reflect industry decisions. This scenario is very optimistic when compared to historical trends in the Beaufort Sea, where leasing since 1979 has resulted in only one offshore development that partly tapped Federal OCS resources (Northstar in State waters). An optimistic development scenario ensures that the environmental analysis covers the potential effects at the "high end" of the range of petroleum activities, including those that could occur as a result of any increase in activities due to incentives. For these reasons, the exploration and development scenarios and environmental effects analysis presented in the multiple-sale final EIS are a reasonable estimate of the consequences of any Beaufort Sea sale as scheduled in the current 5-Year Offshore Oil and Gas Leasing Program.

In determining the amount of oil assumed to be developed and produced in this EA, MMS considers several factors for purposes of analysis. They include the technical and economically recoverable amounts of oil estimated from the MMS resource assessment to be contained in the geologic basin. Other factors include a calculation of the number and sizes of possible oil pools that feasibly could be developed.

Another significant factor is the MMS evaluation of the level of industry interest in the area. At the time that MMS originally estimated the exploration and development scenario for Sale 202, MMS' perception of industry interest was that no more than one field of approximately half a billion barrels (460 MMbbl) would be developed. This volume was based on the minimum economic field size needed for commercial development, after ensuring that an undiscovered oil pool of that size existed in our geologic database of prospects. With increases in oil price since that original estimate, a smaller field might be economic to develop. However, because we have not observed a corresponding increase in new exploration wells, new field development plans, or production from newly developed fields, our original estimate that one field would be developed from Sale 202 remains, in MMS' view, a reasonable and appropriate expectation.

In January, 2006, MMS published a new resource assessment (http://www.mms.gov/alaska/re/reports/2006Asmt/index.HTM). It showed a relatively small increase in technically recoverable oil resources from about 7-8 Bbbl in the Beaufort Sea. However, because of projected higher costs and improvements made to the estimating methodology, a substantial decline occurred in economically recoverable resources at given oil prices, e.g, a reduction of about 80% at an oil price of $30 per barrel. Nevertheless, the aggregate amount of economically recoverable resources for the geologic basin as a whole under the new assessment at the current higher oil price is above the earlier level of economically recoverable resources at the lower anticipated price.

What is germane here is the accuracy and relevance of the resources and level of development activity projected for this sale rather than for the planning area as a whole. In that regard, it is important to note that an unanticipated level of interest from a single major company resulted in a far larger than anticipated number of leases being issued in the second sale (Sale 195). Thus, offsetting the revised estimate of higher aggregate planning area resources is a higher proportional reduction in the remaining prospective acreage available to be offered than was originally projected for Sale 202, that is, acreage containing an identified geologic prospect that could contain oil. Only this remaining acreage can be offered in Sale 202. Of that, only a fraction is expected to be leased, and only a fraction of that is expected to be explored. Although multiple accumulations of hydrocarbon resources could be discovered, only one accumulation was previously expected to lead to development. Thus, despite changes in world petroleum market conditions and in our resource estimating methodology, our best judgment remains that a single field is likely to be developed from the leases issued in Sale 202.

In real terms, crude oil prices were even higher in the mid-1980's and many exploration wells were drilled in the arctic and elsewhere on the Alaskan OCS, but none resulted in development except for a few downhole locations from the Northstar island in State waters. It seems reasonable to assume that high hopes were brought on at least in part by high oil prices in the mid-1980's. The dashing of such high hopes by unsuccessful exploration and/or an eventual drop in prices is not uncommon in the oil and gas industry.

Industry does not make development decisions based on the current price volatility, but instead bases decisions on longer term, average prices, which are considerably lower. Even if MMS would assume that today's relatively high oil prices are sustained in the longer run and we used estimates of $46 or $59 per barrel oil for our analysis in this EA, the single field development still likely would be reasonable, because numerous factors dictate what actual developments occur and these can collectively deflate the optimism motivated by high oil price expectations. Other factors affecting oil- and gas-company development decisions include the high geologic, economic, environmental, technical, regulatory, and political risks associated with such development, especially in an isolated frontier environment with very severe weather and ice conditions as commensurately high costs.

Additional factors also make development hard to achieve—lack of existing infrastructure (the Beaufort Sea OCS has no oil and gas infrastructure); the remoteness of tracts from Prudhoe Bay and other onshore infrastructure; high capital costs to support a development; the company's required time to achieve payback on any capital investment; uncertainty about the existence of a future gas pipeline to the lower 48 states and transportation costs of using the pipeline; the minimum economic field size for a given area; the competition the companies face in acquiring tracts; the competing alternative investment opportunities the companies have; potential future interest rate increases; let alone the fluctuations of the general economy, stock market values, inflation, etc.

In the Sale 202 analysis, the projected levels and types of activities associated with exploration and development are grouped into three geographic zones—the Near/Shallow-Water (Near) Zone, Midrange/Medium (Midrange) Zone, and Far/Deepwater (Far) Zone (Table III-1). The zones were delineated primarily on distance to existing infrastructure and secondarily on water depth. As explained in Section II.B.2 of the multiple-sale final EIS, we assumed that leasing and exploration work would occur primarily in the Near Zone as a result of Sale 186, and that there would be less industry interest in the more remote zones. This assumed pattern of leasing did not occur during Sale 186, in which nearly half of the total bids were located in the Far Zone, although it remains to be seen if exploration activities (marine seismic and drilling) will occur on these remote leases. In the long run, we believe the exploration and development estimates for the three zones ultimately will be validated after all three sales are held. Accordingly, for Sale 195, we expected leasing and eventual exploration activities to occur primarily in the Midrange Zone, with a smaller percentage occurring in the Near Zone and in the Far Zone. Table III-1 has been reviewed based on the leasing results from Sales 186 and 195. The MMS still expects that leasing, exploration, and development activities will expand into more remote, deeper water during proposed Sale 202, and our estimates for the total sales-related activities remain unchanged.

We reviewed the previously projected timeframes for exploration and development as a result of proposed Sale 202—projections that were included in the multiple-sale final EIS. We concluded that likely timeframes for these activities would be similar to those that were anticipated previously. The total number of exploration and development wells drilled and the type of exploration and production platforms remain unchanged (Tables III-2 and III-3). The probable timing of exploration, development and production activities also remains unchanged, Exploration drilling is anticipated to begin in 2010, 3 years after the proposed sale. A commercial discovery is assumed to occur 5 years after the sale and installation of a production platform occurs 5 years later in 2018. Production from Sale 202 leases is forecast to continue until 2038, about 5 years beyond the end of Sale 186 production. Projected pipeline landfall sites for this sale are the same as for Sales 186 and 195—near Smith Bay, Harrison Bay, Oliktok Point, Gwydyr Bay, and/or Foggy Island Bay (USDOI, MMS, 2003:Map A-4b). Because potential new fields leased in Sale 202 could be possibly located farther from existing infrastructure, a new onshore support facility might be proposed for either the National Petroleum Reserve-Alaska (NPR-A) or the eastern North Slope. Plans have been proposed for an expansion of development surrounding the Alpine field and these facilities could gather oil production from the Beaufort OCS. Although a recent development plan (Exxon Corporation) has been postponed for the Point Thomson field, this area remains a likely site for industrial expansion on the eastern North Slope. Future onshore projects in the Point Thomson area are likely to be used as an onshore support facility for any eastern Beaufort Sea development.

III.C. Mitigation.

The following section both summarizes standard mitigation that has been approved and describes proposed new mitigation that has not yet been approved.

III.C.1. Standard Mitigation. The effects of any exploration and development would be moderated by approved mitigating measures and ITL's. The following is a list of mitigating measures; Appendix B contains a list of the ITL's that are in effect, plus references to the MMS web sites with the full texts of the stipulations and ITL's:

- Protection of Biological Resources
- Orientation Program
- Transportation of Hydrocarbons
- Industry Site-Specific Bowhead Whale-Monitoring Program
- Conflict Avoidance Mechanisms to Protect Subsistence Whaling & Other Subsistence Activities
- Pre-Booming Requirements for Fuel Transfers
- Lighting of Lease Structures to Minimize Effects to Spectacled and Steller's Eiders
- Permanent Facility Siting in the Vicinity Seaward of Cross Island
- Permanent Facility Siting in the Vicinity Shoreward of Cross Island

After the assessment of Sale 195, there was a slight change in the stipulation about lighting of OCS structures to minimize potential effects to spectacled and Steller's eiders. As explained in Appendix B, the protocol to minimize the outward radiation of light and, thereby, the attraction of migrating eiders, was modified slightly by MMS and the Fish and Wildlife Service (FWS).

III.C.2. Proposed New Mitigation. The proposed new mitigation includes an ITL for protection of polar bears and proposed revisions to two standard ITL clauses. The ITL's are focused on MMS rules in 30 CFR part 250.

III.C.2.a. Proposed New ITL for Protection of Polar Bears:

Planning for Protection of Polar Bears. Lessees are advised to consult with the Fish and Wildlife Service (FWS) and local Native communities while planning their activities and before submission of their Oil-Spill Contingency Plans (OSCP's) to ensure potential threats to polar bears are adequately addressed based on the most current knowledge regarding their habitat use, distribution, and population status, and to ensure adequate geographic coverage and protection are provided under the OSCP. Coastal aggregations of polar bears during the open-water/broken-ice period are particularly vulnerable to the effects of an oil spill, which lessees must address in their OSCP's. For example, well-known polar bear aggregations have occurred at Kaktovik, Cross Island, and Point Barrow in close proximity to subsistence-harvested whale-carcass remains. Measures to ensure adequate timely geographic coverage and protection of polar bears may include, but are not limited to, the prestaging of oil-spill equipment at or near locations of polar bear aggregations to support oil-spill-response operations. Lessees are encouraged to consult and coordinate with FWS and the local Native communities to develop plans and mitigation strategies in their OSCP to prevent adverse effects to known bear aggregations. Making subsistence-harvested whale carcasses unavailable to polar bears on land during the fall open-water period may reduce polar bear aggregations and, thus, lower the potential for an oil spill to impact polar bears.

As part of the MMS review of proposed activities and mitigation measures, the Regional Supervisor Field Operations (RS/FO) will notify FWS at the review of proposed Exploration Plans and Development and Production Plans (and associated OSCP) and make copies of these documents available to the FWS for review and comment.

Lessees are encouraged to continue existing or initiate new training programs for oil-spill-response teams in local villages to facilitate local participation in spill response and cleanup. This effort allows local Native communities to use their knowledge about sea ice and the environment in the response process and can enhance their ability to provide protection to key resources, including polar bears.

As noted in ITL 4 Section (h), Bird and Marine Mammal Protection, the incidental take of marine mammals is prohibited unless authorization is obtained by those proposing the activity, whether or not the marine mammals are endangered or threatened. To protect polar bears and other marine mammals, MMS encourages OCS operators to obtain an incidental take authorization (ITA) from FWS under the Marine Mammal Protection Act (MMPA) prior to any operation. The ITA's must be requested annually. Obtaining an ITA will ensure that lessees' operations are planned and conducted with the most current knowledge of polar bears' habitat use, distribution, and population status.

Lessees are advised that polar bears may be present in the area of operations, particularly during the solid-ice period. Lessees should conduct their activities in a way that will limit potential encounters and interaction between lease operations and polar bears. Lessees are advised to contact FWS regarding proposed operations and actions that might be taken to minimize interactions with polar bears. Lessees also are advised to consult OCS Study MMS 93-0008, *Guidelines for Oil and Gas Operations in Polar Bear Habitats.*

Lessees are reminded of the provisions of the 30 CFR 250.300 regulations, which prohibit discharges of pollutants into offshore waters. Trash, waste, or other debris that might attract polar bears or might be harmful to polar bears should be properly stored and disposed of to minimize attraction of, or encounters with, polar bears.

III.C.2.b. Revisions to Standard Information to Lessee Clauses:

Standard ITL No.4 Section *(h) Bird and Marine Mammal Protection.* Lessees are advised that during the conduct of all activities related to leases issued as a result of this sale, the lessee and its agents, contractors, and subcontractors will be subject to the following laws, among others: the provisions of the Marine Mammal Protection Act (MMPA) of 1972, as amended (16 U.S.C. 1361 et seq.); the Endangered Species Act (ESA), as amended (16 U.S.C. 1531 et seq.); and applicable International Treaties.

Lessees and their contractors should be aware that disturbance of wildlife could be determined to constitute harm or harassment and, thereby, be in violation of existing laws and treaties. With respect to endangered species and marine mammals, disturbance could be determined to constitute a "taking" situation. Under the ESA, the term "take" is defined to mean "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or to attempt to engage in such conduct." Under the MMPA, "take" means "harass, hunt, capture, collect, or kill or attempt to harass, hunt, capture, or kill any marine mammal." Violations under these Acts and applicable Treaties may be reported to the NOAA Fisheries or the FWS, as appropriate.

Incidental taking of marine mammals and endangered and threatened species is allowed only when the statutory requirements of the MMPA, the ESA, or both are met, depending on the species that is taken. Section 101(a)(5) of the MMPA, as amended (16 U.S.C. 1371(a)(5)), provides a mechanism for allowing, upon request and during periods of not more than 5 consecutive years each, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographic region, provided that NOAA Fisheries or the FWS finds that the total of such taking during each 5-year (or less) period would have no more than a negligible impact on such species or stock and will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses.

Applicants can receive authorization to incidentally, but not intentionally, take marine mammals under the MMPA through two types of processes: the Letter of Authorization (LOA) process and the Incidental Harassment Authorization (IHA) process. In either case, under the MMPA, incidental take of marine mammals is prohibited unless authorization is obtained by those proposing the activity, whether or not the marine mammals are endangered or threatened.

Based on current guidance from the NOAA Fisheries' Office of Protected Resources web site, if the applicant can show that: (a) there is no potential for serious injury or mortality; or, (b) the potential for serious injury or mortality can be negated through mitigation requirements that could be required under the authorization, the applicant should apply for an IHA and does not need an LOA for the activity.

If the potential for serious injury and/or mortalities exists and no mitigating measures are available to prevent this form of 'take' from occurring, to receive authorization for the take, the applicant must obtain an LOA. The LOA requires that regulations be promulgated and published in the *Federal Register* outlining: (a) permissible methods and the specified geographical region of taking; (b) the means of effecting the least practicable adverse impact on the species or stock and its habitat and on the availability of the species or stock for subsistence uses; and (c) requirements for monitoring and reporting, including requirements for the independent peer review of proposed monitoring plans where the proposed activity may affect the availability of a species or stock for taking for subsistence uses.

In 1994, Section 101(a)(5) of the MMPA was amended to establish an expedited process by which citizens of the U.S. can apply for an authorization (an IHA) to incidentally take small numbers of marine mammals by harassment. Specific time limits for public notice and comment on any requests for authorization that would be granted under this new provision were established. According to the NOAA Fisheries Office of Protected Resources' Small Take web site: "In 1996 NOAA Fisheries published an interim final rule (50 CFR Part 216.101-108) implementing this aspect of the program. The interim rule will be amended and written upon completion of NOAA Fisheries' criteria for acoustic harassment" (www.nmfs.noaa.gov/prot_res/PR2/Small_Take/smalltake_info.htm#LOA).

Of those marine mammal species that occur in Alaskan waters, under the MMPA, the National Marine Fisheries Service (NMFS) is responsible for species of the order Cetacea (whales and dolphins) and the suborder Pinnipedia (seals and sea lions) except walruses; the FWS is responsible for polar bears, sea otters, and walruses. Thus, requests for ITA's should be directed towards the appropriate agency. Procedural regulations implementing the provisions of the MMPA are found at 50 CFR Part 18.27 for the FWS and at 50 CFR Part 216 for NMFS.

If an applicant is requesting authorization for the incidental, but not intentional taking of a marine mammal that is the responsibility of NOAA Fisheries, he/she must submit a written request to the NOAA Fisheries

Office of Protected Resources and the appropriate NOAA Fisheries Regional Office where the specified activity is planned. If an applicant is requesting authorization for the incidental, but not intentional, taking of a marine mammal that is the responsibility of the FWS, he/she must submit a written request to the FWS Regional Office where the specific activity is planned. More information on this process, and application materials, are available from the NOAA Fisheries Office of Protected Resources website (www.nmfs.noaa.gov/prot_res/PR2/Small_Take/smalltake.info.htm).

According to NOAA Fisheries Small Take web site, most LOA's and IHA's to date have involved the incidental harassment of marine mammals by noise. Activities with the greatest potential to harass by noise include seismic airguns, ship and aircraft noise, high-energy sonars, and explosives detonations.

Please note that the NOAA Fisheries web site on small-take authorizations indicates the following timetables for LOA and IHA decisions: "Decisions on LOA applications (includes two comment periods, possible public hearings and consultations) may take from 6-12 months. The IHA decisions normally involve one comment period and, depending on the issues and species involved, can take anywhere from 2-6 months" (www.nmfs.noaa.gov/prot_res/PR2/Small_Take/smalltake_info.htm#applications).

Section 7(b)(4) of the ESA allows for the incidental taking of endangered and threatened species under certain circumstances. If a marine mammal species is listed as endangered or threatened under the ESA, the requirements of both the MMPA and the ESA must be met before the incidental take can be allowed.

Of particular concern is disturbance at major wildlife-concentration areas, including bird colonies, marine mammal haulout and breeding areas, and wildlife refuges and parks. Maps depicting major wildlife-concentration areas in the lease area are available from the RS/FO. Lessees also are encouraged to confer with the FWS and NOAA Fisheries in planning transportation routes between support bases and lease holdings.

Lessees also should exercise particular caution when operating in the vicinity of species that are not listed under the ESA but are proposed for listing, designated as candidates for listing, or are listed as a "Species of Concern" (any such species are listed in ITL [j] below) or whose populations are believed to be in decline, such as the yellow-billed loon, walrus, and polar bear.

Generally, behavioral disturbance of most birds and mammals found in or near the lease area would be unlikely if aircraft and vessels maintain at least a 1-mile horizontal distance and aircraft maintain at least a 1,500-foot (ft) vertical distance above known or observed wildlife-concentration areas, such as bird colonies and marine mammal haulout and breeding areas.

For the protection of endangered whales and marine mammals throughout the lease area, MMS recommends that all aircraft operators maintain a minimum 1,500-ft altitude when in transit between support bases and exploration sites. The MMS encourages lessees and their contractors to minimize or reroute trips to and from the leasehold by aircraft and vessels when endangered whales are likely to be in the area.

Human safety will take precedence at all times over these recommendations.

Standard ITL No.11 Section ***(m) Sensitive Areas to Be Considered in the Oil-Spill Contingency Plans (OSCP's).*** Lessees are advised that certain areas are especially valuable for their concentrations of marine birds, marine mammals, fishes, other biological resources, or cultural resources, and for their importance to subsistence harvest activities, and should be considered when developing OSCP's. Coastal aggregations of polar bears during the open-water/broken-ice period are particularly vulnerable to the effects of an oil spill, which lessees must account for in their OSCP's. Identified areas and time periods of special biological and cultural sensitivity include:

(1) the lead system off Point Barrow, April-June;
(2) the saltmarshes from Kogru Inlet to Smith Bay, June-September;
(3) the Plover Islands, June-September;

(4) the Boulder Patch in Stefansson Sound, June-October;
(5) the Camden Bay area (especially the Nuvugag and Kaninniivik hunting sites), January, April-September, November;
(6) the Canning River Delta, January-December;
(7) the Barter Island - Demarcation Point Area, January-December;
(8) the Colville River Delta, January-December;
(9) the Cross, Pole, Egg, and Thetis Islands, June-October;
(10) the Flaxman Island waterfowl use and polar bear denning areas, January-December; (Leffingwell Cabin, a National Historic Site, is located on Flaxman Island);
(11) the Jones Island Group (Pingok, Spy, and Leavitt Islands) and Pole Island are known polar bear denning areas, November-April;
(12) the area from Brownlow Point to Barter Island;
(13) the Sagavanirktok River delta, January-December;
(14) the anadromous waters of the North slope identified as spawning and/or rearing habitat by NOAA Fisheries, year-round; and
(15) coastal sandy beaches and adjacent nearshore waters along the Beaufort and Chukchi seas that might be used as spawning and/or rearing habitat by capelin or Pacific sand lance, year-round.

These areas are among areas of special biological and cultural sensitivity to be considered in the OSCP required by 30 CFR 250.300. Lessees are advised that they have the primary responsibility for identifying these areas in their OSCP's and for providing specific protective measures. Additional areas of special biological and cultural sensitivity may be identified during review of exploration plans and development and production plans.

Industry should consult with FWS or State of Alaska personnel to identify specific environmentally sensitive areas within National Wildlife Refuges or State special areas that should be considered when developing a project-specific OSCP.

Consideration should be given in an OSCP as to whether use of dispersants is an appropriate defense in the vicinity of an area of special biological and cultural sensitivity. Lessees are advised that prior approval must be obtained before dispersants are used.

III.D. Leasing Incentives.

Leasing incentives are intended to encourage activities leading to commercial production of oil resources and to partially offset the high cost and financial risks for operations in challenging areas. The MMS reduced the required minimum bid amount and rental rates for tracts leased in Sales 186 and 195. The agency also offered a royalty-reduction incentive that varied with the price of oil. It was offered through the price range ($18-30 per barrel in constant dollars) that was used to prepare the assessment scenario. However, at very high prices (above $39 per barrel), the royalty reduction was not offered and would not be needed to spur exploration and development activity. This assessment was prepared with the same scenario and assumptions about leasing incentives that were used for the assessments of Sales 186 and 195. As noted previously, there was strong industry interest in Sale 195, especially in the areas near existing infrastructure. The AEWC is concerned about greater levels of activity in the nearshore subsistence-whaling areas (Appendix A); however, the weak industry interest in remote areas indicates that there still is a need for incentives in the remote areas to promote industry interest.

III.E. Other Alternatives.

The following are the six alternatives to the Proposed Action.

III.E.1. Alternative I – The Area of Call. The area is illustrated in Figure 1 and includes 1,877 whole or partial blocks that encompass 9,770,000 acres (about 3,954,000 hectares). This alternative was described as the Proposed Action in the multiple-sale final EIS.

III.E.2. Alternative II – No Sale. This alternative would cancel proposed Sale 202 and defer leasing until after 2007 as part of the next 5-Year Program.

III.E.3. Alternative III - Barrow Subsistence Whaling Deferral. This alternative is similar to Alternative VII, except that it would exclude (not offer for lease) only a subarea within which Barrow residents conduct subsistence whaling. The area that would be removed by the Barrow Subsistence Whaling Deferral (Figure 1) consists of 26 whole or partial blocks equaling approximately 138,000 acres, or 1% of the Area of Call. The full rationale for the deferral is explained in the multiple-sale final EIS (USDOI, MMS, 2003:Sec. I.C.2.a(3)). Protection of the Barrow subsistence area was requested during Sales 186 and 195 by the AEWC, Inupiat Community of the Arctic Slope (ICAS), and North Slope Borough (NSB). Protection of the area was requested again by the AEWC in a letter about proposed Sale 202 (Appendix A). A letter from Senator Murkowski to Secretary Norton, dated August 24, 2005, about the 2007-2012 5-year leasing program being developed, referred to future deferral of the subsistence-whaling area. Senator Murkowski acknowledges that MMS has stipulations to protect biological resources, to require a bowhead monitoring program, and to require conflict avoidance agreements, but requests that MMS use lease deferrals in addition to these stipulations to protect Native whaling.

III.E.4. Alternative IV – Nuiqsut Subsistence Whaling Deferral. This alternative is similar to Alternative VII, except that it would not offer for lease a subarea within which Nuiqsut residents conduct subsistence whaling to the northeast of Cross Island. The area that would be removed by the Nuiqsut Subsistence Whaling Deferral (Figure 1) consists of 30 whole or partial blocks equaling approximately 162,000 acres, or 2% of the Area of Call. The full rationale for the deferral is explained in the multiple-sale final EIS (USDOI, MMS, 2003:Sec. I.C.2.a(4)). Protection of the Nuiqsut subsistence area was requested during Sales 186 and 195 by the AEWC, Native Village of Nuiqsut, ICAS, and NSB. As noted above, protection of subsistence-whaling areas was requested also by the AEWC in a letter about proposed Sale 202 and by Senator Murkowski in a letter about future leasing.

III.E.5. Alternative V – Kaktovik Subsistence Whaling Deferral. This alternative is similar to Alternative VII, except that it would not offer for lease only a subarea within which Kaktovik residents conduct subsistence whaling. The area that would be removed by the Kaktovik Subsistence Whaling Deferral (Figure 1) consists of 28 whole or partial blocks equaling approximately 121,000 acres, or 1% of the Area of -Call. The full rationale for the deferral is explained in the multiple-sale final EIS (USDOI, MMS, 2003:Sec. I.C.2.a(5)). Protection of the Kaktovik subsistence area was requested during Sales 186 and 195 by the AEWC, Native Village of Kaktovik, ICAS, and NSB. As noted above, protection of subsistence-whaling areas also was requested by the AEWC in a letter about proposed Sale 202 and by Senator Murkowski in a letter about future leasing.

III.E.6. Alternative VI - Eastern Deferral. This alternative is similar to Alternative I, except that it would not offer for lease a subarea within which bowheads feed. The area that would be removed by the Eastern Deferral (Figure 1) consists of 60 whole or partial blocks equaling approximately 283,000 acres, or 3% of the Area of Call. The full rationale for the deferral is explained in the multiple-sale final EIS (USDOI, MMS, 2003:Sec. I.C.2.a(6)). Deferral of this area was requested during Sales 186 and 195 by the AEWC, Native Village of Kaktovik, ICAS, and NSB. As noted above, protection of the area also was requested by the AEWC in a letter about proposed Sale 202 and by Senator Murkowski in a letter about the 2007-2012 5-Year Program being developed.

IV. UPDATED IMPACT ANALYSIS

The multiple-sale final EIS (USDOI, MMS, 2003) concluded that, in the unlikely event of a large oil spill, there could be significant effects on subsistence-harvest patterns and sociocultural systems, several bird species, and local water quality. It concluded also that the potential cumulative effects on several resources, including bowhead whales, would be a primary concern and would warrant continued close attention and effective mitigation practices.

The Sale 195 EA (USDOI, MMS, 2004) updated the oil-spill-occurrence estimates for large spills, because the potentially significant effects in the multiple-sale final EIS were related to a large spill. The EA concluded that no new significant impact would occur that was not already assessed in the multiple-sale EIS, and it identified ringed seals and other ice-dependent pinnipeds as additional resources of primary concern due to the speculative effects of climate change in the Arctic.

This Sale 202 EA updates the oil-spill-occurrence estimates, information on routine, permitted operations, and the effects assessment for each resource. As in the Sale 195 EA, the effects of spills on the significantly affected resources are assessed first, reflecting MMS guidance to focus EA's on those aspects of the Proposal that could cause adverse effects that are significant. This EA includes updated information on the affected environment, updated effects assessments of other alternatives, updated cumulative effects assessments, and an overall summary. The summary concludes in Section IV.B that parts of the Beaufort Sea environment have changed substantially since preparation of the multiple-sale EIS. For example, the statistical analysis of long-term data sets indicates substantial reductions in both the extent and thickness of the arctic sea-ice cover during the past 20-40 years. Also, some resources that are dependent on summer and autumn ice cover have declined in abundance. The Sale 195 EA projected that more polar bears might be forced to stay onshore during summer, leading to increased interaction between polar bears and oil-industry personnel (USDOI, MMS, 2004:Appendix I, Sec. I.2.g). Recent observations confirm that more polar bears are staying onshore during the autumn, as explained in Sections IV.B.4.b and IV.C.2.e.

This EA concludes in Section IV.C.2, that the likelihood of one or more large oil spills occurring and contacting a land segment still is very low (e.g., <2% within 60 days). Due primarily to increased concentrations of polar bears on parts of the coast, the relative oil-spill risk to the population has increased since preparation of the multiple-sale EIS. The biological potential for polar bears to recover from any perturbation is low because of their low reproductive rate. The MMS rules can require mitigation that will moderate the spill risk to polar bears (Sec. III.C.2). Our overall finding is that the Proposed Action with the mitigation would lead to no new significant impact that was not already assessed in the Beaufort Sea multiple-sale EIS.

IV.A. Updated Information on the Physical Environment and Potential Operations.

This section updates the available information on physical oceanography, summarizing recent studies of circulation and sea ice, and the acoustic environment in the Beaufort Sea. This section also updates the information on the oil-spill risk and an increase in the anticipated level of seismic exploration.

IV.A.1. Physical Oceanography. Comparison of ocean temperature, salinity, sea-ice extent, and sea-ice thickness data from the 1990's and 2000's to earlier data shows changes in the Arctic Ocean. Both the multiple-sale EIS and the Sale 195 EA (USDOI, MMS 2003, 2004) and an MMS study report (Eicken et al., 2006) summarize the reduction in sea-ice extent and thickness in recent years. The statistical analysis of long-term data sets indicate substantial reductions in both the extent and thickness of the arctic sea-ice cover during the past 20-40 years, with record minimum extent in 2002 and again in 2005, and extreme minima in 2003 and 2004 (Stroeve et al., 2005; NASA, 2005; Comiso, 2006). In September 2002, sea ice in the Arctic reached a record minimum during summer, 4% lower than any previous September since 1978 and 14% lower than the 1978-2000 mean (Serreze et al., 2003). Three years of low ice extent followed 2002. Taking these 3 years into account, the September ice-extent trend for 1979-2004 declined by 7.7% per decade (Stroeve et al., 2005) and from 1979-2005 declined by 9.8% per decade (Comiso, 2006). The multiple-sale EIS (USDOI, MMS 2003:Sec III.A.4.g) discussed the estimated ice-reduction rate of 3% per decade. This rate is now approximately three times faster. Within the Arctic, the Chukchi and Beaufort seas have some of the largest declines in ice extent during summer. In 2005, the ice in the Beaufort Sea did not retreat towards the central Arctic as far as the previous 3 years (Comiso, 2006). Melling, Riedel, and Gedalof (2005) report a small trend (0.07 meters [m]/decade) of thinner ice with a low statistical significance in the Canadian Beaufort Sea from Herschel Island to McClure Strait.

When the ice cover is reduced, particularly during the late arctic summer, the amount of open water and the influence of the wind on the water increases, and the waves grow in height. Typical wave heights are up to 1.5 m during summer and up to 2.5 m during fall. Expected maximum wave heights are 7-7.5 m in the Beaufort Sea (Brower et al., 1988). A late-summer storm in the Beaufort in September 2000 developed waves 3 m high near Point Barrow (Lynch et al., 2003).

Changes in the landfast ice have been occurring. The landfast ice season is now shorter, with a less stable ice cover in the Alaskan Beaufort Sea (Eiken et al., 2006). Events of shorefast ice breaking off have occurred near Barrow in January or February and even as late as March (George et al., 2003).

While changes in the reduction of sea ice are apparent, the cause(s) of change is ambiguous. Lindsay and Zhang (2005) hypothesize that the thinning of sea ice, based on a combination of modeling and analysis of data; is due to:

> (1) the fall, winter, and spring air temperatures over the Arctic Ocean have gradually increased over the last 50 yr, leading to reduced thickness of first-year ice at the start of summer; (2) a temporary shift, starting in 1989, of two climate indices caused a flushing of older, thicker ice out of the basin and an increase in the summer open water extent; and (3) the increasing amounts of summer open water allow for increasing absorption of solar radiation which melts the ice, warms the water and promotes creation of winter first-year ice that often entirely melts by the end of the subsequent summer.

Francis et al., (2005) suggest that downwelling long-wave radiation fluxes account for a large percentage of the variability of perennial sea-ice extent in the Beaufort and Chukchi sea area. In the Chukchi Sea, meridonal wind (one with a strong north-south component) also had an influence but played a lesser role in the Beaufort. Shimada et al. (2006) present evidence that the pattern of sea-ice extent is similar to the distribution of warm Pacific summer Water. Kwok (2004) and Kwok, Maslowski, and Laxon (2005) identify and discuss the implications of multiyear ice distribution both in terms of an unusual outflow of multiyear ice into the Barents Sea and its consequences as a freshwater source to the transformation of Atlantic Water circulating in the Arctic.

Widespread changes of temperature and salinity occurred in the central Arctic Ocean water column during the 1990's. There were observations of widespread temperature increases in the Atlantic water layer (Carmack et al., 1995; McLaughlin et al., 1996; Morrison, Steel, and Anderson, 1998; Grotefendt et al., 1998). These appear related to an increased temperature (Swift et al., 1998) and strength (Zhang, Rothrock, and Steele, 1998) of the Atlantic inflow into the Arctic Basin. Increased transport caused a displacement of the Pacific-Atlantic water boundary toward the Canadian Basin. The pronounced warming of Atlantic water in the central basin tapered off by 1998-1999 (Gunn and Muench, 2001; Boyd et al., 2002). Kikuchi, Inoue, and Morison (2005) report that the temperature anomalies appear first on the Markov Basin side of the Lomonosov Ridge and then arrive on the Amundsen side of the basin approximately 7 years later. Karcher et al. (2003) suggest, from modeling, that the warming of the Atlantic Layer resulted from changes in inflow from Fram Strait and the Barents Sea as well as changes in local current speeds. They suggest these events are episodic with a warming event in the early 1980's and again in the early 1990's. Woodgate et al. (2001) also present observations of warming and cooling events near the Chukchi Borderlands. There still is discussion in the literature regarding the cause of the warming.

Shimada et al. (2004) identify the remnants of this warmed Atlantic Water recently reaching the Canada Basin. Comparisons of recent and historical data show that the Canada Basin waters are in transition and are responding to inflow from upstream (McLaughlin et al., 2004). The appearance of higher temperatures near the Chukchi Plateau suggests that temperatures may continue to increase in the Beaufort Sea in coming years. Steele et al. (2004) state that the distribution of summer Pacific halocline is changing in the Canada Basin of the Arctic Ocean and so is its influence. They relate these changes to the two different Arctic Oscillation states where during a high Arctic Oscillation, Alaska Coastal Water and summer Bering Shelf Water may outflow at different locations from the Arctic. During a low Arctic Oscillation, both watermasses are mixed into the Beaufort Gyre, and the separation of these watermasses is reduced.

Determining whether this trend persists depends on acquiring additional data. Polyakov et al. (2005) report two warm Atlantic Water anomalies (1999 and 2004) in the eastern Eurasian Basin that could propagate towards the Arctic Ocean interior with a time lag. Polyakov et al. (2004) present data showing multidecadal fluctuations in temperature, with time scales of 50-80 years for Atlantic Water temperature variability. Observations in the next years may be particularly important in view of the changes observed in the Arctic Oscillation, which had a persistent, positive phase through the 1990's, but it has been negative or near neutral for 6 of the previous years from 1996-2004 (Overland and Wang, 2005). This warming in the early 1990's was thought to be associated with cyclical, large-scale shifts in atmospheric forcing (Proshutinsky and Johnson, 1997; Proshutinsky et al., 2000). Even without the driving force of a positive Arctic Oscillation, Arctic indicators continue to indicate a continuing linear trend of warming. Tracking multiple lines of evidence will be crucial to understanding change in the Arctic as a whole (Overland, 2006).

IV.A.2. Acoustic Environment. Sounds generated by the oil and gas industry are propagated into a marine environment that already receives sounds from numerous natural and human sources. The main sources of noise occurring in the Beaufort Sea, both natural and anthropogenic (manmade) are described in detail in the Programmatic Environmental Assessment (PEA) for seismic surveys in the Arctic Ocean (USDOI, MMS, 2006a:Sec. III.B), are incorporated by reference and are summarized below.

IV.A.2.a. Ambient Sound. Ambient noise levels in the Beaufort Sea can vary dramatically between and within seasons because of: (1) variability in components of environmental conditions such as sea ice, temperature, wind, and snow; (2) the presence of marine mammals; (3) the presence of industrial shipping, research activities, and subsistence activities; and (4) other miscellaneous factors. Natural sound sources in the Beaufort Sea include the wind stirring the surface of the ocean, lightning strikes; animal vocalizations and noises (including whale calls, echolocation clicks, and snapping shrimp); subsea earthquakes; and ice movements. Burgess and Greene (1999) report that collectively, these sources create an ambient noise range of 63-133 decibels (dB).

The presence of ice can contribute substantially to ambient noise levels and can affect sound propagation, as ice cover radically alters the ocean noise field with factors such as the type and degree of ice cover (National Research Council [NRC], 2001). The NRC (2001, citing Urick, 1984) reported that variability in air temperature over the course of the day can change received sound levels by 30 dB between 300 and 500 Hertz (Hz). Temperature also affects the mechanical properties of the ice, and temperature changes can result in cracking, especially in winter and spring when landfast ice produces loud thermal cracking noises (Milne and Ganton, 1964). In areas characterized by a continuous fast-ice cover, the dominating source of ambient noise is the ice cracking induced by thermal stresses (Milne and Ganton, 1964). The spectrum of cracking noise typically displays a broad range from 100 Hz-1 kiloHertz, and the spectrum level has been observed to vary as much as 15 dB within 24 hours due to the diurnal change of air temperature. Ice deformation occurs primarily from wind and currents and usually produces low frequency noises around 4-200 Hz (Greene, 1981). As icebergs melt, they produce additional background noise as they tumble and collide with each other.

While sea ice can produce high levels of background noise, it also can function to dampen ambient noise. Areas of water with 100% sea-ice cover can reduce or completely eliminate noise from waves or surf (Richardson et al, 1995). In the Arctic, wind and waves (during the open-water season) are important sources of ambient noise with noise levels tending to increase with increased wind and sea state, all other factors being equal (Richardson et al., 1995).

Marine mammals contribute to the background noise in the acoustic environment of the Beaufort Sea. For example, source levels of seal songs and calls have been estimated to be up to 178 decibels re 1 microPascal at 1 meter (178 dB re 1 μPa at 1 m) (Cummings et al., 1983; Richardson et al., 1995). Bowhead whales, which are present in the Arctic Region from early spring to mid- to late fall, produce sounds with source levels ranging from 128-189 dB re 1 μPa at 1 m in frequency ranges from 20-3,500 Hz.

IV.A.2.b. Anthropogenic Sound. Human sources include noise from vessels (motor boats used for subsistence and local transportation, commercial shipping, research vessels, etc.); navigation and scientific research equipment; airplanes and helicopters; human settlements; military activities; and marine development.

IV.A.2.b(1) Vessel Activities and Traffic. Shipping noise, often at source levels of 150-190 dB, since 1950 has contributed a worldwide 10- to 20-dB increase in the background noise in the sea (Acoustic Ecology Institute, 2005). The types of vessels that produce noise in the Beaufort Sea include barges, skiffs with outboard motors, icebreakers, scientific research vessels, and vessels associated with geological and geophysical exploration and oil and gas development and production. In the Beaufort Sea, vessel traffic and associated noise presently is limited primarily to late spring, summer, and early autumn.

In shallow water, vessels more than 10 kilometers (km) away from a receiver generally contribute only to background noise (Richardson et al., 1995). In deep water, traffic noise up to 4,000 km away may contribute to background-noise levels (Richardson et al., 1995). Barging associated with activities such as onshore and limited offshore oil and gas activities, fuel and supply shipments, and other activities contributes to overall ambient noise levels in some regions of the Beaufort Sea. The use of aluminum skiffs with outboard motors during fall subsistence whaling in the Alaskan Beaufort Sea also contributes noise. Fishing boats in coastal regions also contribute sound to the overall ambient noise. Sound produced by these smaller boats typically is at a higher frequency, around 300 Hz (Richardson et al., 1995).

Icebreaking vessels used in the Arctic for activities including research and oil and gas activities produce stronger, but also more variable, sounds than those associated with other vessels of similar power and size (Richardson et al., 1995). Even with rapid attenuation of sound in heavy ice conditions, the elevation in noise levels attributed to icebreaking can be substantial out to at least 5 km (Richardson et al., 1991). In some instances, icebreaking sounds are detectable from more than 50 km away.

IV.A.2.b(2) Oil and Gas Development and Production Activities. There are two oil-production facilities on artificial islands in the Beaufort Sea (Endicott/Duck Island and Northstar). Richardson and Williams (2004) summarized results from acoustic monitoring of the offshore Northstar production facility from 1999-2003. Northstar is located on an artificial gravel island in the central Alaskan Beaufort Sea. In the open-water season, in-air broadband measurements reached background levels at 1-4 km and were not affected by vessel presence. However, Blackwell and Greene (2004) pointed out that "...an 81 Hz tone, believed to originate at Northstar, was still detectable 37 km from the island." Based on sounds measurements of noise from Northstar obtained during March 2001 and February-March 2002 (during the ice-covered season), Blackwell et al. (2004) found that background levels were reached underwater at 9.4 km when drilling was occurring and at 3-4 km when it was not. Irrespective of drilling, in-air background levels were reached at 5-10 km from Northstar.

During the open-water season, Northstar-associated vessels such as tugs, self-propelled barges, and crew boats were the main contributors to underwater sound levels, with broadband sounds from such vessels often detectable approximately 30 km offshore. In 2002, sound levels were up to 128 dB re 1 μPa at 3.7 km when crew boats or other operating vessels were present (Richardson and William, 2003). In the absence of vessel noise, underwater-averaged broadband island sounds generally reached background levels 2-4 km from Northstar. Underwater sound levels from a hovercraft, which BPXA began using in 2003, were quieter than similarly sized conventional vessels.

IV.A.2.b(3) Miscellaneous Sources. Acoustical systems are associated with some research, military, commercial, or other vessel use of the Beaufort Sea. Such systems include multibeam sonar, sub-bottom profilers, and acoustic Doppler current profilers. Active sonar is used for the detection of objects underwater. These range from depth-finding sonar, found on most ships and boats, to powerful and sophisticated units used by the military. Sonar emits transient, and often intense, sounds that vary widely in intensity and frequency. Acoustic pingers used for locating and positioning oceanographic and geophysical equipment also generate noise at high frequencies. LGL, Ltd. (2005) describes many examples of acoustic navigational equipment.

IV.A.2.c. Seismic Sound. The oil and gas industry in Alaska conducts marine geophysical surveys in the summer and fall, and on-ice seismic surveys in the winter, to locate geological structures potentially capable of containing petroleum accumulations. These surveys use individual airguns or a combination of individual airguns called an airgun array to produce high-energy sound waves that typically are aimed directly at the seafloor. The sound is created by the venting of high-pressure air from the airguns into the water column and the subsequent production of an air-filled cavity (a bubble) that expands and contracts, creating sound with each oscillation. Airgun sizes are quoted as chamber volumes in cubic inches, and individual guns may vary in size from a few tens to a few hundreds of cubic inches. While the seismic airgun pulses are directed towards the ocean bottom, sound propagates horizontally for several kilometers (Greene and Richardson, 1988; Hall et al., 1994). In waters 25-50 m deep, sound produced by airguns can be detected 50-75 km away, and these detection ranges can exceed 100 km in deeper water (Richardson et al., 1995). In addition to the airgun arrays, vessels also tow long cables with hydrophones (streamers), which detect the reflected airgun-generated sounds from the seafloor.

Seismic-survey sounds vary, but a typical two-dimensional/three dimensional (2D/3D) seismic survey with multiple airguns would emit energy at about 10-120 Hz, and pulses can contain energy up to 500-1,000 Hz (Richardson et al. 1995). Goold and Fish (1998) recorded a pulse range of 200 Hz-22 kHz from a 2D survey using a 2,120-cubic inch (in^3) array.

Richardson et al. (1995) summarized that typical signals associated with vibroseis sound source used for on-ice seismic survey sweep from 10-70 Hz, but harmonics extend to about 1.5 kHz (Richardson et al., 1995). In this activity, hydraulically driven pads mounted beneath a line of trucks are used to vibrate, and thereby energize the ice. Noise incidental to the activity is introduced by the vehicles associated with this activity.

Safety radii traditionally are established around a seismic-survey operation to help prevent potential harm to marine mammals that are exposed to the high-energy sound sources. The safety radii around an airgun array vary with water depth. Tolstoy et al. (2004) provide both predicted and measured values for a variety of airgun configurations ranging from 2-20 airguns. Recent National Marine Fisheries Service (NMFS) incidental harassment authorizations (IHA's) (e.g., Lamont-Doherty, 2005; University of Alaska, 2005) used the data from Tolstoy et al. (2004) to estimate safety radii and exclusion zones for shallow (less than [<]100 m), intermediate, (100-1,000 m), and deep (greater than [>] 1,000 m) waters, depending on the type of airgun configuration used.

The NMFS has established two levels of harassment: Level A and Level B. Simplified, Level A harassment has the potential to injure a marine mammal, while Level B harassment is a disturbance impact. Current Level A harassment criteria for nonexplosive sounds are 180 dB for cetaceans and 190 dB for pinnipeds. A Level B harassment criterion for impulse noises is 160 dB. These criteria are then coupled with existing data (e.g., Tolstoy et al., 2004) or field-test data to determine exclusion zones or safety radii on a case-by case basis based on water depths and airgun configurations. Typically, lower output systems produce smaller exclusion zones.

IV.A.3. Oil-Spill-Risk Analysis. This section summarizes information on the oil-spill data and assumptions we use in the analysis of large spills in this EA as well as new information about oil spills relevant to the Proposed Action and its alternatives. This information has become available since the publication of the Beaufort Sea multiple-sale EIS in February 2003 and the Sale 195 EA in 2004.

Information regarding the source, type, and sizes of oil spills; their behavior; the estimated path they follow; and the conditional remain the same as discussed in the multiple-sale EIS in Section IV.A and Appendix A. For purposes of analysis, we assume one large spill of 1,500 barrels (bbl) or 4,600 bbl for crude or diesel oil, depending upon whether the assumed spill originates from a platform or a pipeline.

In our analysis, we assume the following fate of the crude oil without cleanup. After 30 days in open water or broken ice:

- 27-29% evaporates,
- 4-32% disperses, and
- 28-65% remains.

After 30 days under landfast ice:

- nearly 100% of the oil remains in place and unweathered.

The chance of one or more large spills occurring is derived from two components: (1) the spill rate and (2) the oil production estimates. The oil production estimate remains 460 million barrels (MMbbl) for the entire sale area, as discussed in the Beaufort multiple-sale EIS (USDOI, MMS, 2003:Sec. II.B). This resource volume is undiscovered and there is no accurate way to predict the size and location of future commercial fields. Because sufficient historical data on offshore arctic oil spills for the Beaufort Sea region do not exist to calculate a spill rate, a model based on a fault-tree methodology was developed and applied for the Beaufort multiple-sale EIS (Bercha Group, Inc., 2006). Using fault trees, oil-spill data from the offshore Gulf of Mexico and California were modified and incremented to represent expected performance in the Arctic. The multiple-sale EIS and the Sale 195 EA explain that the confidence estimate includes only part of the variability in the Arctic effects on the spill rate. During Fiscal Year 2004, MMS procured the study NSL AK-04-02, entitled *Improvements in the Fault Tree Approach to Oil Spill Occurrence Estimators for the Beaufort and Chukchi Seas*. The study included the non-arctic variability of spill frequency and spill size. An implication from this study for this EA is that the chance of one or more large spills increased from 8-10% (USDOI, MMS, 2003:Section IV.A.4.a.(1)) to 21% for Sale 202. Appendix C discusses this study further, and the reader is directed to Appendix C.

Considering the variance in the arctic and non-arctic effects, our best estimate of the spill rate for large spills (greater than or equal to [≥] 1,000 bbl) from platforms and pipelines total is that there may be 0.53 oil spills (95% confidence interval 0.35-0.73 oil spills) per billion barrels produced. We are 95% confident that the spill rate for large spills from platforms and pipelines will be no more than 0.73 spills per billion barrels produced.

Using the platform and pipeline spill rates to estimate the mean spill number, we estimate the following: the chance of one or more large pipeline spills would be 9%, and the chance of one or more large platform spills would be 13-14% for Alternative VII, the Proposed Action and its alternatives over the life of the project. The chance of one or more large spills from platforms and pipelines combined is 21% versus 8-10% (USDOI, MMS, 2003:Section IV.A.4.a.(1)). Using the spill rate at the 95% confidence interval, the chance of one or more large spills from platforms and pipelines combined ranges from 14-29%. Appendix C discusses how these spill rates were derived, and the reader is directed to Appendix C for more detail.

Regardless of the likelihood of future production or the chance of spill occurrence, for purposes of analysis we analyzed the consequences of one large oil spill.

IV.A.4. Oil-Spill Prevention and Response.

The Beaufort Sea multiple-sale EIS explains that MMS has standard regulations with regard to both the prevention of spills and response to spills.

IV.A.4.a. Spill Prevention. The MMS safety and pollution prevention regulations (30 CFR 250 and 254) govern oil, gas, and sulfur exploration, development, and production operations on the OCS. These Federal regulations require that OCS exploration and development are conducted according to the OCS Lands Act (OCSLA); the lease or right-of-way permit requirements; and other applicable laws, regulations, and amendments. The regulations establish strict regulatory requirements to prevent oil spills. The regulations address topics such as shallow-hazards surveys; well design and construction; redundant well-control equipment; well-control training; emergency plans for adverse weather; platform design and construction verification; production safety systems; subsurface safety valves; production safety equipment training; and pipeline design, operation, maintenance, and monitoring.

The MMS conducts on-site inspections for compliance with environmental protection measures. The Alaska Region uses a Potential Incident of Noncompliance (PINC) checklist developed from the MMS safety and pollution prevention regulations. In addition to the PINC list, the Alaska Region also develops project-specific compliance checklists highlighting any unique environmental protection measures. This checklist includes mitigation adopted by the operator as described in their OCS plan and conditions of approval imposed by the Alaska Region. Through the compliance and inspection process, MMS ensures that the stipulations of all the items on the checklists are met by the lessee. In the event of noncompliance, MMS has the authority to shut down operations until compliance is achieved.

The Beaufort Sea Multi-Sale final EIS noted that leak detection of chronic small leaks over an extended period of time from buried subsea pipelines under the ice has been a concern. One of the requirements placed on the approval of the Northstar pipeline was the requirement to develop a prototype leak-detection system to be used in addition to the two proposed state-of-the-art systems. BPXA met this requirement by installing a German leak detection system, Leck Erkennurgs Ortungs Sytems (LEOS), which was developed 20 years ago for a pipeline project in Bavaria, Germany (*Oil and Gas Journal*, 2002). As stated in the article, the LEOS system detects a leak by collecting vapor through a liquid impermeable acetate layer within a perforated tube. The system is tested every 24 hours, and the sensitivity of the system depends on the type of the hydrocarbon being detected, proximity to the leak and, to a lesser extent, on the type of soil surrounding the sensor tube. The LEOS system was installed as part of the bundled-pipeline systems for the Northstar Project. Prior to transporting oil through the pipeline, the LEOS system was checked to ensure it was functioning properly (*Oil and Gas Journal*, 2002). As noted in the article, "After a year of operation the LEOS systems has been field calibrated to account for increasing background methane due to soil warming" (*Oil and Gas Journal*, 2002). The ability to detect hydrogen from all the anodes demonstrates the system is working. The article notes the leak-detection thresholds for fluids is <1 liter per hour and <1 m^3 per hour for gas. This type of technology will help prevent large, undetected oil spills from small, chronic leaks under the ice.

One method to determine whether a leak has occurred during solid-ice conditions is to drill holes through the ice surface at various intervals throughout the solid-ice season. The MMS and others continue research to develop new technology to detect leaks in both solid-ice and broken-ice environments. Field trials for detecting oil under ice using remote sensing and detection technologies were conducted recently in the Beaufort Sea in the first quarter of 2007. Methods to date include satellite imagery, forward-looking infrared radar, acoustic-detection systems, and external pipeline leak-detection systems that identify hydrocarbons in the water column through a permeable membrane.

The MMS requires that pipelines be designed to accommodate site-specific environmental loads, including ice and permafrost. Pipelines include real-time leak-detection systems that measure changes in pressure or volumetric measurements between the start and end of the pipeline. Pipelines must be protected against internal and external corrosion using anodes, protective coatings and chemical inhibitors. Pipelines are monitored using smart pigs (instruments that are run inside a pipeline) that can detect potential corrosion, settlement, or other changes to the pipeline design. Pipeline operators are required to have scheduled maintenance programs to correct potential problems with pipelines that could result in an oil spill. The MMS monitors these pipeline activities.

IV.A.4.b. Spill Response. As also explained in the Beaufort Sea multiple-sale final EIS, each OCS permittee is required to have an Oil-Spill-Response Plan with sufficient cleanup equipment and trained personnel to meet Federal and State regulations. The Federal regulations are found in 30 CFR 250.300 and 254 and 40 CRF 110, 112, and 300. To help comply with these regulations, oil and gas companies have combined their capabilities in a joint spill-response organization, Alaska Clean Seas (ACS).

The spill response organization at Prudhoe Bay, ACS, has been conducting routine drills in the Arctic since the 1980's. The ACS and an offshore operator, BPXA, have determined that, based on the tests of their equipment and tactics in the shallow and nearshore environment around the Northstar development, smaller vessels are more flexible platforms for conducting response activities in the changing conditions of the Beaufort Sea. The focus of the BPXA spill-response planning and equipment has shifted from the barge-based concept to one using smaller, more maneuverable vessels to conduct recovery operations even in broken ice conditions. The smaller vessels are better able to access pools of collected oil against the ice edge, move between floes and large pieces of ice, and respond more quickly to changing weather and ice conditions. Two river-class tugs, dedicated for oil-spill response activities, are now anchored at West Dock and ready for immediate deployment. These vessels enable skimming operations to be conducted in water depths of 3 feet (ft) and less.

To ensure that logistics support is readily available, BPXA now intends to employ a smaller logistics vessel such as a river-class tug that will service the skimming vessels and any staging points established for spill-response activities. This vessel will be able to navigate in shallower waters than the barge and tug system currently used. In the course of response tactic testing, BPXA also discovered that for response efforts for the Northstar facility, it is time-effective to cycle the minibarges used for storing recovered oil to West Dock for lightering and return to service. This also allows the empty minibarges to be used as cargo barges to carry supplies back out to on-water skimming operations.

The barge was initially thought to provide safety advantages in heavy ice and weather conditions, but reviews of safety incidents have indicated that more safety hazards exist on the barge than on smaller vessels. Also in the area around Northstar, smaller vessels can respond quickly to changes in weather and return to shore instead of relying on the barge for protection. A barge-based spill-response system would be a more appropriate approach, when development moves further offshore into deeper waters and a large logistics platform is needed because of the distance from shore.

In addition to mechanical recovery equipment, ACS also maintains the largest inventory of fire boom in the United States for the purpose of conducting in situ burns (ISB) of spilled oil in the environment. An ISB burns oil as it floats on the water's surface and has been demonstrated to remove in excess of 90% of oil from the water surface (Buist and S.L. Ross Environmental Research, Ltd., 1999). During broken-ice conditions, the ice acts as a natural containment boom concentrating the oil and enabling greater usage of ISB tactics. Responders would be able to conduct more burns with less equipment, thereby removing more oil from the environment and limiting sensitive resource exposure to the oil.

IV.A.5. Seismic Surveying. This section updates the assumed level of activity first for seismic exploration with 2D/3D surveys, and then for high-resolution site-clearance surveys. The recent seismic-survey PEA assumed that 14 2D/3D seismic surveys would be conducted in the Beaufort Sea between 2006 and 2010, but the estimate included some surveys in State of Alaska water (USDOI, MMS, 2006a:Table III.C-1). The multiple-sale EIS assumed that, as a result of Sale 202, 11 exploration and delineation wells would be drilled between 2010 and 2018; however, it did not specify the amount of 2D/3D survey for this exploratory drilling (USDOI, MMS, 2003:Table IV.A-3). Because the projected number of wells for exploration/delineation has changed only slightly (i.e., from 11 in the multiple-sale EIS to less than 14 in the seismic-survey PEA), the level of seismic for exploration/delineation also probably has changed only slightly.

With regard to high-resolution site-clearance surveys, the projected amount has approximately doubled since the assessment for the multiple-sale final EIS. Specifically, the projection for site-specific seismic surveys from the multiple-sale final EIS (USDOI, MMS, 2003:Sec. IV.A.2.b(1)(a)) is that:

> We estimate each survey would cover roughly six OCS blocks (9 square miles or 23 square kilometers) for each exploration well. For Sales 186, 195, and 202, the total area covered by these surveys would equal 54 square miles (approximately 138 square kilometers). The average time needed to survey each site should range between 2 and 5 days, allowing for down time for bad weather and equipment failure.

As stated, 54 square miles (mi^2) (approximately 138 square kilometers [km^2]) was the estimated amount of seismic exploration for Sales 186, 195, and 202.

The seismic-survey PEA contains new projections of high-resolution seismic surveys. The projected amount of seismic activity in the Beaufort OCS between 2006 and 2010 is 11 high-resolution site-clearance surveys, with 3 surveys during the peak year (Table III-4).

Assuming still that each of the 11 high-resolution surveys would cover roughly 6 OCS blocks (9 mi^2 or 24 km^2), the total estimated amount of seismic exploration for the Beaufort Sea is 99 mi^2 (approximately 226 km^2). The 99 mi^2 is about twice the former projection of 54 mi^2.

IV.B. Updated Information on the Affected Environment.

This section updates the information that was unavailable at the time of the Sale 195 EA (USDOI, MMS, 2004). The section includes an introduction, updates of the information on the specific resources, and a brief summary of the updated information.

The resources in this section are organized according to the severity of the potential impacts as determined in the multiple-sale final EIS and the Sale 195 EA. The information is updated first for the resource with potentially significant levels of effects: (a) subsistence-harvest patterns and sociocultural systems; (b) coastal and marine birds; and (c) local water quality. It is updated next for bowhead whales, polar bears, and other resources. Information on subsistence-harvest patterns and sociocultural systems is updated first also because of comments on the Request for Information for the proposed lease sale (Appendix A). Information on Environmental Justice and Coastal Zone Management is updated last, partly because of different scales of effects and of significance criteria. Detailed updates of the information for some resources are contained in Appendix D.

After publication of the Sale 195 EA (USDOI, MMS, 2004), the Arctic Climate Impact Assessment (ACIA, 2004) became available. The EA and ACIA contain similar conclusions about climate change. For example, the multiple-sale final EIS concluded that the potential cumulative effects on several resources would be a primary concern and would warrant continued close attention and effective mitigation practices. The Sale 195 EA identified ringed seals and other ice-dependent pinnipeds as additional resources of primary concern due to the speculative effects of climate change in the Arctic. And the ACIA Key Finding Number 4 is similar, stating in part that reductions in sea ice will drastically shrink marine habitat for some ice-dependent animals. The following summaries show that the distribution and abundance has changed for several ice-associated resources in the proposed lease-sale area—changes that correlate with the Arcticwide retreat of the summer ice cover.

IV.B.1. Subsistence-Harvest Patterns and Sociocultural Systems. This section contains a summary of the updated information on subsistence-harvest patterns and sociocultural systems presented in Section 1 of Appendix D. It updates the information on subsistence-harvest patterns and sociocultural systems that might be affected by proposed Beaufort Sea Lease Sale 202, which was assessed in the multiple-sale final EIS and Sale 195 EA (USDOI, MMS, 2003, 2004). The final EIS and EA summarize information about subsistence and sociocultural systems in especially the villages of Barrow, Nuiqsut, and Kaktovik that have offshore subsistence-harvest areas within the proposed Sale 202 area. The information was updated recently in the seismic-survey PEA (USDOI, MMS, 2006a:Sec. III.G.2.a). The PEA is available on the MMS web site at: http://www.mms.gov/alaska/ref/pea_be.htm.

The MMS is conducting long-term environmental monitoring around the Northstar development, which is near the Nuiqsut subsistence-whaling area. As part of this monitoring effort, MMS has conducted a multiple-year collaborative project with Nuiqsut whalers that describe present-day subsistence whaling practices at Cross Island to empirically verify any changes to whaling due to weather, ice conditions, or oil and gas activities. The project findings were summarized during the 2005 MMS Information Transfer Meeting (USDOI, MMS, 2005a). Overall, the project has shown that the Nuiqsut whalers have continued to obtain their quota of whales. However, Nuiqsut whalers reported the following recent changes in whale behavior and whaling practices:

In 2004:

- Ice conditions in 2004 were even more moderate than in previous years.
- Weather prevented scouting a significant number of days but not as many days as in 2003.

- The level of whaling effort, as measured by time spent out on the water, was about twice that of 2003, but still much less than in 2002 or 2001.
- Whalers reported seeing many whales; whalers did not compare one year to another, but 2004 was probably comparable to 2003 in terms of whales sighted, and "better" than in 2002 or 2001.
- Whalers found whales relatively close to Cross Island; whales were harvested about the same distance from Cross Island in 2004 as in 2003 (which was closer than in 2001 or 2002).
- Whalers took shorter trips, both in terms of length and time duration, than in 2002 or 2001, but longer than in 2003 (which is why total effort was greater in 2004 than in 2003).
- No whaler explicitly mentioned observing skittish or "spooky" whale behavior.

Possible causes suggested by whalers for these behavioral changes were:

- The lack of ice that could have moderated the effects of the wind.
- Weather generally was poor, and whalers sometimes went scouting in relatively marginal conditions.
- Whales may have been more difficult to spot, due to wave height.
- Whales could have been traveling more rapidly than in past years (Galginaitis and Funk, 2006a).

In 2005:

- Whalers encountered a great deal of ice in 2005, which was a dramatic change from the previous four years.
- Weather also was very unfavorable and was dominated by strong east winds.
- Whalers saw relatively few whales in 2005 compared to previous years; swells and waves due to wind made spotting and observing difficult.
- In most cases, whalers were not able to follow or chase whales long enough to have a good opportunity for a strike.
- Whalers indicated that whales were traveling fast, not staying on the surface very long, and changing directions in unpredictable ways when first sighted.
- Ice and weather were not considered to be factors in making whales more "skittish."
- There were no reports of whale feeding behavior.

Possible causes suggested by whalers for these behavioral changes were:

- Heavy ice cover was encountered on most days.
- Significant ice cover allows whales to "hide" and makes them more difficult to spot.
- Significant ice cover allows whales that are seen to escape more easily and makes them more difficult to follow.
- "Spooked" behavior by whales was attributed to their reactions to encounters with barges and other vessel activity in the area.
- Whalers believed that the migration of whales in 2005 was similar to that of previous years, but that ice and weather conditions prevented them from reaching the whales.
- The same ice and weather conditions made nearshore waters the preferred operating areas for nonwhaling vessel traffic and increased potential encounters with whalers (Galginaitis and Funk, 2006b).

According to Galginaitis, "the need for a better mechanism to implement the common goal of conflict avoidance for years of extreme environmental conditions as 2005 is quite obvious" (Galginaitis and Funk, 2006b).

The Nuiqsut subsistence-whaling area is discussed in the Sale 195 EA (USDOI, MMS, 2004:Appendix H). Appendix H illustrates the extent of Nuiqsut whaling crew voyages for the 2001 and 2002 whaling seasons. The data just cited have been updated. Updates were gathered as part of the ongoing MMS Arctic Nearshore Impact Monitoring in Development Area (ANIMIDA) monitoring effort in development regions

(Galginaitis and Funk, 2004, 2005), which reports on recent data about the level of subsistence activity around Cross Island. For example, the reports explain that during 2001, the four whaling crews on Cross Island spent more than 10 hours on each scouting trip looking for whales. The total amount of time scouting was about 600 hours (Galginaitis and Funk, 2004). Rough weather prevented scouting during about one-third of the time that the whalers were on Cross Island during 2001 (Galginaitis and Funk, 2004:24) and about half of the time during 2003 (Galginaitis and Funk, 2005:18).

The unusually rough water that restricted the scouting for whales might have been related to the unusual retreat of the summer ice cover in the Beaufort Sea during recent years, which created an unusually long fetch (see Sec. IV.A.1). The changes in the ice cover and some of its effects on coastal erosion were summarized by Comiso (2005) and Wisniewski (2005). Comiso (2005) showed the minimum extent and minimum area for the arctic ice cover from 1979-2003, depicted in a graph as determined by satellite imagery. The graph illustrated that the ice cover was unusually small during 2003—the year when Nuiqsut subsistence-whaling activity was cut to half of its normal time by rough water.

In summary, the recent offshore subsistence-whale hunts have been affected by the retreat of the ice cover far from the coast. This contrasts with the situation decades ago, when the whale hunts were sometimes limited by heavy ice covers.

IV.B.2. Marine and Coastal Birds. This section summarizes the updated information on marine and coastal birds presented in Section 2 of Appendix D. It summarizes information that has become available since publication of the multiple-sale EIS, incorporating information from recent research, the Sale 195 EA and the PEA for seismic surveys in the Chukchi and Beaufort seas (USDOI, MMS, 2003, 2004, 2006a). The MMS also hosted an information exchange meeting October 30-31, 2005 (Appendix F), which included presentations by researchers on the latest information on bird species of concern in the Beaufort and Chukchi seas. The updated information includes recently obtained research results on size, status, trends, and distribution of eiders, the long-tailed duck, the yellow-billed loon, and other bird (species/guilds) populations potentially at risk of substantial effects from the Proposed Action. Also included is new information on breeding biology, habitat use, and migratory patterns that may help to improve our understanding of the vulnerability of these species to oil and gas exploration and development activities.

As described in the multiple-sale EIS, spectacled and Steller's eiders are listed as threatened under the Endangered Species Act (ESA). The Kittlitz's murrelet (*Brachyramphus brevirostris*) is designated a candidate species under the ESA (69 *Federal Register* (*FR*) 24876-24904) and is thought "likely to occur" in the Beaufort Sea by the Fish and Wildlife Service (FWS) (USDOI, FWS, 2006a). The MMS, however, has no records of its occurrence in the Beaufort Sea Sale 202 project area. If any Kittlitz's murrelets occur in or near the project area, their numbers would be expected to be very small and there would be a low potential for effects on this species.

IV.B.2.a. Spectacled Eider. Aerial surveys of spectacled eiders conducted in June 2005 on the Arctic Coastal Plain resulted in a population index of 7,820, which was above the 2004 index of 5,985 and the long-term average of 6,916 (Larned, Stehn, and Platte, 2005). The 13-year trend has remained level, and the mean annual population growth rate for the last 7 years was not statistically different than 1.0 (a stable population = 1.00) (Larned, Stehn, and Platte, 2005). For 2005, one can extrapolate crude estimates of relative contributions (%) for each of the breeding populations. Using North Slope (n = 7,820) aerial survey estimates (Larned, Stehn, and Platte, 2005) and corrected Yukon-Kuskokwim Delta (Y-K Delta) nest estimates from ground plots (n = 5,822) (in Platte and Stehn, 2005) and dividing by the Arctic Russian 'population' estimate (146,000; USDOI, FWS, 1999), roughly 5.1% and 3.8% of the world spectacled eiders nested on the North Slope and Y-K Delta, respectively (less than or equal to [$\leq$]2% if one considers Petersen, Larned, and Douglas, 1999 estimates).

Changes in benthic habitats of the wintering area have been suggested as one cause of interannual population changes in spectacled eiders. Petersen and Douglas (2004) developed annual indices based on historic remotely-sensed ice conditions and weather patterns and literature-based descriptions of benthic communities. In general, Petersen and Douglas (2004) found that annual population estimates on the breeding grounds can be negatively impacted by extended periods of dense sea ice and weather during the previous winter. However, the examination of population indices did not support the hypothesis that changes in the benthic community on the wintering grounds has contributed to the decline or inhibited the recovery of spectacled eiders breeding in western Alaska.

IV.B.2.b. Steller's Eider. When the Steller's eider was petitioned in December 1990 to be listed as endangered under the ESA, listing the species rangewide did not appear to be warranted given the relatively large number (~138,000) of Steller's eiders observed on the wintering area(s) in southwest Alaska. However, the Alaska breeding population of Steller's eiders was listed as threatened on June 11, 1997, based on an apparent contraction of the species' breeding range in Alaska (e.g., Kertell [1991] reported that Steller's breeding virtually was absent from 1975-1990 and due to a perceived increase in its vulnerability to extirpation [62 *FR* 31,748-31,757]).

So few Steller's eiders were detected during the annual eider breeding population survey of the Arctic Coastal Plain in 2005 that Larned, Stehn, and Platte (2005) concluded it was of little value in calculating a population trend. Similarly, very few Steller's eiders are observed during annual aerial population surveys designed for common eiders in nearshore and along barrier islands (Dau and Larned, 2004, 2005).

Steller's eiders were surveyed in marine waters within 100 km of the Beaufort Sea shoreline east of Barrow to Demarcation Point by Fischer and Larned (2004) during the summers 1999-2001. Steller's eiders were the least numerous (n=3) of all the birds (27, 517 total) observed during the surveys (Fischer and Larned 2004).

IV.B.2.c. Yellow-Billed Loon. Aerial breeding-pair surveys have been conducted in late June on the Arctic Coastal Plain for the past 19 years (Mallek, Platte, and Stehn, 2005). The yellow-billed population index for 2004 was 2, 262 and was 22.5% below the previous 18-year average. The 19-year growth trend is flat. However, the Center for Biological Diversity (CBD) petitioned the FWS to list the yellow-billed loon as an endangered or threatened species under the ESA on March 30, 2004 (CBD, 2004). The petition identifies threats to the species as oil and gas development, human disturbance, increased predation, small population size and low productivity, marine health, incidental bycatch from fishing, hunting, and the inadequacy of existing regulatory mechanisms. The FWS has not issued a 90-day finding on the CBD petition but has worked with local, State, and Federal resource agencies to draft a Conservation Agreement for the yellow-billed loon (YBLO), available for public comment in April 2006 (71 *FR* 13,155-13,157). The goal of the draft Conservation Agreement was to "... protect YBLO and their breeding, brood-rearing, and migrating habitats in Alaska, such that current or potential threats in these areas are avoided, eliminated or reduced to the degree that the species will not become threatened or endangered from these threats within the foreseeable future."

IV.B.2.d. Other Bird Species. Recent data on the king eider, common eider, long-tailed ducks, etc. are summarized in Appendix D. Most other species in the proposed Beaufort Sea lease-sale area have exhibited relatively stable populations in recent surveys, although populations of black guillemot and several shorebird species (buff-breasted sandpiper and bar-tailed godwit) are of some concern.

IV.B.3. Local Water Quality. This section contains a summary of the updated information on local water quality presented in Section 3 of Appendix D. The section updates the information in the multiple-sale final EIS and Sale 195 EA, incorporating recent research (USDOI, MMS, 2003, 2004).

Several studies showed that the hydrocarbons in marine particulate matter and sediments were characteristic of immature bitumens, shales, or coals; the degree of anthropogenic influence on the polycyclic aromatic hydrocarbon load in the Mackenzie River delta was small; and a large amount of dissolved organic carbon was carried into the coastal Beaufort Sea during peak flows at the time of river breakup in early June (USDOI, MMS, 2004). A recent study of Beaufort Lagoon inshore sediments examined the concentrations of 12 metals (copper, chromium, cadmium, nickel, vanadium, lead, tin, zinc, arsenic, barium, iron, and manganese in the mud fraction) and of total mercury and hydrocarbons (Naidu et al., 2005). The concentrations of metals and hydrocarbons generally were lower than those reported for polluted marine sediments. The hydrocarbon components in the sediments essentially were of terrestrial and biogenic sources with undetectable petroleum inputs. Another study of sediment samples through 2004 (Brown et al., 2005) analyzed for a full suite of hydrocarbons useful in determining petroleum contamination. These data from a subset of sediment cores, where deposition rates can be well established, generally show uniform levels and distributions of background hydrocarbons, extending back 50 years and more, with no discernable increases from recent offshore development activities. Preliminary results from the 2004 field season reveal hydrocarbon levels within the range of previous years. These studies confirm the multiple-sale EIS conclusion that North Slope rivers carry hydrocarbons from peat, coal, and natural seeps into the coastal waters, and that the petroleum hydrocarbon concentrations were relatively low.

Water quality in the Arctic Ocean is determined by both physical properties and chemical composition, and it may be affected by both anthropogenic and natural sources. The principal sources of pollutants entering the marine environment in general include discharges from industrial activities (petroleum industry) and accidental spills or discharges of crude or refined petroleum and other substances. The broad arctic distribution of pollutants is described in the Arctic Monitoring and Assessment Program (AMAP, 1997) report *Arctic Pollution Issues: A State of the Arctic Environmental Report.*

Available water quality data exist mainly for the Beaufort Sea area and are associated with monitoring of oil and gas development. Background hydrocarbon concentrations in Beaufort Sea waters appear to be biogenic and on the order of 1 part per billion (ppb) or less; however, sediment concentrations are relatively high compared with other undeveloped OCS areas (Steinhauer and Boehm, 1992). The greatest concentrations of hydrocarbons (suggestive of petroleum sources) were found offshore near the Colville and Kuparuk rivers. Marine sediment concentrations there are greater than riverine sediment concentrations and suggest the possibility of natural marine seeps (USDOI, MMS, 1996). Hydrocarbon concentrations in the Chukchi Sea also appear to be biogenic in origin and are typical of levels found in unpolluted marine waters and sediments (USDOI, MMS, 1996). The oil- and gas-related activities in the vicinity of Prudhoe Bay may have localized effects from year-round input of treated sewage and industrial wastes. The increased oxygen demand of these inputs may lower oxygen levels and increase turbidity.

Degradation to OCS water quality may occur from seasonal plankton blooms (a natural process); seasonal changes in water turbidity due to terrestrial runoff and shoreline erosion; and, water column stratification due to temperature differentials. Another natural source of altered water quality is sea-ice cover. As sea ice forms during the fall, particulates are removed from the water column by ice crystals as they form and are locked into the ice cover. The result is very low turbidity levels during the winter. Seasonal plankton blooms occur primarily during spring and fall, with the most active blooms during spring, as the ice cover melts and sunlight reaches the nutrient-rich surface waters.

Trace metal concentrations in the Chukchi and Beaufort seas are elevated compared to the eastern portions of the Arctic Ocean. However, these waters are still considerably lower in trace-metal concentrations than the USEPA criteria for the protection of marine life (Boehm et al., 1987; Crecelius et al., 1991).

IV.B.4. Resources With Lower Levels of Effects. Other resources are those for which a potentially significant level of effects was not identified in the multiple-sale EIS or Sale 195 EA. These resources include bowhead whales, polar bear, other marine mammals, fish and Essential Fish Habitat, and air quality.

IV.B.4.a. Bowhead Whales. This section contains a summary of the updated information on bowhead whales presented in Appendix D, Section 4.a. It updates the information in the multiple-sale final EIS and Sale 195 EA (USDOI, MMS, 2003, 2004) for proposed Beaufort Sea Lease Sale 202. The information recently was updated recently in the seismic-survey PEA and updates the information on subsistence and sociocultural systems (USDOI, MMS, 2006a:Sec. III.G.2.a). Updated information on bowhead whales also can be found in MMS' Biological Evaluation (BE) (USDOI, MMS, 2006b) on the potential effects on bowhead whales of oil and gas leasing and exploration in the Arctic OCS. The BE is available on the MMS website. The seismic-survey PEA is available on the MMS web site at: http://www.mms.gov/alaska/ref/pea_be.htm. The information on bowhead whales in the PEA and BE is incorporated by reference in this EA and summarized below and in Section 4a of Appendix D. Beluga and gray whales also inhabit the proposed lease area; information on these whales is updated in Section IV.B.2.d(3) of this EA.

There is one ESA-listed marine mammal species, the bowhead whale, that regularly and seasonally occurs within the Beaufort Sea OCS Planning Area and within areas of the Chukchi Sea that could be affected by actions within the Beaufort Sea. This population stock of bowheads is the most robust and viable of surviving bowhead populations and, thus, its viability is critical to the long-term future of the biological species as a whole. There is scientific uncertainty about the population structure of bowheads that use the Beaufort and Chukchi seas. Available new information does not indicate that there has been any statistically significant changes in the population status of the Bering-Chukchi-Beaufort Sea (BCB Seas) bowhead whale population since MMS consulted with NMFS in 2003 regarding Beaufort Sea Lease Sale 195 (USDOI, MMS, 2004) or the Beaufort Sea multiple-sale EIS (USDOI, MMS, 2003). Data indicate that what is currently referred to as the Western Arctic stock (by the National Marine Fisheries Service [NMFS]) or as the BCB Seas stock (by the International Whaling Commission [IWC]) of bowheads is increasing in abundance. All recent available information indicates that the population has continued to increase in abundance over the past decade and may have doubled in size since about 1978. The estimated current annual rate of increase is similar to the estimate for the 1978-1993 time series. There are scientific analyses indicating that BCB Seas bowheads may have reached or are approaching, the lower limit of their historic population size. There is discussion in the scientific and regulatory communities regarding the potential delisting of this population. The cause of the historic decline of this species was overharvesting by commercial whalers. The primary known current human-related cause of mortality is a regulated subsistence hunt by Alaskan Natives. Conservation concerns include: the introduction of noise and related disturbance from existing, but especially potential future, oil and gas activities; shipping; other vessel traffic; hunting in calving, migration, and feeding areas; contamination of their habitat by pollutants from planned and potential future oil and gas activity and by other local and distant pollution sources; uncertain potential impacts of climate warming; vessel strikes; and entanglement. No data are available indicating that, other than historic commercial whaling, any previous human activity has had a substantial, adverse impact on the current status of BCB Seas bowheads or their recovery. The uncertainty of the stock structure adds some uncertainty to summaries of the status of bowheads that may be impacted by the Proposed Action. Currently available information indicates that bowheads that use the Alaskan Beaufort Sea and Chukchi Sea Planning Areas are resilient at least to the level of human-caused mortality and disturbance that currently exists, and has existed since the cessation of commercial whaling, within their range. Data indicate that at least some bowheads are extremely long-lived (100+ years or more), and this longevity can affect the potential for a given individual to be exposed to a high number of disturbance and pollution events in its lifetime.

Geographic areas of particular importance to this stock include the spring lead system in both the Chukchi and Beaufort Seas and areas that are used for feeding by large numbers of individuals in some years, but not in all years. However, the importance of feeding in particular areas to the overall food requirements of the population or segments of the population is not clear. Available information indicates that most or much of the total calving of the bowheads, which comprise most of the bowhead whales in the world, occurs during the spring migration in, and adjacent to, the spring lead systems especially in the eastern Chukchi Sea and also in the Beaufort Sea. Bowheads feed in the Alaskan Beaufort Sea, but the extent and location of that feeding varies widely among years and locations. Bowheads are extremely long lived, slow growing, slow to mature, and currently have high survival rates. These characteristics affect their vulnerability to pollution and disturbance in their environment. They are also unique in their ecology and their obligate use of lead systems to transit to summering grounds. This reliance on spring leads, and the fact that they apparently calve during the spring northward migration, also are features of their ecology that heightens their vulnerability to disturbance and oil spills in some areas.

Available new information does not indicate there has been any substantial change in the distribution of this population during the autumn in the Beaufort Sea since NMFS wrote its Biological Opinion in 2001. Recent data on distribution, abundance, or habitat use in the Chukchi Sea are not available, and there is little information about summer use in the Beaufort Sea. We have taken available information into account in the update of our analyses of potential effects on this population.

The MMS has recently prepared a Biological Evaluation (USDOI, MMS, 2006b). Information provided in this section provides, updates and, in some cases, summarizes information from the Beaufort Sea multiple-sale EIS (USDOI, MMS, 2003), the Biological Evaluation for Lease Sale 195, and the EA for Sale 195 (USDOI, MMS, 2004) and supplements this information with more recent information on the Western Arctic stock of the bowhead whale. All available information is considered in our update of our analyses of the potential effects of the Proposed Action on bowhead whales. Additionally, we provide an update of information related to evaluating potential cumulative anthropogenic impacts on this population, as defined under the National Environmental Policy Act (NEPA). As noted in the beginning of this document, we incorporate by reference all information provided previously in the Beaufort Sea multiple-sale final EIS, which provided a detailed evaluation of the bowhead whale and its habitat, the potential effects of three lease sales in the Beaufort Sea Planning Area and related activities on this stock of whales, and an evaluation of cumulative effects on this population stock.

The following are some additional sources of information that have been reviewed for this update of bowhead information. The NOAA and the North Slope Borough (NSB) convened a Workshop on Bowhead Whale Stock Structure Studies in the Bering-Chukchi-Beaufort Seas: 2005-2006 (USDOC, NOAA and NSB, 2005). The Scientific Committee of the IWC reviewed and critically evaluated new information available on the bowhead whale at their 2003 and 2005 meetings (IWC, 2003a, 2005a,b) and conducted an in-depth status assessment of this population in 2004 (IWC, 2004a,b). The MMS published *Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 2002-2004* (Monnett and Treacy, 2005). The report described the yearly distance of bowhead whale sightings from the coast, and specifically calculated the statistical mean value and the 25th and 75th quartile range for the sightings in two survey Regions. The report concludes that mean values for both Regions in all 3 years were within the respective 25th – 75th quartile ranges for all years (1982-2001). The *Final 2003 Alaska Marine Mammal Stock Assessment* (Angliss and Lodge, 2003) for this stock remains the most recent finalized stock assessment available, as no stock assessment was finalized in 2004. There is a revised draft stock assessment for 2005 available for this population (Angliss and Outlaw, 2005). The NMFS published the *Notice of Determination - Endangered and Threatened Species; Final Determination on a Petition to Designate Critical Habitat for the Bering Sea Stock of Bowhead Whales* (67 *FR* 55767). Details on bowheads that might lie outside the scope of the material provided here, in our multiple-sale EIS, or in our EA for proposed Lease Sale 195, may be provided in one or more of these documents. We have reviewed and considered information in these documents and other available information in our evaluation of potential environmental impacts.

IV.B.4.b. Polar Bear. This section contains a summary of the updated information on the polar bear in Appendix D, Section 4.b. The section updates the information in the multiple-sale final EIS, incorporating information from the Sale 195 EA, the seismic-survey PEA, and recent research (USDOI, MMS, 2003, 2004, 2006a).

On February 16, 2005, the CBD petitioned the FWS to list the polar bear as a threatened species under the ESA due to global warming and the melting of their sea ice habitat (CBD, 2005). In June, 2005 the World Conservation Union/Species Survival Commission (IUCN/SSG) Polar Bear Specialist Group (PBSG) concluded that the IUCN Red List classification of the polar bear should be upgraded from Least Concern to Vulnerable, based on the likelihood of an overall decline in the size of the total world polar bear population by more than 30% within the next 35-50 years. The principle reason for this projected decline is "climatic warming and its consequent negative effects on the sea ice habitat of polar bears" (IUCN/PBSG press release, 2005). On February 7, 2006, the 90-day finding by the FWS determined that the CBD petition contained sufficient information indicating that listing polar bears as threatened may be warranted. Therefore, the FWS is conducting a 12-month status review of the species to determine whether listing is warranted; if that finding is positive, the FWS will publish a proposed rule to list the species.

Recent information suggests that the Southern Beaufort Sea (SBS) polar bear population may be smaller than previously estimated. In May, 2006, U.S. Geological Survey (USGS) researchers stated that:

> High recapture rates during capture/recapture studies in 2005 and 2006 suggest that the number of polar bears in the Beaufort Sea region may be smaller than previously estimated. Final analyses of

these new population data will not be completed until early in 2007, but preliminary evaluations of ongoing data collection suggest that conservative management is warranted until final estimates are calculated (S. C. Amstrup and E. V. Regehr, pers. comm.).

Reduction in the summer ice cover in the Beaufort Sea would affect polar bears in several ways. For example, the Sale 195 EA explained that reductions in sea-ice coverage would adversely affect the availability of pinnipeds as prey for polar bears (USDOI, MMS, 2004:Appendix I, Sec. I.2.e(1)). Also, summer sea-ice reduction would affect the severity of storm events along the coast of Alaska, with consequent effects on polar bears. When the ice cover is reduced, particularly during late summer, the available open-water surface increases, and waves are able to grow in height. Specifically, rough weather prevented scouting about one-third of the time that whaling crews were on Cross Island during 2001 (Galginaitis and Funk, 2004:24) and about half of the time during 2003 (Galginaitis and Funk, 2005:18). The unusually rough water that restricted the scouting for whales might have been related to changes in the summer sea-ice cover during recent years, which created an unusually long fetch, as explained in Section IV.A.1. The analysis of long-term data sets indicate substantial reductions in both the extent and thickness of the arctic sea-ice cover during the past 20-40 years, with record minimum extent in 2002 and again in 2005, and extreme minima in 2003 and 2004 (Stroeve et al., 2005; NASA, 2005). Wave heights in the Beaufort Sea typically range from 1.5 meters (m) during summer to 2.5 m during fall, although maximum wave heights of 7-7.5 m are expected (Brower et al., 1988). In fact, a late-summer storm in the Beaufort in September 2000 developed waves 6-7 m high at Point Barrow (Lynch et al., 2003). Such large waves undoubtedly would induce energetic stress, or worse, if any swimming bears were unfortunate enough to be caught in them.

Polar bears are excellent swimmers and swim while actively hunting, while moving between hunting areas, and while moving between sea ice and terrestrial habitats. In June 2005, USGS researchers identified a female polar bear that apparently swam over 557 km, from Norton Sound back to the retreating pack ice in the Beaufort Sea northwest of Wainwright (Amstrup et al., 2006). Swimming is believed to be more energetically costly than walking, which helps explain why bears often will abandon the melting sea ice in favor of land, when ice concentrations drop below 50% (Derocher, Lunn, and Stirling, 2004). Polar bears also may become energetically stressed when the pack ice retreats and carries them to deeper waters beyond the productive continental shelf zone. These bears eventually may choose to swim for shore where annual food resources, such as carcasses of whales killed by Alaskan Natives, can be found along the coast. Despite being strong swimmers, energetically stressed bears are susceptible to misfortune on such long-distance swims. For example, Monnett and Gleason (2006) reported that substantial polar bear mortality may have occurred following a severe storm event in the Beaufort Sea in fall 2004. While acknowledging their limited ability to provide accurate estimates of polar bear mortality during a survey that covered about 10% of their study area, they extrapolated that 27 bears may have died as a result of this one storm; they attributed this phenomenon to longer open-water periods and reduced sea-ice cover. Considering that current human removals of the SBS population are believed to be at or near maximum sustainable levels, it could take polar bears in the SBS from 4-7 years or longer to recover from such mass mortalities (USDOI, FWS, pers. commun.).

Additionally, polar bear use of coastal areas during the fall open-water period has increased in recent years in the Beaufort Sea (Schliebe et al., 2005). In fact, nearshore densities of polar bears were usually two to five times greater in autumn than in summer (Durner and Amstrup, 2000). Aerial surveys flown in September and October from 2000-2005 revealed that 53% of the bears observed along the coast were females with cubs, and that 71% of all bears observed were within a 30-km radius of the village of Kaktovik, on the edge of the Arctic National Wildlife Refuge (ANWR) (USDOI, FWS, pers. commun.). Congregations of more than 60 polar bears and as many as 12 brown bears have been observed feeding on whale carcasses near Kaktovik in recent years during the fall open-water period (Miller, Schliebe, and Proffitt, 2006). These observed changes in polar bear distribution have been correlated with the distance to the pack ice at that time of year. The farther from shore the leading edge of the pack ice is, the more bears are observed onshore in fall (Schliebe et al., 2005).

IV.B.4.c. Other Marine Mammals. This section contains a summary of the updated information presented in Section 4.c of Appendix D. It updates the information on other marine mammals that might be affected by proposed Beaufort Sea Sale 202. The section updates the information in the multiple-sale final EIS, incorporating information from the Sale 195 EA, the seismic-survey PEA, and recent research (USDOI, MMS, 2003, 2004, 2006a). The Sale 195 EA concluded that ringed seals and other ice-dependent pinnipeds were resources of primary concern, partly because of climate change (USDOI, MMS, 2004:Appendix I, Sec. I.2.e(1)). For that reason, special attention has been focused on them.

IV.B.4.c(1) Seals. The only ice-dependent seal in the proposed lease-sale area is the ringed seal. No reliable estimate for the size of the Alaska ringed seal stock is currently available (Angliss and Outlaw, 2005), although past estimates ranged from 1.0 million to 3.6 million (Frost et al., 1988). Because of the absence of a reliable estimate, we summarize some background information. Ringed seal numbers are considerably higher in the Bering and Chukchi seas, particularly during winter and early spring (71 *FR* 9783). They are closely associated with ice and have the unique ability to maintain breathing holes in thick ice; therefore, they are able to exploit the ice-covered parts of the Arctic during the winter when most other marine mammals have migrated south (Rosing-Asvid, 2006).

In winter and spring, the highest densities of ringed seals are found on stable shorefast ice. In the summer, ringed seals often occur along the receding ice edges or farther north in the pack ice. Ringed seals seem to prefer large icefloes >48 m in diameter and often are found in the interior pack ice, where sea ice concentrations exceed 90% (Simpkins et al., 2003). Ringed seal densities in the Beaufort Sea are greatest in water with >80% ice cover (Stirling, Kingsley, and Calvert, 1981) and depths between 5 and 35 m (Frost et al., 2004). Densities also are highest on relatively flat ice and near the fast-ice edge, declining both shoreward and seaward of that edge (Frost et al., 2004). Ringed seal densities historically have been substantially lower in the western than the eastern part of the Beaufort Sea (Burns and Kelly, 1982; Kelly, 1988). The lower densities to the west appear to be related to very shallow water depths in much of the area between the shore and barrier islands. Surveys flown from 1996-1999 indicate that the highest density of seals along the central Beaufort Sea coast in Alaska occurred from approximately Kaktovik west to Brownlow Point (Frost et al., 2004). This may be due to the fact that relative productivity, as measure by zooplankton biomass, is approximately four times greater there than the average biomass in other areas of the eastern Beaufort Sea (Frost et al., 2004). Additional information on ringed seal, and on other Beaufort Sea seal species that are not ice-dependent, is included in Appendix D.

IV.B.4.c(2) Pacific Walrus. Pacific walruses range throughout the shallow continental shelf waters of the Bering and Chukchi seas, where their distribution is closely linked with the seasonal distribution of the pack ice. The juxtaposition of broken ice over relatively shallow continental shelf waters is important to them for feeding, particularly for females with dependent young that may not be capable of deep diving or long-term exposure to the frigid water. Considering this, the recent observations of nine motherless calves stranded on icefloes in deep waters off of northwest Alaska are troubling (Cooper et al., 2006). Recent trends in seasonal sea-ice breakup have resulted in seasonal sea-ice retreating off the continental shelves and over deep Arctic Ocean waters. This trend poses adaptive challenges for the walrus population (Tynan and DeMaster, 1997). In contrast, adult males generally abandon the sea ice in spring for coastal haulouts in Bristol Bay and Gulf of Anadyr (Jay and Hills, 2005). The Chukchi Sea west of Barrow is the northeastern extent of the main summer range of the walrus; few are seen farther east in the Beaufort Sea (e.g., Harwood et al., 2005). Those observed in the Beaufort Sea typically are lone individuals. No reliable estimate for the size of the Alaska Pacific walrus stock is available (Angliss and Outlaw, 2005), although the FWS is launching a substantial effort to produce a more precise abundance estimate of Pacific walrus. Results from these survey efforts should be available in 2007 (USDOI, FWS, 2006b). The population size has never been known with certainty, although the most recent survey estimate was approximately 201,039 animals (Gilbert et al., 1992). Walrus are benthic feeders, and prefer areas <80 m deep (Fay, 1982). In a recent study, 98% of satellite locations of tagged walruses in Bristol Bay were in water depths of 60 m or less (Jay and Hills, 2005). Walrus most commonly feed on bivalve mollusks (clams), but they also will feed on other benthic invertebrates (e.g., snails, shrimp, crabs, worms). Pacific walrus are an important subsistence species for Alaskan Native hunters. The number of walrus taken annually has varied over the years, with recent harvest levels much lower than historic highs. Based on harvest data from Alaska and Chukotka in the years 2001-2005, mean harvest mortality levels are estimated at 5,458 animals per year (USDOI, FWS, 2006b).

IV.B.4.c(3) ***Beluga Whales.*** Beluga whales are found throughout the arctic and subarctic waters of the Northern Hemisphere. In Alaska there are five recognized stocks: (1) Eastern Chukchi Sea; (2) Beaufort Sea; (3) Cook Inlet; (4) Bristol Bay; and (5) Eastern Bering Sea (O'Corry-Crowe et al., 1997). Within the Proposed Action area, only the Beaufort Sea stock and eastern Chukchi Sea stocks are present. The NMFS has set the minimum population estimate for the Beaufort Sea beluga whale stock at 32, 453 and the total corrected abundance estimate for the eastern Chukchi Sea stock at 3,710 (Angliss and Outlaw, 2005). Beluga whales of both stocks winter in the Bering Sea and summer in the Beaufort and Chukchi seas, migrating around western and northern Alaska (Angliss and Outlaw, 2005). The majority of belugas in the Beaufort stock migrate into the Beaufort Sea in April or May, although some whales may pass Point Barrow as early as late March and as late as July (Braham et al., 1984; Ljungblad et al., 1984; Richardson et al., 1995). Belugas of the eastern Chukchi stock satellite tagged in the eastern Chukchi Sea in summer traveled 1,100 km north of the Alaskan coastline and to the Canadian Beaufort Sea within 3 months of tagging (Suydam et al., 2001), indicating extensive stock overlap with the Beaufort Sea stock. Belugas are rarely seen in the central Alaskan Beaufort Sea during the summer. They are strongly associated with the ice (Burns, Shapiro, and Fay, 1981), and prefer areas with moderate to high ice cover (54-66%) (Moore and DeMaster, 1997).

IV.B.4.c(4) ***Gray Whales.*** There are two stocks of gray whale recognized in the North Pacific: the eastern north Pacific stock, which lives along the west coast of North America and the western north Pacific stock, which lives along the coast of eastern Asia (Angliss and Lodge, 2005). The latest abundance estimate for the eastern north Pacific stock is 18,178 individuals (Rugh et al., In press, as cited in Angliss and Outlaw, 2005). The NMFS has provided a minimum population estimate of 17,752 (Angliss and Outlaw, 2005). Federal protection under the ESA was removed in 1994, and further evaluation determined that the stock was neither in danger of extinction nor likely to become endangered in the foreseeable future (Rugh et al., 1999). Gray whales are bottom feeders, sucking sediment from the seafloor. Their primary prey is amphipods, although other food items are ingested. Although gray whales probably feed opportunistically throughout their range, they return annually to primary feeding areas in the northern Bering Sea and Chukchi Sea (e.g., Nerini, 1984; Moore et al., 1986; Weller et al., 1999). Only a small number of gray whales enter the Beaufort Sea east of Point Barrow, though in recent years, ice conditions around Barrow have become lighter and gray whales may have become more common there. In fact, Moore et al. (2006) reported that Native hunters have noticed increasing numbers of gray whales near Barrow in the late summer and autumn, which may indicate a northward shift in the distribution of this species. Gray whale calls also were recorded each month from October 2003 through May 2004 northeast of Barrow, indicating that some whales did not migrate to California as expected (Moore et al., 2004). This extended occurrence of gray whales in the Beaufort Sea complements observations of feeding whales moving north from the Bering Sea to the Chukchi Sea in summer (Moore, Grebmeier, and Davies, 2003), and may be indicative of marine ecosystem changes occurring in the North Pacific. For example, Moore, Grebmeier, and Davies (2003) suggested that gray whale use of the Chirikov Basin has decreased, likely as a result of the combined effects of changing currents and a downturn in amphipod productivity.

Additional information on the above species, and on other marine mammals, is included in Appendix D.

IV.B.4.d. Fishes and Essential Fish Habitat. This section is a summary of the information presented in Appendix D, Section D.4. It updates the information on fishes and Essential Fish Habitat (EFH) that might be affected by proposed Beaufort Sea Lease Sale 202. The section updates the information in the multiple-sale final EIS and Sale 195 EA (USDOI, MMS, 2003, 2004). As summarized in the EIS, the marine coastal environment of the Beaufort Sea consists of inlets, lagoons, bars, and numerous mudflats. During the open-water season, the nearshore zone of this area is dominated by a band of relatively warm, brackish water that extends across the entire Beaufort Sea coast. It is formed after breakup by freshwater input from rivers such as the Ikpikpuk, the Colville, the Sagavanirktok, and the Canning. The summer distribution and abundance of coastal fishes (marine and migratory species) is strongly affected by this band of brackish water. The band typically extends 1-6 mi offshore and contains more abundant food resources than waters farther offshore.

The information in the multiple-sale final EIS and the Sale 195 EA is augmented by a summary in the seismic-survey PEA (USDOI, MMS, 2006a). Only two of the updated PEA descriptions will be summarized here, because the entire PEA is available on the MMS web site at: http://www.mms.gov/alaska/ref/pea_be.htm.

We have updated information about recent evidence of the effect of the changing ice cover on arctic fish and about the few commercial fisheries in the Alaskan Beaufort Sea and, therefore, the few species covered by fishery-management plans in these waters.

Distribution and Abundance Trends of EFH Pacific Salmon in the Alaskan Beaufort Sea. The literature largely treats the Beaufort Sea as a population sink for Pacific salmon, in some cases suggesting that none of the salmon species have established sustained populations in waters east of Point Barrow (Bendock and Burr, 1984). Many reports describe salmon as "straying" into the Beaufort Sea (Craig and Halderson, 1986) or comprising only a few isolated spawning stocks of pink and chum salmon (Craig and Halderson, 1986; Fechhelm and Griffiths, 2000). The occurrence of pink and chum salmon in arctic waters probably is due to their relative tolerance of cold water temperatures and their predominantly marine life cycle (Craig and Halderson, 1986, citing Salonius, 1973). The expansion of chinook, sockeye, and coho salmon into the Arctic appears restricted by cold water temperatures, particularly in freshwater environments (Craig and Halderson, 1986). However, the recent range extensions of pink, sockeye, and chum salmon in the Canadian Arctic, as described by Babaluk et al. (2000), indicate that some Pacific salmon may be expanding their distribution in arctic waters, and possibly their abundance as well. Babaluk et al. (2000) also note that large temperature increases in arctic areas as a result of climate warming may result in greater numbers of Pacific salmon in the area.

Because Pacific salmon appear to be expanding their range eastward and northward in the Canadian Beaufort Sea, it is reasonable to expect that Pacific salmon are expanding their distribution in the Chukchi Sea and that their populations may be increasing in both the northeastern Chukchi Sea and western Beaufort Sea.

Further information on fish and EFH is summarized in Appendix D. Information on current distribution and abundance (e.g., density per square kilometer) estimates, age structure, population trends, or habitat use areas are not available or are outdated for fish populations in the western Beaufort Sea. For example, it is not known if the findings of Frost and Lowry (1983) still accurately portray the diversity and abundance of demersal fishes in the Alaskan Beaufort Sea. Another important data gap is the lack of information concerning discrete populations for arctic fishes using modern scientific methods. Although Pacific salmon are known to occur in the region, studies directed at investigating their population dynamics, migration, and habitat use are nonexistent.

IV.B.4.e. Other Resources. This section updates the information on local air quality, archaeological resources, and additional resources.

IV.B.4.e(1) Local Air Quality. As explained in the summary of air quality in the seismic-survey PEA (USDOI, MMS, 2006a), the combination of limited industrial development and low population density results in good to excellent air quality throughout the Beaufort Seas area. Only a few small, scattered emissions from widely scattered sources exist on the adjacent onshore areas. The only major local sources of industrial emissions are in the Prudhoe Bay/Kuparuk/Endicott oil-production complex. However, during the winter and spring, additional pollutants are transported by the wind to the Alaska Arctic Ocean from industrial sources in Europe and Asia (Rahn, 1982). These pollutants cause a phenomenon known as arctic haze.

The Environmental Protection Agency (USEPA) defines Air Quality Control Regions (AQCR's) for all areas of the United States and designates classifies them based on six "criteria pollutants," and has established for each of them a maximum concentration above which adverse effects on human health may occur. These threshold concentrations are called National Ambient Air Quality Standards (NAAQS). When an area meets NAAQS, it is designated as an "attainment area." An area not meeting air quality standard for one of the criteria pollutants is designated as a "nonattainment area."

Areas are designated "unclassified" when insufficient information is available to classify areas as attainment or nonattainment. All areas in and around the Chukchi and Beaufort seas are classified as attainment areas.

The provisions of Alaska's Prevention of Significant Deterioration (PSD) program are applied to attainment areas and unclassified AQCR's with good air quality to limit its degradation from development activities. The areas are classified as PSD Class I, II, or III areas (in decreasing order of relative protection) based on land status/use and the associated protection afforded to the area. The region of Alaska adjacent to the Chukchi and Beaufort seas is a PSD Class II area. The nearest PSD Class I area is the Denali National Park. There are no Class III areas in Alaska. States strive to allow industrial and commercial growth within PSD Class II areas without causing significant degradation of existing air quality or exceeding the NAAQS.

IV.B.4.e(2) Archaeological Resources. This is a summary of the updated information in presented Appendix D. "Archaeological resources" can be defined as "any prehistoric or historic district, site, building, structure, or object [including shipwrecks].... Such term includes artifacts, records, and remains which are related to such a district, site, building, structure, or object" (National Historic Preservation Act, Sec. 301[5] as amended, 16 U.S.C. 470W[5]). Important archaeological resources are either historic or prehistoric and generally include properties older than 50 years that: (1) are associated with events that have made a definite contribution to the broad patterns of our history; (2) are associated with the lives of important persons in the past; (3) embody the distinctive characteristics of a type, period, or method of construction; (4) represent the work of a master; (5) possess high artistic values; (6) present an outstanding and distinguishable entity whose components may lack individual distinction; or (7) have yielded, or may be likely to yield, information important in history. These resources represent the remains of the material culture of past generations of the region's prehistoric and historic inhabitants. They are basic to our understanding of the knowledge, beliefs, art, customs, property systems, and other aspects of the nonmaterial culture. The two major locational categories and two major time sequences of archaeological resources identified in the Sale 202 area are, respectively, offshore/onshore and prehistoric/historic. Archaeological resources in the Beaufort Sea region that may be impacted by the Proposed Action, primarily from ocean-bottom cable seismic surveys and/or the drilling of exploration wells, include historic shipwrecks, aircraft, and inundated prehistoric sites offshore. A more extensive discussion of archaeological resources can be found in the seismic-survey PEA (USDOI, MMS, 2006a). The PEA is available on the MMS web site at: http://www.mms.gov/alaska/ref/pea_be.htm.

IV.B.4.e(3) Additional Resources. This section updates some recent findings on terrestrial mammals and lower trophic-level organisms. There is no new information on caribou and other terrestrial mammals that would alter the analysis of potential effects of OCS operations on them. With regard to lower trophic-level organisms, the distribution of phytoplankton chlorophyll-a (chl-a) in the Beaufort Sea was illustrated with satellite images in the multiple-sale final EIS (USDOI, MMS, 2003:Figs. III.B-1a and III.B-1b). The final EIS explained that the images show the "greenness" of the water, and that chl-a was highest in the coastal water. That explanation is confirmed and augmented by a recent study of many satellite images from the summers 1998-2004 (Mizobata and Wang, 2006). The investigators confirm that chl-a was highest during 1998 in a stable surface layer near the Mackenzie River Delta. The investigators observed a gradual extension of the high chl-a concentrations westward from the Mackenzie through the proposed lease area during the summers of 1999, 2000, and 2001. The investigators describe also the low chl-a concentrations in offshore waters, except for upwelling events in the Barrow Canyon during 2003. In summary, the chl-a concentrations indicate that production is highest in coastal water near river deltas, and typically is low in offshore waters.

Grebmeier et al. (2006) observed some changes in the planktonic food webs, which they relate to the changing ice cover. In the past, the ice cover has delayed the spring phytoplankton bloom, causing it to be intense for a short duration. As a result, the bloom was not grazed efficiently by zooplankton, and much of the phytoplankton organic matter sank to the seafloor. Many of the higher trophic-level consumers that were abundant in the marginal ice zone were benthic feeders. Recent changes in the ice cover have resulted in a bloom over a longer period of time that is not as intense. The planktonic production is grazed more efficiently by pelagic consumers such as fish, making them more like pelagic food webs in the Bering Sea.

IV.B.5. Environmental Justice. Environmental Justice analysis began with President Clinton's February 11, 1994, Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, and an accompanying Presidential memorandum. The EO requires each Federal Agency to make the consideration of Environmental Justice part of its mission. Its intent is to promote fair treatment of people of all races, so no person or group of people shoulders a disproportionate share of the negative environmental effects from this country's domestic and foreign programs. It focuses on minority and low-income people. However, the USEPA defines environmental justice as the "equal treatment of all individuals, groups or communities regardless of race, ethnicity, or economic status from environmental hazards" (U.S. Department of Energy, 1997; USEPA, 2006). Specifically, EO 12898 requires an evaluation as to whether the proposed project would have "disproportionately high adverse human health and environmental effects...on minority populations and low income populations." The EO also includes consideration of potential effects to Native subsistence activities and, to this end, MMS continues to maintain a dialogue on Environmental Justice with local communities in this region.

Since 1999, all MMS public meetings have been conducted under the auspices of Environmental Justice and the concerns of Inupiat residents, and discussions about mitigation are conducted. Environmental Justice-related concerns are taken back to MMS management and incorporated into environmental study designs and new mitigating measures.

Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments*, requires Federal Agencies to consult with tribal governments on Federal matters that significantly or uniquely affect their communities. In January 2001, a USDOI Alaska Regional Government-to-Government policy was signed by all the USDOI Alaska Regional Directors, including the MMS.

The Inupiat People of the NSB have made MMS aware of the potential burden of participating in too many planning and public meetings. Therefore, MMS has taken measures to plan more carefully the number and timing of meetings with regional tribal groups and local governments. The following three aspects of the Inupiat's demographics and culture relate particularly to Environmental Justice: race, income, and consumption of fish and game.

IV.B.5.a. Race. Alaska Inupiat Natives, a recognized minority, are the predominant residents of the NSB and the Northwest Arctic Borough (NWAB), which make up the Alaska regional governments in the project area. The 2000 Census counted 7,385 persons resident in the NSB; 5,050 identified themselves as American Indian and Alaskan Native, for a 68.38% indigenous population. In the NWAB, the 2000 Census counted 7,288 persons, 5,944 identified themselves as American Indian and Alaskan Native, for an 82.5% indigenous population (USDOC, Bureau of the Census, 2000).

Inupiat Natives are the only minority population allowed to conduct subsistence hunts for marine mammals in the region and, in potentially affected Inupiat communities, there are no substantial numbers of "other minorities." Additionally, "other minorities" would not be allowed to participate in subsistence marine mammal hunts and, therefore, would not constitute a potentially affected minority population (North Slope Borough, 1999).

Because of the NSB and NWAB's homogenous Inupiat population, it is not possible to identify a "reference" or "control" group within the potentially affected geographic area, for purposes of analytical comparison, to determine if the Inupiat are affected disproportionately. This is because a nonminority group does not exist in a geographically dispersed pattern along the potentially affected area of the NSB and the NWAB.

IV.B.5.b. Income. The U.S. average median household income in 2000 was $42,148, and the U.S. average per-capita income was $29,469. The Alaskan average median household income in 2000 was $50,746, and the Alaska average per-capita income was $29,642. The average NSB median household income ($63,173) was above State and national averages, but the average per-capita income ($20,540) was below the State and national averages. The median household incomes in all subsistence-based communities in the Borough were above State averages except Nuiqsut ($48,036), and all were above national averages. Per-capita incomes in all these communities were below State and national averages. The average NWAB median household income ($45,976) was below the State average but above the national average, but the average per-capita income ($15,286) was below State and national averages. The median household incomes of the subsistence-based communities of Kivalina ($30,833), Buckland ($38,333), and Deering ($33,333) were below State and national averages, and those for Kotzebue ($57,163) and Noorvik ($51,964) were above. Per-capita incomes in all these communities were below State and national averages.

Low income commonly correlates with Native subsistence-based communities in coastal Alaska; however, subsistence-based communities in the region qualify for Environmental Justice analysis based on their racial/ethnic minority definitions alone (USDOC, Bureau of the Census, 2000, 2002). The poverty-level threshold for a family of four, based on the U.S. Census Bureau, 2000 Survey data, is $17,761. Low income is defined by the U.S. Census Bureau as 125% of the poverty level or $22,201. Median household incomes for the NSB and the NWAB fall well above the Census Bureau threshold for low income. The 2000 Census "tiger" files (files from the U.S. Census' Topologically Integrated Geographic Encoding and Referencing [TIGER] database) identify no nonsubsistence-based coastal communities in the NSB and the NWAB with median household incomes that fall below the low income threshold.

IV.B.5.c. Consumption of Fish and Game. As defined by the NSB Municipal Code, subsistence is "an activity performed in support of the basic beliefs and nutritional need of the residents of the borough and includes hunting, whaling, fishing, trapping, camping, food gathering, and other traditional and cultural activities" (State of Alaska, 1997). This definition gives only a glimpse of the importance of the practice of the subsistence way of life in Inupiat culture, but it does underscore that it is a primary cultural and nutritional activity on which Native residents of the North Slope depend. For a more complete discussion of subsistence and its cultural and nutritional importance, see Appendix D, Sections 1 and 5.

IV.B.6. Land Use Plans and Coastal Zone Management.

This section contains a summary of the detailed information presented in Appendix D, Section 6.

IV.B.6.a. Land Use Plans. Revisions during 2005 to the documents addressing land use in the NSB include the NSB Comprehensive Plan (NSBCP) and the NSB Coastal Management Program (NSBCMP). The revisions to the NSBCP simplified the regulatory process but did not alter the basic premise of the comprehensive plan, which is to preserve and protect the land and water habitat essential to the subsistence character of Inupiat life. The revisions to the NSBCMP are explained in the following.

IV.B.6.b. Alaska Coastal Management Program. The State of Alaska recently amended its Alaska Coastal Management Plan (ACMP) program and adopted new regulations under Title 11, Alaska Administrative Code (AAC), Chapters 110, 112, and 114. The State regulations became effective on October 29, 2004. On December 29, 2005, the USDOC, NOAA, Office of Ocean and Coastal Resource Management (OCRM), completed its review and approved the amendments to the ACMP, finding that the amended ACMP meets all requirements of the Coastal Zone Management Act (CZMA).

Under the amended ACMP, all coastal districts including the North Slope Borough must revise their local plans to conform to the new Statewide standards. A district's existing coastal management program, including its enforceable policies, remains in effect until March 1, 2007, unless the Department of Natural Resources (ADNR) disapproves or modifies all or part of the district's program before March 1, 2007. However, any existing district-enforceable policy that duplicates, restates, or incorporates by reference a statute or regulation of a Federal or State agency or addresses any matter regulated by the Department of Environmental Conservation (ADEC) are repealed and declared null and void under State law. Consequently, while the existing NSBCMP remains in effect, some of the enforceable policies may no longer apply under the amended ACMP.

The amended Statewide standards that may be relevant to hypothesized sale activities include: (1) coastal development; (2) natural hazard areas; (3) coastal access; (4) energy facilities; (5) utility routes and facilities; (6) sand and gravel extraction; (7) subsistence; (8) transportation routes and facilities; (9)

habitats; (10) air, land, and water quality; and (11) historic, prehistoric, and archaeological resources. With a few exceptions, the amended Statewide standards are similar to the old standards under which OCS Sales 187 and 195 were conducted.

Under the amended ACMP, several of the Statewide policies first require that an area be designated before any enforceable policies can be established to protect the resource. For example, the subsistence policy requires a designation of an area in which subsistence is an important use of coastal resources. Once designated, a Federal OCS project affecting a subsistence-use area would need to avoid or minimize impacts to subsistence uses. Another example is the policy addressing historic, prehistoric, and archaeological resources, which requires the designation of areas of the coastal zone that are important to the study, understanding, or illustration of national, State, or local history or prehistory, including natural processes. A Federal OCS project affecting a properly designated historic area would need to comply with the applicable requirements of AS 41.35.010-41.35.240 and 11 AAC 16.010-11 AAC 16.900. Districts also may designate areas for recreation, tourism, important habitats, or commercial fishing, or areas where natural hazards are an important consideration, or areas appropriate for the development of major energy facilities. The amended ACMP also defers to the mandates and expertise of ADEC to protect air, land, and water quality. The standards incorporate ADEC's statutes, regulations, and procedures.

There currently are no designated areas on the North Slope, although the ADNR has the authority to designate areas as part of a coastal project consistency review. In conclusion, because the amended Statewide standards are similar to the old standards, no conflicts with the amended Statewide standards or with the enforceable policies of the NSBCMP are anticipated.

IV.B.7. Summary of Sections IV.A and IV.B. Overall, parts of the Beaufort Sea environment have continued to change since preparation of the multiple-sale EIS. For example, the summer Arcticwide ice cover has continued to decrease, now at a rate of about 10% per decade (Sec. IV.A.1). The resources that are dependent on summer and autumn ice cover also have changed. The Sale 195 EA predicted that more polar bears might be forced to stay onshore during summer, and recent observations confirm that more are staying onshore during the autumn (Sec. IV.B.2.d(2)). In contrast, no substantial changes have been observed in either anadromous fish or marine and coastal birds (Secs. IV.B.2.b and d(3)(b)). Further, the MMS monitors the bowhead whale migration yearly via aerial surveys; the most recent survey report concludes that bowhead sightings were within the normal historical range from the coast (Sec. IV.B.2.d(1)). Similarly, the Beaufort stock of ringed seals, which are dependent on the ice cover during spring (as opposed to summer and autumn), appear to be within their normal historical range (Sec. IV.B.2.d(3)(a)(1)).

IV.C. Updated Effects of the Proposed Action.

This section updates the assessments in the multiple-sale final EIS and the Sale 195 EA. The Proposed Action is Alternative VII; this is the Area of Call, excluding the Barrow and Kaktovik Deferral Areas (see Sec. III.B). The effects are updated in the context of current environmental situation, including the leasing in Sale 195.

IV.C.1. Impact Significance Criteria and Major Findings. The following section specifies the impact criteria and the major findings of the detailed assessments that are contained in following Section IV.C.2.

IV.C.1.a. Impact Significance Criteria. As stated above, this EA updates the assessments in the multiple-sale EIS, so the significance criteria are those in the EIS. The MMS recently published the *Programmatic Environmental Assessment, Arctic Ocean Outer Continental Shelf Seismic Surveys – 2006* (USDOI, MMS, 2006a), which is available on the MMS web site at: http://www.mms.gov/alaska/ref/pea_be.htm. Because the assessed operation was more specific in scope and duration than those assessed in the multiple-sale EIS, plus the Sale 195 EA and this update for proposed Lease Sale 202, the seismic assessment used a more specific significance threshold than those used for lease-sale assessments. In the near future, we intend to meet with other regulatory agencies to discuss further the significance criteria used in all MMS NEPA documents.

The significance criterion is slightly different for each of these resources, as explained in the multiple-sale final EIS (USDOI, MMS, 2003:Sec. IV.A.1). Specifically, we have defined a "significance threshold" for each resource category as a level of effect that equals or exceeds the adverse changes indicated in the following impact situations:

- **Subsistence-Harvest Patterns:** One or more important subsistence resources would become unavailable, undesirable for use, or available only in greatly reduced numbers for a period of 1-2 years.
- **Sociocultural Systems:** Chronic disruption of sociocultural systems occurs for a period of 2-5 years, with a tendency toward the displacement of existing social patterns.
- **Biological Resources (seals, walrus, beluga whale, polar bear, marine and coastal birds, terrestrial mammals, lower trophic-level organisms, fishes, essential fish habitat, and vegetation and wetlands):** An adverse impact that results in an abundance decline and/or change in distribution requiring three or more generations for the indicated population to recover to its former status, and one or more generations for polar bears.
- **Threatened and Endangered Species (bowhead whale, spectacled and Steller's eiders):** An adverse impact that results in a decline in abundance and/or change in distribution requiring one or more generation for the indicated population to recover to its former status.
- **Water Quality:** A regulated contaminant is discharged into the water column, and the resulting concentration outside a specified mixing zone is above the acute (toxic) State of Alaska standard or Environmental Protection Agency criterion more than once in a 1-year period and averages more than the chronic State of Alaska Standard or Environmental Protection Agency criterion for a month.
    1. Turbidity exceeds 7,500 parts per million suspended-solid concentration outside the mixing zone specified for regulated discharges more than once in a 3-year period and averages more than chronic State standards or environmental Protection Agency criteria for a month.
    2. The accidental discharge of crude or refined oil in which the total aqueous hydrocarbons in the water column exceeds 1,500 micrograms per liter (1.5 parts per million; the assumed acute [toxic] criteria) for more than 1 day and 15 micrograms per liter (0.015 parts per million; the assumed [chronic] criteria) for more than 5 days.
    3. Violations would be caused by exceeding an effluent limit or creating an oil sheen. The accidental discharge of a small volume of crude or refined oil also might cause an adverse impact and could result in concentrations of hydrocarbons that are greater than the acute criteria in a local area (less than 1 square mile) for less than a day and concentrations that are greater than the chronic criteria in a larger area (less than 100 square miles) for fewer than 5 days. However, an action of violation or accidental discharge of a small volume crude or refined oil would not necessarily constitute a significant environmental impact as defined in 40 CFR 1508.27.
- **Archaeological Resources:** An interaction between an archaeological site and an effect-producing factor occurs and results in the loss of unique, archaeological information.
- **Air Quality:** Emissions cause an increase in pollutants over an area of at least a few tens of square kilometers that exceeds half the increase permitted under the Prevention of Significant Deterioration criteria or the National Ambient Air Quality Standards for nitrogen dioxide, sulfur dioxide, or particulate matter less than 10 microns in diameter; or exceeds half the increase permitted under the National Ambient Air Quality Standards for carbon monoxide or ozone.
- **Environmental Justice:** The significance threshold for Environmental Justice would be disproportionate, high adverse human health or environmental effects on minority or low-income populations. This threshold would be reached if one or more important subsistence resource becomes unavailable, undesirable for use, or available only in greatly reduced numbers for a period of 1-2 years; or chronic disruption of sociocultural systems occurs for a period of 2-5 years, with a tendency toward the displacement of existing social patterns.

Tainting of subsistence foods from oil spills and contamination of subsistence foods from pollutants would contribute to potential adverse human-health effects.

For the assessment, MMS has determined that the appropriate approach for assessing "Significance of Potential Impacts" is to consider and evaluate effects on the regional (North Slope/Arctic) populations of nonendangered species. The multiple-sale EIS (USDOI, MMS, 2003) described and evaluated biological populations at that level, and MMS believes that such level of population analysis is still appropriate for this EA. In some instances, potential effects may be identified for a specific species at a specific location(s). While effects on a particular species at a specific location may be locally measurable and perhaps disproportionately high compared to adjacent areas, the conclusion of each NEPA effects assessment herein will be in reference to the regional population of the species of concern.

IV.C.1.b. Major Findings. The following section summarizes the major findings for each resource in light of the new information. The detailed updates of the multiple-sale assessments for the Proposed Action are contained in Section IV.C.2.

IV.C.1.b(1) Subsistence-Harvest Patterns and Sociocultural Systems. As explained in Section IV.C.2.a., the conclusions and definitions about subsistence and sociocultural resources remain appropriate in the context of the new information that has become available since publication of the multiple-sale EIS and the Sale 195 EA. The conclusion about oil-spill and seismic-disturbance effects on subsistence and sociocultural systems that was reached for Sale 202 in the multiple-sale EIS does not change in the context of the new information. Seismic activity in the Beaufort Sea will need to continue mitigation defined by conflict avoidance measures between subsistence whalers and the oil industry. In the unlikely event of a large oil spill, there would be potentially significant effects on subsistence–harvest patterns and sociocultural systems. Potential long-term impacts from climate change would be expected to exacerbate overall potential effects on sociocultural systems.

IV.C.1.b(2) Marine and Coastal Birds. As explained in Section IV.C.2.b, for purposes of analysis, the multiple-sale EIS assessed the effects of an accidental oil spill, assuming that a spill of 1,500 bbl or 4,600 bbl could occur as a result of the three proposed sales. This review of new information confirms that document's conclusions that mortality of fewer than 100 spectacled eiders, low hundreds of king and common eiders, 1,000 or more long-tailed ducks, and few Steller's eiders could result from such a spill. The magnitude of the effect would vary with spill volume, location with respect to bird concentrations, the spill response, and ice conditions. However, such losses would represent biologically significant effects in the case of these species, as noted in the multiple-sale EIS, and recovery of their Alaskan populations is not likely to occur for species currently exhibiting a decline (i.e., all but the king eider). While an oil spill under certain conditions would result in a potentially significant effect to spectacled and Steller's eiders, the coincidence of all the factors that would have to occur simultaneously to result in such an impact to spectacled eiders is improbable. Thus, we concluded that potentially significant impacts to spectacled and Steller's eiders are not anticipated. The FWS, in their 2002 Biological Opinion (reaffirmed in May 2006), concurred that an appreciable reduction in the likelihood of survival and recovery of spectacled eiders is not reasonably certain to occur. There is no suggestion in recent study results that disturbance effects or potential mortality of eiders, long-tailed ducks, or other species from collisions with structures associated with activities following Sale 202 would exceed the small losses estimated for Sales 186 and 195, and none of these factors are expected to result in significant effects. In the context of new information that has become available since publication of the multiple-sale EIS, these conclusions remain consistent; thus, the updated potential level of effect on marine and coastal bird populations is expected to be the same as stated in the multiple-sale EIS.

IV.C.1.b(3) Local Water Quality. As explained in Section IV.C.2.c, in spite of the standard mitigation, the new information on water quality and spill responses indicates that the conclusion in the multiple-sale EIS is still appropriate, primarily because of the low level of turbulence in Beaufort ice-covered waters and partly because of the difficulty of spill responses during the broken-ice season. Specifically, a spill of 1,500 bbl or 4,600 bbl in the proposed lease area still would lead to hydrocarbon concentrations in the surface water in excess of the 1.5 parts per million (ppm) acute toxic criteria during the first day in a local area, and in excess of the 0.015 ppm chronic criteria for up to a month in an area the size of a small bay. This is a refinement of the conclusion in the multiple-sale EIS and is not about a new level of effect.

IV.C.1.b(4) Bowhead Whale. As explained in Section IV.C.2.d, The updated Oil-Spill Risk Analysis (OSRA) shows specifically that the probability of a spill has increased slightly, but that the chance that spills would occur and contact the Beaufort Spring Lead still is <1%. The overall level of effect of accidental spills and of permitted exploration drilling and other operations is summarized by NMFS in the Arctic Region Biological Opinion (ARBO) which they updated during June 2006 (Appendix E). The NMFS' ARBO concludes in Sections VI and VII that:

> After reviewing the current status of the bowhead whale, the environmental baseline for the action area, the biological and physical impacts of oil leasing and exploration, and cumulative effects, and in consideration that the described actions are expected to impact only the Western Arctic stock of bowhead whales, it is NMFS's biological opinion that oil and gas leasing and exploration in the Chukchi and Beaufort Seas is not likely to jeopardize the continued existence of the *Balaena mysticetus* endangered bowhead whale. No critical habitat has been designated for the bowhead whale, therefore none will be affected.
>
> Taking these factors into consideration, NMFS concludes that, at this time, there is reasonable likelihood that oil and gas development and production in the Alaska Beaufort and Chukchi Seas, as described, would not violate section 7(a)(2) of the ESA.

We conclude similarly that, based on our consideration of information available since the publication of the EIS and of previously available information, our reanalysis of potential effects for bowhead whales supports the conclusion that no significant impacts to this endangered species are expected due to activities associated with proposed Lease Sale 202, including the effects of an assumed oil spill.

IV.C.1.b(5) Polar Bear. As explained in Section IV.C.2.e, reducing the concentrations of polar bears on shore in the fall would be the most effective way to mitigate potential oil-spill impacts. This could be accomplished by removing the remains of Native-harvested whales from the beaches outside of Kaktovik and Barrow. However, the whale remains are on Native-owned lands; thus, that decision will have to be negotiated with the Native communities. The FWS and USGS scientists have been advocating this approach for some time and are very aware of the benefits of discouraging concentrations of polar bears on land in the fall. Discouraging congregations of polar bears on land during the fall open-water period, by properly disposing of Native-harvested whale carcasses, would lower substantially the potential impacts to polar bears and enhance the effectiveness of mitigation. Further, if mitigation such as prestaging oil-spill-response equipment and training response crews in Kaktovik and Barrow were adopted, the level of effect on polar bears would be further moderated.

In summary, documented impacts to polar bears to date in the Beaufort Sea by the oil and gas industry appear minimal. Due primarily to increased concentrations of bears on parts of the coast, the relative oil-spill risk to the population has increased since preparation of the multiple-sale EIS. Close cooperation among MMS, the FWS, and OCS operators, in addition to the standard stipulations and proposed new mitigation in Section III.C, will help to ensure that the level of risk does not increase. Therefore, our overall finding is that the Proposed Action with existing MMS operating regulations, the standard mitigating measures, and the proposed new Information to Lessees (ITL's) in Section III.C.2, would moderate the spill risk.

IV.C.1.b(6) Other Marine Mammals. As explained in Section IV.C.2.f, our review of new information on pinnipeds and beluga and gray whales for this EA confirms the multiple-sale EIS conclusion that "no significant effects are anticipated from routine permitted activities" as a result of proposed Sale 202; and that a large oil spill would affect perhaps 100-200 ringed seals, probably fewer than 10-20 spotted and 30-50 bearded seals, fewer than 100 walruses, and fewer than 10 beluga and gray whales, with populations recovering within about 1 year. This EA concludes that no new impact to pinnipeds, belugas, or gray whales was identified for the proposed sale that was not already assessed in the multiple-sale EIS. In the context of new information that has become available since publication of the multiple-sale EIS, these conclusions remain consistent; thus, the updated potential level of effect on pinniped and beluga and gray whale populations is expected to be about the same as stated in the multiple-sale EIS.

IV.C.1.b(7) Fishes and Essential Fish Habitat. As explained in Section IV.C.2.g, in light of new information, we slightly modify the conclusion in the Beaufort Sea multiple-sale EIS about the effects of proposed Sale 202 on fishes and EFH. The multiple-sale EIS concluded that the effects of seismic on fish would be "low," but the recent seismic-survey PEA concluded that the effects would "result in adverse but not significant impacts to fish resources, EFH, and commercial/recreational fisheries." Therefore, the updated conclusion about the effects of proposed Sale 202 on fishes and EFH is that the effects of an oil spill would be considered higher than in Sales 186 and 195 but still moderate because in most cases, fishes and EFH would recover within one generation. One year of salmon smolt would be affected, and salmon populations likely would recover. Effects from disturbances and seismic-survey activity in both the exploratory and development stages on freshwater and marine fish would result in adverse but not significant impacts.

IV.C.1.b(8) Additional Resources. The levels of effects on air quality, archaeological resources, lower trophic-level organisms, and other resources have not increased, as explained in Section IV.C.2.h.

IV.C.1.b(9) Environmental Justice. As explained in Section IV.C.2.i, the definitions and conclusions about Environmental Justice remain the same in the context of the new information that has become available since publication of the multiple-Sale EIS and the Sale 195 EA. The conclusion about disproportionate high adverse impacts to low-income and minority populations as a result of an oil spill that was reached for Sale 202 in the multiple-sale EIS does not change in the context of the new information.

The following section contains detailed updates of the effects analysis for each resource.

IV.C.2. Update of Effects Analysis.

In this section, the resources are reassessed in detail with the new information that is summarized in Section IV.B. The resources are assessed in the same sequence in which they were summarized in Section IV.B: subsistence-harvest patterns and sociocultural systems, marine and coastal birds, water quality, bowhead whales, polar bear, other marine mammals, additional resources, and Environmental Justice.

IV.C.2.a. Subsistence-Harvest Patterns and Sociocultural Systems. The Beaufort Sea multiple-sale EIS and Sale 195 EA concluded that routine, permitted activities as a result of these sales would have no significant effects. Seismic activity in the Beaufort Sea will need to continue to be mitigated by conflict avoidance measures between subsistence whalers and the oil industry. In the unlikely event of a large oil spill, there would be potentially significant effects on subsistence-harvest patterns and sociocultural systems.

IV.C.2.a(1) Subsistence-Harvest Patterns - Summary of Multiple-Sale EIS and Sale 195 EA Assessments Updated by this EA for Sale 202. The multiple-sale EIS assessed the effects of an accidental spill of 1,500 bbl or 4,600 bbl as a result of proposed Sales 186, 195 and 202 on subsistence-harvest patterns, concluding in Sections IV.C.11.b(2) that oil spills could affect subsistence *resources* periodically in the communities of Barrow, Nuiqsut, and Kaktovik. In the unlikely event of a large oil spill, many harvest areas and some subsistence resources could be unavailable for use. Some resource populations could suffer losses and, as a result of tainting, some bowhead whales could be rendered unavailable for use. The multiple-sale EIS also concludes that:

> Tainting concerns in communities nearest the spill event could seriously curtail traditional practices for harvesting, sharing, and processing bowheads and threaten a pivotal element of Inupiat culture. There also is concern that the IWC, which sets the quota for the Inupiat subsistence harvest of bowhead whales, would reduce the harvest quota following a major oil spill or, as a precaution, as the migration corridor becomes increasingly developed to ensure that overall population mortality did not increase. Such a move would have a profound cultural and nutritional impact on Inupiat whaling communities. Whaling communities distant from and

unaffected by potential spill effects would likely share bowhead whale products with impacted villages. Harvesting, sharing, and processing of other subsistence resources should continue but would be hampered to the degree these resources were contaminated. In the case of extreme contamination, harvests could cease until such time as resources were perceived as safe by local subsistence hunters. Tainting concerns also would apply to polar bears, seals, beluga whales, walruses, fish, and birds. Additionally, effects from a large oil spill likely would produce potential short-term but serious adverse effects to long-tailed duck and king and common eider populations. Overall, such effects are not expected from routine activities and operations.

All areas directly oiled, areas to some extent surrounding them, and areas used for staging and transportation corridors for spill response would not be used by subsistence hunters for some time following a spill. Oil contamination of beaches would have a profound impact on whaling because even if bowhead whales were not contaminated, Inupiat subsistence whalers would not be able to bring them ashore and butcher them on a contaminated shoreline. The duration of avoidance by subsistence users would vary depending on the volume of the spill, the persistence of oil in the environment, the degree of impact on resources, the time necessary for recovery, and the confidence in assurances that resources were safe to eat. Such oil-spill effects would be considered significant.

IV.C.2.a(1)(a) Updated Oil-Spill Effects for the Alternative VII – The Proposed Action. As defined by the Sale 202 OSRA, the chance of one or more large spills is 21% for the Proposed Action based on the mean spill rate over the life of the project. Using spill rates at the 95% confidence interval for the Proposed Action, the percent chance of one or more large spills total ranges from 14-29%. The relative risk from the Proposed Action is low, because we estimate that the likelihood of one or more oil spills occurring and contacting resources ranges from <0.5-5% over a year, or the coastline within 30 days.

Combined probabilities express the percent chance of one or more oil spills ≥1,000 bbl occurring and contacting a certain environmental resources area (ERA) or land segment (LS) over the production life of the Beaufort Sea multiple sales. For combined probabilities, the oil-spill model estimates a chance ≤0.5-2% that an oil spill would occur from a platform or a pipeline (LA1-LA18 or P1-P13, respectively) and contact subsistence-specific ERA's 2 (Point Barrow/Plover Islands), 3 (Thetis and Jones Islands), 42 (Barrow Subsistence Whaling Area), 69 (Harrison Bay/Colville Delta); 74 (Cross island), 83 (Kaktovik), and Land Segment 27 (Kurgorak Bay/Dease Inlet) within 360 days (Tables C-15 and C-21).

The multiple-sale EIS defines "significant" effects on subsistence-harvest patterns as: One or more important subsistence resources would become unavailable, undesirable for use, or available only in greatly reduced numbers for a period of 1-2 years. The analyses for Sales 186, 195, and 202 use the lower threshold of 1 year and interpret this to mean unavailable, undesirable for use, or available only in greatly reduced numbers for one harvest season.

IV.C.2.a(1)(b) Seismic Activity. Much of this information was updated recently in the seismic-survey PEA (USDOI, MMS, 2006a), which is available on the MMS web site at: http://www.mms.gov/alaska/ref/pea_be.htm. This section augments and summarizes the PEA descriptive information.

Noise and disturbance impacts would be associated with concurrent seismic surveys (both 2D and 3D) ongoing in the Chukchi and Beaufort seas for the 2006 open-water season. The Beaufort Sea season would run from July through September and later, after the hunt.

The greatest potential disruption of the subsistence whale hunt would be expected during fall whaling in Kaktovik, Nuiqsut, and Barrow, if multiple seismic-survey operations deflect whales away from traditional hunting areas. Conflict avoidance agreements between the AEWC and oil operators conducting one or perhaps two seismic operations per open-water season have tended to mitigate disruptions to the fall hunt in these communities, but the magnitude of four concurrent seismic shoots would test the ability of oil operators and whalers to coordinate their efforts to prevent disruptions to the hunt.

Barrow's fall hunt would be particularly vulnerable. Noise effects from multiple seismic surveys to the west in the Chukchi Sea and to the east in the Beaufort Sea could cause migrating whales to deflect farther out to sea, forcing whalers to travel farther—increasing the effort and danger of the hunt—and increasing the likelihood of whale meat spoilage, as the whales would have be towed from greater distances. Barrow's fall hunt is particularly important, as it is the time when the Barrow whaling effort can "make up" for any whales not taken by other Chukchi and Beaufort Sea whaling communities. These communities give their remaining whale strikes to Barrow, hoping that Barrow whaling crews will successfully harvest a whale and then share the meat back with the donating community. This practice puts a greater emphasis on the Barrow fall hunt.

Additionally, changing spring lead conditions—ice becoming thinner due to global climate change—has made the spring hunt more problematic and makes the fall hunt even more pivotal in the annual whale harvest for all communities in the region. Thus, any disruption of the Barrow bowhead whale harvest could have disruptive effects on regional subsistence resources and harvest practices (USDOI, MMS 1987; Brower, 2005).

An increasing level of seismic-survey activity in the Beaufort Sea could displace whales, pinnipeds, and polar bears alter their availability for an entire harvest season, causing potentially significant impacts to these subsistence resources and harvest practices. Protective mitigation and conflict avoidance measures incorporated in the EA and in the seismic-survey permits would reduce effects to below a significant level.

Required mitigation, monitoring, and conflict avoidance measures under Incidental Take Authorizations (ITA's) requirements issued by NMFS and FWS must be followed in locations where the subsistence hunt is affected. The ITA requirements obligate operators to demonstrate no unmitigable adverse impacts on subsistence practices. Conflict avoidance measures between permittees and the Alaska Eskimo Whaling Commission (AEWC) work toward avoiding unreasonable conflicts and disturbances to hunters and bowhead whales. Similar conflict avoidance measures could be required for the subsistence beluga whale hunt by the Alaska Beluga Whale Committee (ABWC), for the subsistence walrus hunt by the Alaska Eskimo Walrus Commission (EWC), and for the subsistence polar bear harvest by the Nanuk Commission (NC). Such conflict avoidance agreements likely would follow protocols similar to those reached annually between permittees and the AEWC for the subsistence bowhead hunt and address industry seismic-vessel activities under provisions of the Marine Mammal Protection Act (MMPA). With the use of the conflict avoidance agreement methodology, Native subsistence-whale hunters generally have been successful in reaching their annual whale "take" quotas. Without conflict avoidance measures in place, potentially significant impacts to the subsistence resources and hunts for bowhead and beluga whales, walruses, bearded seals, and polar bears still would result.

IV.C.2.a(1)(c) Benefits of the Standard Mitigation. Several mitigation measures are proposed for Sale 202. The measures are listed in Appendix B. Mitigation that would apply to subsistence-harvest patterns includes standard proposed Stipulations No. 2 Orientation Program, No. 4 Industry Site-Specific Bowhead Whale-Monitoring Program, and No. 5 Conflict Avoidance Mechanisms to Protect Subsistence Whaling and Other Subsistence-Harvest Activities.

Stipulation No. 2, Orientation Program, requires the lessee to educate people working on exploration, development, and production about the environmental, social, and cultural concerns that relate to the area and its communities. The program should increase workers' sensitivity to, and understanding of, values, customs, and lifestyles of local Native communities and help prevent any conflicts with subsistence activities. The overall training program will be submitted to the Regional Supervisor, Field Operations for review and approval. Personnel will receive appropriate training on at least an annual basis, and full training records will be maintained for at least 5 years.

Stipulation No. 4, Industry Site-Specific Bowhead Whale-Monitoring Program, would help to provide mitigation to potential effects of oil and gas activities on the local Native whale hunters and subsistence users. It is considered as positive mitigation under Environmental Justice. Other positive aspects of this stipulation in terms of subsistence and sociocultural concerns would be the involvement of the Native community in the selection of peer reviewers and in providing observers for the monitoring effort.

Stipulation No. 5, Conflict Avoidance Mechanisms to Protect Subsistence Whaling and Other Subsistence Activities, would help to reduce noise and disturbance conflicts from oil and gas operations during specific periods, such as the annual spring and fall whale hunts. It requires that the lessees meet with local communities and subsistence groups to resolve potential conflicts. This stipulation reduces potential adverse effects from proposed sales to subsistence harvest patterns, sociocultural systems, and to Environmental Justice. This stipulation has proven to be effective mitigation in prelease (primarily seismic activities) and exploration activities and through the development of the annual oil/whaler agreements between the AEWC and oil companies.

Other stipulations that are relevant to this assessment are Stipulation No. 6, Pre-Booming Requirements for Fuel Transfers, Stipulation No. 7, Lighting of Lease Structures to Minimize Effects to Spectacled and Steller's Eider, and Stipulation No. 8a, No Permanent Facility Siting in the Vicinity Seaward of Cross Island, and No. 8b, No Permanent Facility Siting in the Vicinity Shoreward of Cross Island. Stipulation 8a, would reduce the potential conflict between subsistence-hunting activities and oil and gas development and operational activities with the key areas seaward of Cross Island, where subsistence whaling for the community of Nuiqsut occurs. This stipulation also could reduce potential noise from a facility in this area that could deflect bowhead whales farther offshore. Stipulation 8b would reduce the potential conflict between subsistence-hunting activities and oil and gas development and operational activities within the area shoreward of Cross Island. However, the whale migration and most whale hunting (based on the whale strike data) occur outside the barrier islands. This stipulation would provide little or no additional protection to subsistence whaling or bowhead whales from that already provided by Stipulation 5.

Recently, North Slope subsistence whalers have stated that present deferral areas are too small. They believe there a need for larger "Quiet Zone" deferral areas in the vicinity of Barrow, Cross Island, and Kaktovik that protect the bowhead whale migration route from seismic-sound disturbance; that protect subsistence staging, pursuit, and butchering areas; and that protect critical whale feeding and calving areas. They also would like to see MMS reinstate a Cross Island deferral area. In lieu of such a deferral, it has been suggested that leasing incentives could be discontinued in the areas off Cross Island most critical to Nuiqsut whaling. Other controversial issues are:

- the ramping up of seismic exploration in the Beaufort and Chukchi Seas;
- noise effects of onshore barge traffic and Canadian shipping on bowhead whales;
- the need to expand conflict avoidance agreements to other resources not considered by the AEWC, such as fish, bearded seals, walrus, and beluga whales;
- the need for MMS to coordinate with and include the BLM, NMFS, the Coast Guard, and the State of Alaska in its public outreach process—the need for a multiagency working group or coordination team;
- the need for MMS, BLM, and the State of Alaska to coordinate their projects, so as to recognize the linkage of onshore and offshore impacts and cumulative impacts;
- the need for MMS to revise its significance thresholds for subsistence and sociocultural systems and bring them in line with the MMPA's "no unmitigable adverse impact" definition;
- the effects of global climate change on ice conditions, subsistence resources and subsistence-harvesting practices in the Alaskan Arctic; and,
- that increased industrial noise levels in the Beaufort Sea will force hunters to travel farther to find whales and that this may lead to reduced success and an increased struck and lost rate for hunters that may, in turn, cause the IWC to reduce the bowhead whale quota because of potential reduced hunting efficiency.

IV.C.2.a(1)(d) Overall Conclusion – The Mitigated Effect. The conclusion in the multiple-sale EIS for Sale 202 about oil-spill effects on subsistence-harvest patterns remains the same in light of recent information. Further, recent information does not suggest that seismic-disturbance effects, if properly mitigated with conflict avoidance agreements, on subsistence-harvest patterns, resources, or practices from activities associated with Sale 202 would change from those evaluated in the multiple sale EIS. Potential long-term impacts from climate change would be expected to exacerbate overall potential effects on subsistence resources and subsistence-harvest patterns.

IV.C.2.a(2) Sociocultural Systems. The multiple-sale EIS assessed the effects of an accidental spill of 1,500 bbl or 4,600 bbl as a result of proposed Sales 186, 195, and 202 on sociocultural systems concluding in Sections IV.C.12 that:

> Effects on the sociocultural systems of the communities of Barrow, Nuiqsut, and Kaktovik could come from disturbance from industrial activities, from changes in population and employment, and from periodic interference with subsistence-harvest patterns from oil spills and oil-spill cleanup. Altogether, effects periodically could disrupt but not displace ongoing social systems, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources. However, in the unlikely event that a large oil spill occurred and contaminated essential whaling areas, major effects could occur when combined impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together. Such impacts would be considered significant. All subsistence whaling communities and other communities that trade for and receive whale products and other resources from the whaling communities could be affected. A large spill anywhere within the habitat of bowhead whales or other important migratory subsistence resources could have multiyear impacts on the harvest of these species by all communities that use them. In addition, harvests could be affected by the IWC to limit harvest quotas in response to a perceived increased threat to the bowhead whale population. Beyond the impacts of a large spill, long-term deflection of whale migratory routes or increased skittishness of whales due to increased industrialization in the Beaufort Sea would make subsistence harvests more difficult, dangerous, and expensive. To date, no long-term deflections of have bowheads have been demonstrated.

IV.C.2.a(2)(a) Updated Spill Effects. As defined by the Sale 202 OSRA, the chance of one or more large($\geq$1,000 bbl) spills occurring is 21% for the Proposed Action and alternatives, based on the mean spill rate over the life of the project. Using spill rates at the 95% confidence interval for the Proposed Action and alternatives, the percent chance of one or more large spills total ranges from 14-29%. The relative risk from the Proposed Action and alternatives is low, because we estimate that the likelihood of one or more large oil spills occurring and contacting resources ranges from <0.5-5% over a year, or coastline up to 30 days. Because the combined probabilities are similar to one another, it is difficult to distinguish differences between the Proposed Action and alternatives based on combined probabilities.

Combined probabilities express the percent chance of one or more oil spills $\geq$1,000 bbl occurring and contacting a certain ERA or land segment over the production life of the Beaufort Sea multiple-sale. For combined probabilities, the oil-spill model estimates a $\leq$0.5-2% chance that an oil spill would occur from a platform or a pipeline (LA1-LA18 or P1-P13, respectively) and contact subsistence-specific ERA' 2 (Point Barrow/Plover Islands), 3 (Thetis and Jones Islands), 42 (Barrow Subsistence Whaling Area), 69 (Harrison Bay/Colville Delta); 74 (Cross island), and 83 (Kaktovik) and Land Segment 27 (Kurgorak Bay/Dease Inlet) within 360 days (Tables C-15 and C-21).

The multiple-sale EIS defines "significant" effects on sociocultural systems as: "A chronic disruption of sociocultural systems that occurs for a period of 2-5 years, with a tendency toward the displacement of existing social patterns." The analyses for Sales 186, 195 and 202 use the lower threshold of 2 years. This increment is used because it is believed it would take at least 2 years for such an effect to become evident in the social system. It should be noted that the significance threshold for subsistence-harvest patterns of a subsistence resources becoming unavailable, undesirable for use, or available only in greatly reduced numbers for one year (meaning one harvest season) would be reached long before the significance threshold for sociocultural systems would be applied.

IV.C.2.a(2)(b) Seismic-Survey Activity. Much of this information was updated recently in the seismic-survey PEA (USDOI, MMS, 2006a). The seismic PEA is available on the MMS web site at: http://www.mms.gov/alaska/ref/pea_be.htm. This section augments and summarizes the PEA descriptive information.

Effects on the sociocultural systems of the communities of Barrow, Atqasuk, Nuiqsut, and Kaktovik could come from noise disturbance produce by seismic exploration activities. Because activity staging would not be from local communities, stresses to local village infrastructure, health care, and emergency response systems are expected to be minimal. Social systems in these communities would experience little direct disturbance from the staging of people and equipment for seismic exploration.

The long-term deflection of whale migratory routes or increased skittishness of whales due to increased exploration activities in the Beaufort Sea would make subsistence harvests more difficult, dangerous, and expensive. To date, no long-term deflections of bowheads have been demonstrated. On the other hand, seismic activity of the magnitude discussed in the scenario for the PEA has not been approached since the 1980's, and potential whale deflections are possible.

Potential impacts on sociocultural systems could occur from potential disruptions of seismic noise on subsistence-harvest patterns (see the discussion in Sec. IV.C.1.a(1)(b)), particularly on the bowhead whale, which is a pivotal species to the Inupiat culture; such disruptions could impact sharing networks, subsistence task groups, and crew structures and could cause disruptions of the central Inupiat cultural value: subsistence as a way of life. These disruptions also could cause a breakdown in sharing patterns, family ties, and the community's sense of well-being and could damage sharing linkages with other communities. Displacement of ongoing sociocultural systems by seriously curtailing community activities and traditional practices for harvesting, sharing, and processing subsistence resources also might occur.

Required mitigation, monitoring, and conflict avoidance measures under IHA's issued by NMFS and FWS would serve collectively to mitigate disturbance effects on Native lifestyles and subsistence practices and likely would mitigate any consequent impacts on sociocultural systems. With such measures in place, impacts to subsistence resources, hunts, and sociocultural systems, would be minimized.

The effectiveness of mitigating measures for sociocultural systems would be similar to the discussion for subsistence-harvest patterns at the beginning of this section. Stipulations pertinent to sociocultural systems would relate to the improvement in the rapid response to oil spills that would reduce concerns about the tainting of bowhead meat.

IV.C.2.a(2)(c) Conclusion. The conclusions and definitions about subsistence and sociocultural resources remain appropriate in the context of the new information that has become available since publication of the multiple-sale EIS and the Sale 195 EA. In other words, the conclusion about oil-spill and seismic disturbance effects on subsistence and sociocultural systems that was reached for Sale 202 in the multiple-sale EIS does not change in the context of the new information. Seismic activity in the Beaufort Sea will need to continue mitigation defined by conflict avoidance measures between subsistence whalers and the oil industry. In the unlikely event of a large oil spill, there would be potentially significant effects on subsistence–harvest patterns and sociocultural systems. Potential long-term impacts from climate change would be expected to exacerbate overall potential effects on sociocultural systems.

IV.C.2.b. Marine and Coastal Birds. This section updates the assessment of effects on marine and coastal birds as a result of the Proposed Action (Alternative VII), and includes the effects on the threatened spectacled and Steller's eiders. There are four subsections, which summarize the multiple-sale EIS and Sale 195 EA assessments that are being updated, updates those effects, add the benefits of the standard mitigation, and summarizes the new overall conclusion (i.e., the mitigated effect).

IV.C.2.b(1) Summaries of Multiple-Sale EIS and Sale 195 EA Assessments Updated by this EA for Sale 202. The multiple-sale EIS (USDOI, MMS, 2003) assessed the effects of routine disturbance and an oil spill of 1,500 bbl or 4,600 bbl accidentally released during development or production activities occurring on leases from proposed Sales 186, 195, and 202. This was discussed in general terms in Sections IV.A.3 and 4 and analyzed in Sections IV.C.5.b(1) and c(1) (endangered and threatened species) and Section IV.C.6.a(2) (marine and coastal birds) of the multiple-sale EIS, where it was concluded, respectively, that:

The effects from normal activities associated with oil and gas exploration and development...are likely to include the loss of a small number of spectacled eiders...as a result of collisions with offshore or onshore structures. Although the eider population...may be slow to recover from small losses or declines in fitness or productivity, no significant overall population effect is likely.

In the unlikely event a large oil spill occurs, spectacled eider mortality is likely to be fewer than 100 individuals; however, any substantial loss (25 or more individuals) would represent a significant effect. Recovery from substantial mortality would not occur while the population exhibits a declining trend.... Low Steller's eider mortality is expected in the unlikely event a large oil spill occurs; however, recovery of the Alaska population from spill-related losses would not occur while the regional population is declining.

The adverse effects on marine and coastal birds from normal exploration and development/ production...are likely to include the loss of small numbers of...birds...as a result of collisions with offshore or onshore structures. No significant overall population effect is likely to result from small losses for most species. In the unlikely event a large oil spill occurs, long-tailed duck mortality is likely to exceed 1,000 individuals, while that of other common species such as king eider, common eider, and scoters would be in the low hundreds, and loon species fewer than 25 individuals each. Mortality at the higher levels predicted by Fish and Wildlife Service data could result in significant effects for long-tailed duck, king eider, and common eider.

The multiple-sale EIS in Section IV.A.1 defined "significance thresholds" for threatened and endangered species, including spectacled and Steller's eiders, as: "An adverse impact that results in a decline in abundance and/or change in distribution requiring one or more generations for the indicated population to recover to its former status." The significance threshold for other biological resources, including nonendangered marine and coastal birds, was described as: "An adverse impact that results in a decline in abundance and/or change in distribution requiring three or more generations for the indicated population to recover to its former status." As stated in the Sale 195 EA (USDOI, MMS,2004:Sec. IV.B.2.b), these conclusions and definitions remain appropriate in the context of the new information that has become available since publication of the multiple-sale EIS.

IV.C.2.b(2) Update of Those Effects. There is additional information regarding bird collisions with oil-exploration/production structures. The MMS data on the probability of spills has been updated and new OSRA tables have been prepared (USDOI, MMS, 2005:Sec. IV.A.1.b and Appendix C). There also are anticipated changes in the arctic climate in ways that could influence the abundance and distribution of marine and coastal birds.

Species-specific updates are included in Section IV.B.2.b and Appendix D, Section D.2. In general, there were few notable changes in population, distribution, or susceptibility information for species that could be affected by Sale 202 activities. There is recent information regarding yellow-billed loons and shorebirds that resulted in updated assessments.

There is updated information for two sources of potential impacts to birds (oil-spill-risk analysis and collision impacts) as well as additional information pertaining to species having special designation under the ESA and species identified as having a greater potential for substantial impacts from an oil spill. New information is reviewed for oil-spill risk, collision impacts, and species-by-species summaries for vulnerable species. There is no relevant information that would change the analysis on species described having a lower potential for substantial impacts from an oil spill.

IV.C.2.b(2)(a) Oil-Spill-Risk Analysis. The assessments for Sales 186 and 195 assumed that most operations would occur in the Near and Mid Zones. Consequently, they assumed that prospects would be discovered in those zones, and that a large spill possibly would occur in those zones. Because of the proximity of such spills to coastal waters with high bird density, the assessments concluded that bird mortality would be significant (USDOI, MMS, 2003:Secs. IV.C.5.b(2)(a) and -6.b(1); USDOI, MMS, 2004:Sec. IV.C.1.a). In contrast, the assessment for Sale 202 assumed that most operations would occur in the Far Zone and, because bird density is lower in far offshore waters, that the bird mortality from a large spill would be lower but still significant (USDOI, MMS, 2003:Secs. IV.C.5.b(2)(c), 5.c(2)(b), and 6.b(3)). The multiple-sale EIS assumed that leasing as a result of proposed Sale 202 would be located primarily in the Far Zone. However, the leasing patterns during Sales 186 and 195 indicate that most of Sale 202 leasing might be located far from the Prudhoe Bay infrastructure but not necessarily far from the coast.

The MMS data on the percent chance that at least one large (>1,000 bbl) spill would occur has been updated, and new OSRA tables have been prepared (Sec. IV.A.1.b and Appendix C). The new data does not affect the OSRA tables with "conditional" probabilities, which assume that a spill has occurred. The assessment of marine and coastal birds in the multiple-sale EIS was based primarily on conditional probabilities, and those probabilities would not change.

The new data affects only the tables with "combined" probabilities, which include the chance that a large spill occurs and reaches an ERA part of the multiple-sale EIS marine and coastal bird assessments section (USDOI, MMS, 2003:Sec. IV.C.6.a(2)(b)2)a)) was based on combined probabilities, stating: "As noted, for purposes of modeling and determining which areas are at highest risk, the foregoing contact probabilities assume that a spill occurs; if the probability of spill occurrence is incorporated, the probability of oil contacting any environmental resource area or land segment is 2% or less (Table A.2-55)."

With the updated OSRA, the chance of one or more large oil spills (>1,000 bbl) occurring and contacting any ERA or land segment in the project area during the life of the project is 4% or less (Appendix C, Table C-20). In other words, the likelihood that a spill would occur and contact bird resource areas has doubled from 2% to 4%, but is still very low.

The extent of direct impacts to migratory birds from a proposed action is extremely difficult to predict and must be modeled. The FWS and MMS modeled marine and coastal bird exposure to assumed oil spills at the Liberty Project in the coastal Beaufort Sea (Stehn and Platte, 2000). A number of simulated spills originating from the Liberty Platform were analyzed according to wind patterns, sea currents, and weathering patterns during a hypothetical ice-free July or August time period. The distribution and abundance of birds in certain zones away from the spill launch point affected the number of encounters with oil. The average proportions of the total populations exposed to oil were between 3% and 9% for long-tailed ducks, glaucous gulls, and common eider (Stehn and Platte, 2000). King eider, spectacled, eider, and scoters were least likely to have a high proportion of their populations exposed to oil because of their widespread distribution or tendency to occur farther from the spill source (Stehn and Platte, 2000). Calculated average exposure to oil from 5,912-bbl or 1,580-bbl spill trajectories resulted in 2,234 and 1,732 individuals, respectively, in July and 2,300 and 1,908 individuals, respectively, for August of nine bird species. The review of new, relevant information confirms that document's conclusions that mortality of fewer than 100 spectacled eiders, low hundreds of king and common eiders, 1,000 or more long-tailed ducks, and few Steller's eiders could result from such a spill.

Aside from spill size, effects also would be influenced by the following three factors. (1) Spill-cleanup responses probably would influence effects, because lessees are required to prepare for spills (e.g., an industry consortium stockpiles response equipment in the Prudhoe area for OCS operations in all three arctic seasons—solid ice, open water, and broken ice). (2) Water depth and mixing depth probably would influence effects—a spill of a certain size probably would affect a relatively large area in shallow water but would be mixed and diluted in deeper water. (3) Ice conditions probably would influence effects; e.g., response equipment is relatively effective in solid ice and open-water situations, but the effectiveness is reduced greatly in broken ice. Even through response plans are required, and responses are assumed for this assessment, the effectiveness of the responses could be improved. For example, oil-spill-response time might be improved if response equipment for remote developments was staged in communities near the development and was deployed by trained personnel from the communities, as discussed also in Section IV.C.1.d(2) about polar bears.

Assessment of oil-spill impacts is based on a combination of risk factors such as probability of a spill; spill size; spill duration; weather conditions; effectiveness of oil-spill response, and the behavior, abundance, and distribution of marine and coastal birds in the area. Many marine and coastal birds are in the Beaufort Sea coastal area during 3-5 months out of the year. Even if a bird were present in the vicinity of an oil spill, it might not be contacted by oil due to ice conditions, avoidance behavior, weather patterns, or spill-response activities. While updated data have resulted in the percent chance that a spill would occur and contact an ERA has doubled (from 2-4%), the conclusion that the coincidence of all these factors, which would have to occur simultaneously to have a potentially significant oil-spill effect to coastal and marine bird species, is improbable. Statistically, significant oil-spill impacts to birds are not reasonably certain to occur.

IV.C.2.b(2)(b) Collision Impacts. Birds can be killed by collisions with onshore and offshore structures (i.e., drilling structures, communication towers with support cables, power lines). Russell (2005) documented 787 avian mortalities (primarily songbirds) associated with offshore structures in the Gulf of Mexico during spring migration. Of the 758 mortalities where cause of death was known, 34% were attributable to collisions. During fall, 780 avian mortalities occurred (653 cause of death was known), of which 48% were attributed to collisions (Russell, 2005).

There are few studies on avian collision studies in Alaska, even though collision-related deaths can represent a major source of avian mortality in certain areas (Faanes, 1987; Erickson et al., 2001; Russell, 2005). Collision-related avian mortality on the North Slope is not known. Estimating collision-related avian mortalities on the North Slope is difficult due to factors including habitat effects (number of birds actually recovered likely vary relative to habitat), observer bias (different observers have different probabilities of actually recovering carcasses), scavenging bias (carcass longevity likely varies relative to local predator composition and abundance), and crippling bias (injured birds may walk or fly away from [i.e., delayed mortality] the collision site).

Sea ducks, including eiders, may be prone to collisions with vessels and on- and offshore structures. Eiders may be particularly vulnerable due to their flight behavior: they travel in relatively large flocks (~110 birds/flock), they fly fast (~83 km/h), they fly low (5-12 m above sea level), and they tend to migrate in 'straight' lines (~98% of observed flocks) (Day, Prichard, and Rose, 2005; Day et al., 2004). A number of factors actually may reduce the height at which eiders migrate, including wind speed and direction, weather (i.e., fog or precipitation), and lighting (day versus night) conditions (Day, Prichard, and Rose, 2005).

Day, Prichard, and Rose (2005) completed a 4-year study of bird migration and collision avoidance at Northstar Island. The authors used bird radar to assess the reaction of migrating eiders and other birds to collision avoidance lights located on the structure. The authors reported that the lights were not so strong that they disrupted eider migration, but the lights caused eiders to slow down and alter their flight paths away from the island. Thirty common eiders, 6 king eiders, and 13 long-tailed ducks were killed due to collisions with Northstar and Endicott Islands in the Alaskan Beaufort Sea during fall migration in 2001-2004 (Day, Prichard, and Rose, 2005). This total was collected over a relatively narrow window (80 days total spread over 4 years) of the fall migration and, thus, probably underestimates total collision loss during fall migration.

The Biological Opinion for the multiple-sale EIS specified a requirement for lighting of lease structures (USDOI, MMS, 2003:Sec. III.C). The stipulation states that structures must be lighted in such a manner to minimize collisions from spectacled and Steller's eiders. There appear to be two important aspects of collision avoidance to consider in implementing this stipulation. Light radiated upward and outward from the structure could disorient flocks of eiders and other birds during periods of darkness or inclement weather when the moon is obscured. If migrating eiders were not disoriented by radiated light, they still could encounter structures in their flight paths. Making surfaces visible to approaching birds may slow flight speed, allowing them to maneuver past collision hazards. Inward-directed lighting would illuminate these surfaces, but surface textures that absorb rather than reflect light could maximize visibility to closely approaching birds and minimize disorientation of distant birds during periods of darkness or inclement weather when the moon is obscured. These features are addressed in a revised mitigation measure regarding structure lighting (see Section 3 below about the benefits of the standard mitigation).

In summary, there is no suggestion in recent study results that disturbance effects or potential mortality of eiders, long-tailed ducks, or other species from collisions with structures associated with activities following Sale 202 would exceed the small losses estimated for Sale 186 and 195, and none of these factors are expected to result in significant effects to marine and coastal birds.

IV.C.2.b(2)(c) Updates for Threatened and Candidates Species. The following summarizes the overall effects on ESA threatened and candidate species and on species with a high potential for substantial effects.

IV.C.2.b(2)(c)1) Spectacled Eider. Data from 2005 aerial surveys on the spectacled eider population index showed that the Arctic Coastal Plain population exhibited a 13% increase over the long-term mean, but the 1993-2005 mean annual population growth rate was not statistically different than 1.0 (a stable population = 1.00). There have not been major changes in the status or trend of the Alaskan breeding population. There also has not been an indication of major change in their breeding or nonbreeding season distributions that would make them more susceptible to the primary potential sources of mortality associated with oil and gas development, collision, and spilled oil. There is no suggestion in these recent values that potential mortality of spectacled eiders from collisions with structures or contact with spilled oil associated with activities following Sale 202 would exceed those estimated for Sales 186 and 195. Thus, the updated potential level of effect on the Alaska spectacled eider population still is expected to be potentially significant, as stated in the multiple-sale EIS, and recovery from substantial mortality would not occur while the population exhibits a declining trend. While an oil spill, under certain conditions, would result in a potentially significant effect to spectacled eiders, the coincidence of all the factors which would have to occur simultaneously in order to result in a potentially significant impact to spectacled eiders is improbable. Thus, we concluded that significant impacts to spectacled eiders are not anticipated. The FWS, in their 2002 Biological Opinion (reaffirmed in May 2006), concurred that an appreciable reduction in the likelihood of survival and recovery of spectacled eiders is not reasonably certain to occur. These conclusions remain the same as those in the multiple-sale EIS and Lease Sale 195 EA.

IV.C.2.b(2)(c)2) Steller's Eider. Reliable Alaska population estimates for the Steller's eider on the Arctic Coastal Plain are not available, because so few Steller's eiders are detected by the protocol used during eider surveys for this area. So few Steller's eiders were detected during the annual eider breeding population survey of the Arctic Coastal Plain in 2005 that biologists concluded it was of little value in calculating population trends. With such a small population, it is likely that only low mortality would result from an oil spill, and recovery would not occur while the regional population is declining. Thus, the updated potential level of effect on the Alaska Steller's eider population is expected to be the same as stated in the multiple-sale EIS.

IV.C.2.b(2)(c)3) Kittlitz's Murrelet. The Kittlitz's murrelet was designated a candidate species under the ESA (70 *FR* 24,869-24,934) since completion of the multiple-sale EIS and the Sale 195 EA. While the FWS considers the Kittlitz's murrelet as "likely to occur" in the Beaufort Sea area, the MMS has no record of the species occurring in the project area and concluded that there would not be any effects on Kittlitz's murrelets in or near the Sale 202 project area.

The MMS requested concurrence from the Fairbanks Fish and Wildlife Field Office that since publication of the multiple-sale EIS, there was no new information or indication of change in spectacled eider or Steller's eider status that required reinitiation of Section 7 consultation (Appendix E). The FWS concurred.

IV.C.2.b(2)(d) Updates for Species with Higher Potential for Substantial Effects.

IV.C.2.b(2)(d)1) King Eider. King eider population estimates, based on data from recent aerial surveys, confirm that the Arctic Coastal Plain population continued to exhibit a positive growth rate (1.021) and was above the 2004 and 13-year average. There is no suggestion of substantial change in the status or trend of the Alaska breeding population in these values that indicates potential mortality of king eiders from contact with spilled oil associated with activities following Sale 202 would exceed those estimated for Sales 186 and 195. There also has been no indication of major change in their breeding or nonbreeding season distributions that would make them more susceptible to this primary potential source of mortality associated with oil and gas development.

Although the king eider is one of those most frequently recorded striking structures on Northstar Island, presumably as a result of the large numbers migrating through the Beaufort Sea area, such mortality is not expected to become substantial relative to the population size. Investigation of eider response to Northstar Island during migration did not indicate that this structure would contribute any substantial mortality. Additional lighting and other practicable modifications to exploration and delineation structures being evaluated are anticipated to improve visibility of these structures and reduce bird disorientation, which would reduce the risk of collision. Thus, the potential level of effect on the king eider population is expected to be the same as stated in the multiple-sale EIS.

Recent aerial surveys have shown that, in contrast to other marine birds, king eider flocks concentrate in deeper offshore waters, often in sea-ice concentrations >20%. If an oil spill were to occur in areas of broken-ice conditions, where cleanup technologies are of limited effectiveness, floating oil could persist for an extended period of time and make common eiders potentially more vulnerable to contact by an oil spill than previously considered.

IV.C.2.b(2)(d)2) Common Eider. Recent aerial survey counts of common eiders in Beaufort Sea barrier island-lagoon systems in late June have exhibited large variation in numbers of animals. However, this may be a result largely of spring migrant birds' response to variable ice conditions allowing or temporarily interrupting eastward progress of birds that will nest in Canada, and/or variable nesting effort related to predator access to nesting islands. Average survey counts over the past 5 years have remained relatively stable. Thus, the potential level of effect on the common eider population is expected to be the same as stated in the multiple-sale EIS.

IV.C.2.b(2)(d)3) Long-Tailed Duck. The long-tailed duck is the most abundant sea duck in the Beaufort Sea Planning Area (Fischer and Larned, 2004). Data from the 2005 mid-June aerial surveys of population estimates confirm that the Arctic Coastal Plain population continues to exhibit a slightly decreasing mean growth rate (0.934) (Larned, Stehn, and Platte, 2005). Surveys conducted in later June 2004 showed an improvement over 2002-2003 indices; the index was 7.8% below the 18-year mean (Mallek, Platte, and Stehn, 2005).

Because of concentration in coastal lagoons during molt and migration, this species is the most likely to experience substantial losses from an oil spill; however, there has been no indication of major change in its breeding or nonbreeding season distributions that would make it more susceptible to this primary potential source of mortality associated with oil and gas development. Although this species is one of those most frequently recorded striking structures on Northstar Island, presumably as a result of its large population in the Beaufort Sea area, such mortality is not expected to become substantial relative to the population size.

There is no suggestion of significant change in the status or trend of the Alaska breeding population in these values that indicates potential mortality of long-tailed ducks from collisions with structures or contact with spilled oil associated with activities following Sale 202 would exceed those estimated for Sales 186 and 195. Thus, the updated potential level of effect on the long-tailed duck population is expected to be the same as stated in the multiple-sale EIS.

IV.C.2.b(2)(d)4) Yellow-billed Loon. There appear to be valid concerns about potential threats to the yellow-billed loon population in Alaska. Northern Alaska's breeding population is small, with probably fewer than 1,000 pairs attempting to breed in an average year, and the low reproductive potential of yellow-billed loons means that the population would not recover from perturbations rapidly (Earnst, 2004; Earnst et al., 2005). Specific activities that could impact yellow-billed loon breeding habitat include developments within the northeast and northwest NPR-A and the Alpine and Alpine Satellite developments. These impacts arise from road and gravel pad construction, oil spills near breeding territories, oil spills in the coastal Beaufort Sea, ice roads, pumping water from lakes and rivers, increased predator abundance, noise and visual disturbance from aircraft, ground vehicles, and human presence. These sources of impact are relevant to Sale 202 in that a possible offshore development could add to the potential for oil spills and result in increased noise and visual disturbances. Recent studies involving population trends and distribution of yellow-billed loons have indicated they have a higher potential for potentially significant effects from activities following Sale 202 than was stated for Sale 186 in the multiple-sale EIS. However, the coincidence of factors that would have to occur simultaneously to have a significant effect to shorebirds is improbable, and significant impacts are not reasonably certain to occur.

IV.C.2.b(2)(d)5) Shorebirds. Powell, Taylor, and Lanctot (2004) monitored the movements and tenure times of shorebirds at two interior breeding sites, three coastal sites, and five staging areas along the Arctic Coastal Plain. It appears that large numbers of shorebirds could be affected during the important postbreeding period should they encounter oil on shorelines, eat contaminated prey, or have their invertebrate food sources be reduced (USDOI, FWS, 2004). Coastal sediments and invertebrates could remain affected by oil for extended periods. While the percent chance that this would occur is considered very unlikely, we concur with the FWS that if it did occur, a large spill could have population-level effects, because large numbers of shorebirds could be affected (USDOI, FWS, 2004).

The possible effects of climate change on shorebirds are difficult to predict (Lindstrom and Agrell, 1999). Direct effects, such as changes in temperature, precipitation, and wind conditions could affect individual birds directly, largely by influencing thermoregulation and subsequent energy available for reproduction and survival. The largest effects of climate change on shorebirds, however, are likely to be from indirect influences of rising sea levels, habitat changes, and changes in food abundance. Lindstrom and Agrell (1999) concluded that while some Arctic breeding habitats would be reduced to about one-third of their existing size, there are other, more difficult challenges facing shorebirds as they migrate to and from wintering habitats that are much more susceptible to climate and human-induced change than is expected to occur over the same amount of time in the Arctic. It is unknown what, if any, conservation measures could be implemented under proposed Sale 202 that could alleviate the anticipated effects of climate change on shorebirds and other arctic species.

Recent studies involving population trends and distribution of shorebirds have indicated certain species have a higher potential for significant effects from activities associated with activities following Sale 202 than was stated for Sale 186 in the multiple-sale EIS. However, the coincidence of factors that would have to occur simultaneously to have a significant effect to shorebirds is improbable, and significant impacts are not reasonably certain to occur.

Recent studies involving population trends and distribution of other species with lower potential for significant effects from activities associated with oil and gas development do not suggest that they would be more susceptible to activities following Sale 202 than was stated for Sale 186 in the multiple-sale EIS.

IV.C.2.b(3) Benefits of the Standard Mitigation. One primary stipulation could moderate the potential for adverse effects from lease sale activities. Stipulation No. 7, The Lighting of Lease Structures to Minimize Effects to Spectacled and Steller's Eiders, resulted from a nondiscretionary condition of the FWS October 22, 2002, Final Biological Opinion for Lease Sale 186. The benefits of this stipulation were explained in the Beaufort Sea multiple-sale EIS (USDOI, MMS, 2003:Sec. II.H.2.d). The stipulation required lessees to incorporate into the design of specified structures any protocols developed by the FWS and MMS intended to minimize the potential for collision of these species with such structures and is a requirement in the Biological Opinion issued by the FWS.

We have updated that stipulation's monitoring protocol following a meeting between MMS and FWS in March 2004. A letter was then forwarded to Beaufort Sea lease holders on March 29, 2004, informing them that in accordance with Stipulation No. 7, MMS and FWS agreed to a protocol that establishes a coordinated process for a performance-based objective of minimizing the radiation of light outward to decrease the likelihood that spectacled or Steller's eiders will be attracted to and collide with these structures. The protocol recognizes that the different types of structures (size, height, configuration, etc.) make it difficult to specify a single common standard, and that newly constructed facilities will have greater flexibility than existing facilities to adopt or modify lighting configurations. Specific measures to be considered included:

- Shading and/or light fixture placement to direct light inward and downward to living and work structures while minimizing light radiating upward and outward
- Types of lights

- Adjustment of the number and intensity of lights as needed during specific activities
- Dark paint colors for selected surfaces
- Low reflecting finishes or coverings for selective surfaces
- Facility or equipment configuration

Lessees would be required to submit to MMS a written statement of measures that will be implemented to meet the intent of this stipulation. Lessees also must submit a plan to MMS for recording and reporting bird strikes that occur during MMS-permitted activities. The statement and plan will be submitted prior to or with the Exploration Plan. Lessees are encouraged to discuss their proposed measures and bird-strike recording and reporting plan in a presubmittal meeting with the MMS and FWS.

The lighting requirements do not apply to structures used east of 146° longitude between October 31 and May 1 of each year, when eiders are not likely to be present. Implementation of these measures during other times of the year and east of 146° longitude, however, could benefit other migratory birds in the Beaufort Sea.

IV.C.2.b(4) Additional Mitigation Considerations.

IV.C.2.b(4)(a) Evaluation of Bird-Hazing Techniques. Conservation recommendations included as part of the FWS Biological Opinion on Sale 186 included that oil-spill-contingency plans for exploration and delineation wells drilled as a result of that sale include measures and capability to deploy at least 10 Breco buoys (or other similar devices, to be approved by the FWS) to haze or scare seaducks from oiled areas in the event of a marine spill. The success of Breco buoys to haze or scare ducks, however, appears mixed (Whisson and Takekawa, 1998; Canadian Wildlife Service, 2006). Hazing also may have limited success during spring, when migrants occupy open water in ice leads. Actively hazing birds out of ice leads that oil is expected to enter may be counterproductive, because there are few alternative habitats that flushed birds can occupy. There do not appear to be clear guidelines of when these buoys should be deployed, maintained, or monitored during an actual spill event or if they would achieve the desired results of displacing birds from oiled areas.

An emerging hazing technique is the use of low-power lasers to scare birds away from certain areas (Briot and Bataille, 2003; USDA, APHIS, 2003). This technology has not been assessed for arctic environments; and it offers some additional potential for reducing impacts to marine and coastal birds from an oil spill. As the greatest potential for significant impacts to marine and coastal birds arises from oil spills, any effort to reduce the interaction between birds and spilled oil could reduce further the potential for significant impacts. A workshop to develop a set of field trials to evaluate hazing technology in marine environments would greatly improve our understanding of the anticipated benefits of hazing devices for use in oil-spill response in the Beaufort Sea. Effective hazing devices, properly deployed and maintained, could mitigate the potential for significant impacts to marine and coastal birds during exploration and delineation activities following Sale 202.

IV.C.2.b(4)(b) Identification of High Value Yellow-Billed Loon Habitats. An assumed pipeline landfall at Smith Bay could be integrated with future oil-transportation infrastructure in the NPR-A, which presumably would avoid or minimize additional adverse impacts to eiders, yellow-billed loons, and other sensitive species. If no infrastructure in the NPR-A exists, a pipeline and associated development features from an offshore production platform routed south of Teshekpuk Lake should be designed and constructed in a manner that would have the least adverse impacts to these species. If core breeding areas for the yellow-billed loon, for example, were to be identified, they might warrant special protections from potential development activities and other human disturbances (Fair, 2002). Such topics would be addressed in a subsequent NEPA review for any development plan for any lease issued under Sale 202.

IV.C.2.b(5) Overall Conclusion – The Mitigated Effect. While a remote possibility, a large spill in the wrong place at the wrong time has the potential to negatively impact certain species through direct losses and through long-term sublethal chronic effects on a population level. The ongoing active monitoring by MMS of lessees' storage and delivery systems, and of effective response to a variety of oil-spill scenarios, probably is the best way to minimize impacts to coastal and marine birds. Proposed and pending studies on bird distribution and species-specific responses to hazing activities would further aid in minimizing bird impacts from a spill during a variety of environmental conditions.

The factors noted above could cause variability in the effects an oil spill might have on bird populations, but there currently is no evidence that would prompt a change in the multiple-sale conclusions that: (1) small numbers of spectacled eiders and other species could be lost through collision with offshore or onshore structures, but no statistical population-level effects are likely to result; and (2) in the unlikely occurrence of an oil spill of 1,500 bbl or 4,600 bbl, potential mortality is likely to be fewer than 100 spectacled eiders, few Steller's eiders, low hundreds of king and common eiders, and 1,000 or more long-tailed ducks. Any substantial loss of spectacled, Steller's, king, or common eiders or long-tailed ducks would represent a potentailly significant effect, as noted in the multiple-sale EIS, and recovery of Alaskan populations of species currently exhibiting a decline (all but king eider and certain shorebirds) is not likely to occur. Other species having limited distribution or low population numbers also could experience substantial mortality.

For purposes of analysis, the multiple-sale EIS assumes that a spill of 1,500 bbl or 4,600 bbl would occur as a result of the three proposed sales. This review of new information confirms that document's conclusions that mortality of fewer than 100 spectacled eiders, low hundreds of king and common eiders, 1,000 or more long-tailed ducks, and few Steller's eiders could result from such a spill. The magnitude of the effect would vary with spill volume, location with respect to bird concentrations, the spill response, and ice conditions. However, such losses would represent potentially significant effects in the case of these species, as noted in the multiple-sale EIS, and recovery of their Alaskan populations is not likely to occur for species currently exhibiting a decline (i.e., all but the king eider).

There is no suggestion in recent study results that disturbance effects or potential mortality of eiders, long-tailed ducks, or other species from collisions with structures associated with activities following Sale 202 would exceed the small losses estimated for Sales 186 and 195, and none of these factors are expected to result in significant effects.

Conclusion: In the context of new information that has become available since publication of the multiple-sale EIS, these conclusions remain consistent; thus, the updated potential level of effect on marine and coastal bird populations is expected to be the same as stated in the multiple-sale EIS.

IV.C.2.c. Local Water Quality. This section updates the assessment of effects on local water quality as a result of the Proposed Action (Alternative VII). The section includes four subsections, which summarize the multiple-sale EIS and Sale 195 EA assessments that are being updated, update those effects, add the benefits of the standard mitigation, and summarize the conclusion (i.e., the mitigated effect).

IV.C.2.c(1) Summaries of Multiple-Sale EIS and Sale 195 EA Assessments Updated by this EA for Sale 202. The OSRA indicated that a spill of 1,500 bbl or 4,600 bbl could occur as a result of Beaufort Sea Sales 186, 195, and 202. The water quality assessment concluded that such a spill would have significant effects, primarily because spill responses were only partially effective in broken ice. The assessment assumed that there would be spill responses because, as explained in Section IV.A.1.c, they are required by existing MMS regulations.

The following is part of the conclusion in the multiple-sale EIS about, specifically, proposed Sale 202 (USDOI, MMS, 2003:Sec. IV.C.1.b(1):

> Hydrocarbons...from a large oil spill could exceed the 1.5 parts per million acute toxic criterion during the first day of a spill and the 0.015 parts per million chronic criterion for up to a month in an area the size of a small bay. Other potential consequences of the lease sale would not have major effects on local water quality, including the following three permitted activities. The increased turbidity from permitted construction activities would be local and short term. Trace metals from permitted discharges of drilling muds and cuttings over the life of the field could

exceed sublethal levels over only a few square kilometers. If produced waters were discharged, the effect on water quality would be local but would last over the life of the field(s).

The Sale 195 EA concluded similarly (USDOI, MMS, 2004:Sec. IV.C.1.c):

> The conclusion in the multiple-sale EIS about the effects of large spills on local water quality is still appropriate. The conclusion is still that large spills in broken ice would lead to hydrocarbon concentrations in the surface water in excess of the acute toxic criteria during the first day in a local area, and in excess of the chronic criteria for up to a month in an area the size of a small bay.

These assessments are updated in the following section.

IV.C.2.c(2) Update of Those Effects for the Proposed Action - Alternative VII. The USEPA issued new standards for the National Petroleum Discharge Elimination System (NPDES), entitled the Arctic NPDES General Permit for Oil and Gas Exploration, and dated October 2005. It defines an unreasonable degradation as "irreparable harm"; i.e., as significant undesirable effects occurring after the date of permit issuance that will not be reversed after cessation or modification of the discharge. The USEPA definition of significance would alter neither the water quality criteria for proposed Sale 202 (Sec. IV.C.1) nor the multiple-sale conclusions about effects of proposed Sale 202 on local water quality.

This update of the assessment for proposed Sale 202 will review first the assessment of oil-spill effects and then the effects of routine, permitted activities.

IV.C.2.c(2)(a) Updated Oil-spill Effects. As explained in Section IV.A.2, MMS data on the probability of spills have been updated and new OSRA tables have been prepared (Sec. IV.A.1.b and Appendix C). The new data do not affect the OSRA tables with "conditional" probabilities, which assume that a spill has occurred. The water quality assessment in the multiple-sale EIS was based only on conditional probabilities (USDOI, MMS, 2003:Sec. IV.C.1.a(1)); therefore, the assessment would not change due to the new OSRA data.

Oil-spill effects would be influenced also by a broad-scale increase in dissolved petroleum in the receiving water, such that chronic or toxic concentrations would be exceeded more frequently. A recent study of polycyclic aromatic hydrocarbons (PAH) and saturated hydrocarbons (SHC) near the Northstar development site detected no signs of Northstar-related petroleum hydrocarbons (Brown et al., 2005). Another recent study of PAH and saturated compounds in Beaufort Lagoon near the Eastern Deferral area concluded that the concentrations were similar to or below those reported for unpolluted nearshore regions (Naidu et al., 2005). The latter study also concluded that the hydrocarbon components in the sediments were biogenic with undetectable signs of petroleum. The two studies indicate that there has been no change in the background level of hydrocarbons in the proposed lease-sale area.

The effect of a spill on water quality would be influenced also by changes in required spill-response plans. As summarized in Section IV.A.1.c of this EA, the multiple-sale EIS explains that spill-response capability is required for OCS operations, and that an industry consortium stockpiles response equipment in the Prudhoe Bay area for all three arctic operating seasons—solid ice, open water, and broken ice (USDOI, MMS, 2003:Sec. IV.A.6). For the solid-ice season, spill-response demonstrations have shown that there are effective tactics and equipment for oil recovery. For the open-water season, the effectiveness of spill-response equipment is similar to that for other OCS areas.

For the broken-ice season, the Beaufort Sea multiple-sale EIS explained that research related to spill response was ongoing (USDOI, MMS, 2003:Sec. IV.A.6.d). Recent spill demonstrations and drills have shown that the effectiveness of response equipment is still reduced greatly by broken ice. An industry spill-response consortium has designed tactics and equipment for the pools of oil that tend to form around broken pieces of ice during late spring and summer. Broken ice can enhance nonmechanical response such as in situ burning. In situ burning of oil as it floats on the ocean surface can remove in excess of 90% of the oil volume (Buist and S.L. Ross Environmental Research Ltd., 1999). Broken ice can serve to concentrate oil along the ice edge, permitting combustion of the oil with minimal use of containment boom and vessels. Tactics have been developed to allow for oil ignition using helicopter-borne torches, giving responders greater access during times when conditions would prohibit access by vessels. Following combustion of the oil, burn residue would be collected manually, further reducing the presence of hydrocarbons in the water. However, as noted in the multiple-sale EIS (USDOI, MMS, 2003:Sec. IV.A.6.a), once ice crystals were present in the water during the autumn broken-ice season, skimming systems effectively were shut down. Therefore, we still conclude that large spills in broken ice could lead to concentrations of hydrocarbons in the surface water in excess of the toxic and chronic criteria.

Spill-response equipment and tactics have continued to improve, but the change in broken-ice spill-response equipment has been conceptual in nature rather than fundamental—broken-ice limits the effectiveness of existing mechanical response equipment yet can enhance in situ burning-response activities.

IV.C.2.c(2)(b) Updated Effects of Routine, Permitted Activities. Factors related to permitted activities and to effects on water quality include discharges and facility construction; the former could influence the concentration of heavy metals in the sediments, and the latter could influence the concentration of suspended sediments. Both suspended sediments and metals in the sediments would be influenced in a general way by water-column mixing. The update on the physical environment (Sec. IV.A.1) explains that recently the ice cover has retreated far offshore during summer and autumn. The seasonal decrease of the ice cover nearshore would increase water-column mixing temporarily, which would tend to mix and dilute the local effects of discharges.

The concentrations of heavy metals in Beaufort plankton were re-examined recently (Stern and MacDonald, 2005). The study showed that the background concentrations of total mercury in plankton were low, and that the concentrations in the Canada Basin were about twofold higher than the concentrations farther west. The study also showed that the concentrations were elevated during and shortly after melt, indicating that snow was the immediate source of the mercury. The study did not determine the ultimate source of the mercury entrained in the snow. The study indicated no change in the concentration of heavy metals in the proposed lease-sale area.

Construction could influence the concentrations of sediments and total suspended solids (TSS). A recent study of seabed sediment near Northstar Island concluded that there was a shift in grain size near the island, and that the island possible influenced the grain size (Brown et al., 2005). Bottom samples near the island from 1999 contained mostly sand and gravel, but samples from similar locations in 2000 contained mostly silt and clay. The largest shifts occurred landward of Northstar Island. The authors concluded that the mechanism for the shift was unknown but suggested that 1999 storms had eroded away most of the fine-grained sediment. The MMS is continuing to fund the study.

The TSS were remeasured recently near an artificial island for an offshore development near Prudhoe Bay (Trefry et al., 2005). The study detected temporary increases in TSS that were related to river runoff and resuspension of bottom sediment by strong winds. However, the study found no statistical differences in TSS concentrations that could be directly linked to oil and gas development.

In summary, the new information on National Pollution Discharge Elimination System (NPDES) criteria, oil-spill effects, and discharges indicates that the multiple-sale conclusion for local water quality is still appropriate.

IV.C.2.c(3) Benefits of the Standard Mitigation. The standard mitigation includes two measures with direct benefits: Transportation of Hydrocarbons and Pre-Booming Requirements for Fuel Transfers.

IV.C.2.c(3)(a) Transportation of Hydrocarbons. The benefits of this stipulation are summarized in the multiple-sale EIS (USDOI, MMS, 2003:Sec. II.H.1.c). The U.S. spill rate from pipelines is lower than the rate from barges, and this stipulation requires pipeline when feasible. Specifically, pipelines will be required if: (a) pipeline rights-of-way can be determined and obtained; (b) laying such pipelines is technologically feasible and environmentally preferable; and (c) in the opinion of the lessor, pipelines can be laid without net social loss, taking into account any incremental costs of pipelines over alternative methods of transportation and any incremental benefits in the form of increased environmental protection or reduced multiple-use conflicts.

IV.C.2.c(3)(b) Pre-Booming Requirements for Fuel Transfers. The benefits of this stipulation are summarized in the multiple-sale EIS (USDOI, MMS, 2003:Sec. II.H.2.c). The stipulation would require the pre-booming of fuel barges during large fuel transfers in the bowhead whale-migration corridor. The stipulation might not reduce the risk of spills, but it would increase the speed and effectiveness of responses. The effectiveness of the response would be increased especially during broken-ice conditions when, as noted in the previous discussion, the effectiveness of existing equipment is particularly limited.

IV.C.2.c(4) Overall Conclusion - The Mitigated Effect. The new information on water quality and spill responses indicates that the conclusion in the multiple-sale EIS is still appropriate; the level of effect still would be potentially significant, partly because of the low level of turbulence in Beaufort ice-covered waters and partly because of the difficulty of spill responses during the broken-ice season. Specifically, the assumed spill of 1,500 bbl from a blowout or 4,600 bbl from a underwater pipeline in the proposed lease-sale area over the life of any leases sold for this sale could lead to hydrocarbon concentrations in the surface water in excess of the 1.5 ppm acute toxic criteria during the first day in a local area, and in excess of the 0.015 ppm chronic criteria for up to a month in an area the size of a small bay.

IV.C.2.d. Bowhead Whales. This section updates the assessment of effects on bowhead whales for the Proposed Action (Alternative VII) for proposed Sale 202. There are four subsections, which summarize the multiple-sale EIS and Sale 195 EA assessments that are being updated, update the effects, incorporate the benefits of the standard mitigation, and summarize the conclusion (i.e., the mitigated effect).

IV.C.2.d(1) Summaries of Multiple-Sale EIS and Sale 195 EA Assessments Updated by this EA for Sale 202. The Beaufort Sea multiple-sale EIS states that the effects of proposed Sale 202 on bowheads whales are expected to be similar to those for Sales 186 and 195 (USDOI, MMS, 2003:Sec. IV.C.5.a(2)(c)2)c)). The following is the updated summary of those effects in the Sale 195 EA (USDOI, MMS, 2004:Sec. IV.C.1.d):

> Bowhead whales exposed to spilled crude oil likely could experience temporary or perhaps permanent nonlethal effects. However, data on other mammals indicates that exposure to large amounts of freshly spilled oil also could kill some whales. While there is uncertainty about the exact nature and level of effect of a very large spill under highly specific distribution patterns, available information, considered in its entirety, does not indicate it is likely that there would be a significant effect from the Proposed Action on this population. The optional stipulation on Pre-Booming Requirement for Fuel Transfers should ensure rapid spill responses, decreasing the likelihood that large fuel spills would affect bowhead whales during their migration. Bowhead whales exposed to noise-producing activities such as vessel and aircraft traffic, drilling operations, and seismic surveys most likely would experience temporary, nonlethal effects. Some avoidance behavior could persist up to 12 hours.... The Industry Site-Specific Bowhead Whale-Monitoring Program should effectively detect a delay or blockage of the migration, thereby alerting regulatory agencies about effects. Both the Marine Mammal Protection Act and the ESA provide sufficient regulatory authority to ensure the long-term protection of this population from noise-producing activities associated with oil and gas activities that are reasonably foreseeable. Based on our consideration of information available since the publication of the EIS and of previously available information, our reanalysis of potential effects for bowhead whales supports the conclusion that no significant impacts to this endangered species are expected due to activities associated with proposed Lease Sale 195.

IV.C.2.d(2) Update of Effects Analysis for the Proposed Action – Alternative VII. The MMS recently prepared two assessments on the potential effects of OCS activities on bowhead whales: the Biological Evaluation (BE) of the potential effects of oil and gas leasing and exploration in the Alaska OCS on endangered bowhead whales, dated March 3, 2006; and the *Programmatic Environmental Assessment, Arctic Ocean Outer Continental Shelf Seismic Surveys - 2006* (USDOI, MMS, 2006a,b). The PEA available on the MMS website: http://www.mms.gov/alaska/ref/pea_be.htm.

This update summarizes and augments the BE and PEA assessments. Introductory information on general effects, assessment assumptions, and potential pathways of impact is provided in PEA Sections III.F.3.f (1) through (3) and in BE Sections IV.A and B. The following sections summarize first the information on the potential effects of oil spills and then of routine, permitted operations, including seismic exploration.

IV.C.2.d(2)(a) Updated Oil-spill Effects. The potential effects of large and very large oil spills on bowhead whales are summarized in BE Sections IV.F. The section summarizes the potential for exposure to spilled oil, potential effects, key observations of cetaceans after spills, potential effects of oil spills on bowheads, including inhalation, direct contact with skin, ingestion, baleen fouling, effects on food sources, displacement from feeding areas, areas and circumstances where effects are likely to be great, and oil-spill-response activities.

The MMS continually updates information on the OSRA. The MMS data on the probability of spills was updated for proposed Sale 202. The new OSRA data is summarized in Section IV.A.1.b, and the tables are included in Appendix C. The new data does not affect the OSRA tables with "conditional" probabilities, which assume that a spill has occurred. The new data affects only the tables with "combined" probabilities, which include the probability of a spill. The assessment of bowhead whales in the multiple-sale EIS was based primarily on conditional probabilities (USDOI, MMS, 2003:Sec. IV.C.5.a(1)(e)), and those probabilities would not change. However, one part of that section was based on combined probabilities, stating:

> For combined probabilities, the Oil-Spill-Risk Analysis model estimates a less than 0.5-1% chance that one or more oil spills greater than or equal to 1,000 barrels would occur from a production facility or a pipeline (LA1-LA18 or P1-P13, respectively) and contact ERA's 19-37 within 180 days (Table A.2-56). There is a 1% chance that one or more spills would occur and contact ERA 28 (Beaufort Spring Lead 10), the resource area with the highest chance of contact.

With the updated OSRA, the probability has increased slightly (see Appendix C, Table C-14), but the chance that spills would occur and contact the Beaufort Spring Lead still is <1%.

During June 2006, NMFS updated the Arctic Region Biological Opinion (ARBO), which covers the effects of proposed Lease Sale 202 (Appendix E). With regard to the effects of oil spills, the ARBO concludes in Section VII about Incremental Step Consultation that:

> MMS investigated the probability of spilled oil contacting bowhead whales (MMS, 2000). Specific offshore areas (Ice/Sea Segments or ISS) were identified and modeled for probability of contact. Certain of these ISS's overlay the migratory corridor of the bowhead. Using data from the MMS oil spill analysis for Sale 170, and assuming an oil spill of 1,000 barrels or more occurred at any of several offshore release areas (launch boxes) during the summer season, the chance of that oil contacting these ISS's within 30 days during the summer season ranged from 5-82%. The reader should note that the MMS model includes ISS's that are within the launch box. That is, some of the offshore habitats being assessed for probability of contact lay within the area of the theoretical spill release. Despite the statistical probabilities presented, which depend on a spill contacting a discrete area, NMFS believes there are many scenarios for which the conditional probability of spilled oil reaching areas utilized by bowhead whales is 100%.
>
> Most whales exposed to spilled oil are expected to experience temporary, nonlethal effects from skin contact with oil, inhalation of hydrocarbon vapors, ingestion of oil-contaminated prey items, baleen fouling, reduction in food resources, or temporary displacement from some feeding areas. A few individuals may be killed as a result of exposure to freshly spilled oil. However, the combined probability of a spill occurring and also contacting bowhead habitat during periods when whales are present is considering (sic) to be low, and the percentage of the Beaufort Sea stock so affected is expected to be very small.

> The probability of an oil spill increases as more oil fields become active. Oil has been documented to be highly toxic to polar bears (Oritsland et al., 1981:6), ringed seals (Geraci and Smith, 1977:402), harbor seals (Frost and Lowry, 1994:1), and sea otters (Mulcahy and Ballachey, 1994:327). No measurable impact on humpback whales in Prince William Sound was observed in 1989 as a result of the Exxon Valdez oil spill (von Ziegesar et al., 1994:188), but a suspicious decline in numbers of killer whales following this spill suggests that whales may be severely impacted by an oil spill (Matkin et al., 1994:160). Without conclusive data, it is assumed that bowhead whales would be susceptible to an oil spill during feeding and migration, particularly if they came in contact with oil in the lead system during spring migration. A number of small oil spills have occurred during oil and gas exploration in the Alaskan Beaufort Sea in past years. Only five spills have been greater than one barrel, and the total spill volume from drilling 52 exploration wells (1982 through 1991) was 45 barrels (USDOI, MMS, 1996:IV.A-10). Based on historical data, most oil spills would be less than one barrel, but a larger oil spill could also occur. Considering the number of days each year that bowhead whales may be present in or migrating through the area, the probability that a spill would occur, the probability for a spill to occur or persist during periods when whales are present, and the probability that oil would more into the migration corridor of the bowheads (at least that portion of the corridor outside of the barrier islands), it is unlikely that bowhead whales would be contacted by oil. Significant adverse affects (sic) would only be expected if all of the low probability events occurred at the same time.

The above paragraph from the ARBO refers to five small spills from 52 exploration wells in Alaskan OCS waters. The likelihood of small spills is discussed further in the Sale 144 EIS (USDOI, MMS, 1996b:IV.A-10) and the multiple-sale EIS (USDOI, MMS, 2003:IV.15).

IV.C.2.d(2)(b) Updated Effects from Routine, Permitted Operations. With regard to the effects of seismic exploration, the NMFS ARBO concludes in Section VII about Incremental Step Consultation that:

> The effects of noise on bowheads from various OCS production activities have been described. The effects from an encounter with aircraft generally are brief, and the whales should resume their normal activities within minutes. Bowheads may exhibit temporary avoidance behavior to vessels at a distance of 1-4 kilometers. Many earlier studies indicate that most bowheads exhibit avoidance behavior when exposed to sounds from seismic activity. Bowheads also exhibited tendencies for reduced surfacing and dive duration, fewer blows per surfacing, and longer intervals between successive blows. Bowheads appeared to recover from these behavioral changes with 30-60 minutes following the end of seismic activity. Monitoring has shown bowheads avoid areas exposed to seismic sounds, with near total avoidance of the area within 20 km or 11 n. mi. (12 st. mi.) of the source vessel at times influenced by airgun operations. Data from monitoring seismic operations from 1996-98 suggested that the offshore displacement may have begun roughly 35 km (19 n. mi. or 22 st. mi.) east of the activity, and may have persisted over 30km to the west (Richardson, 1999a).
>
> Bowheads have been sighted within 0.2-5 kilometers from drill ships, although bowheads change their migration speed and swimming direction to avoid close approach to noise-producing activities. Bowheads may avoid drilling noise at 20-30 kilometers when the S:N is 30 dB. Overall, bowhead whales exposed to noise-producing activities most likely would experience temporary, nonlethal effects. Some avoidance behavior could persist up to 12-24 hours.

IV.C.2.d(3) Overall Conclusion – The Mitigated Effect. With regard to oil spills, the updated OSRA shows that the probability of a spill has increased slightly, but that the chance that spills would occur and contact the Beaufort Spring Lead still is <1%. The NMFS' ARBO concludes in Sections VI and VII that:

> After reviewing the current status of the bowhead whale, the environmental baseline for the action area, the biological and physical impacts of oil leasing and exploration, and cumulative effects, and in consideration that the described actions are expected to impact only the Western Arctic stock of bowhead whales, it is NMFS's biological opinion that oil and gas leasing and exploration in the Chukchi and Beaufort Seas is not likely to jeopardize the continued existence of the

Balaena mysticetus endangered bowhead whale. No critical habitat has been designated for the bowhead whale, therefore none will be affected.

Taking these factors into consideration, NMFS concludes that, at this time, there is reasonable likelihood that oil and gas development and production in the Alaska Beaufort and Chukchi Seas, as described, would not violate section 7(a)(2) of the ESA.

We still conclude that, based on our consideration of information available since the publication of the EIS and of previously available information, our reanalysis of potential effects for bowhead whales supports the conclusion that no significant impacts to this endangered species are expected due to activities associated with proposed Lease Sale 202.

IV.C.2.e. Polar Bear. This section updates the assessment of effects on polar bears as a result of the Proposed Action (Alternative VII). The section includes four subsections, which summarize the multiple-sale EIS and Sale 195 EA assessments that are being updated, update those effects, incorporate the benefits of the standard mitigation, and summarize the conclusion (i.e., the mitigated effect).

IV.C.2.e(1) Summaries of Multiple-Sale EIS and Sale 195 EA Assessments Updated by this EA for Sale 202. The Beaufort Sea multiple-sale EIS (USDOI, MMS, 2003:Sec. IV.C.7.b(2) concludes the following about the effects of proposed Sale 202 on polar bears: "The effects from activities associated with Alternative I for Sale...202 exploration and development are estimated to include the loss of small numbers of...polar bears...(...perhaps 6-10 bears...), with populations recovering within about 1 year."

The EA for Sale 195 concluded that the new information did not change the conclusion of no significant population-level effects to polar bears due to the proposed lease sale.

IV.C.2.e(2) Update of those Effects for the Proposed Action - Alternative VII. Concerns for potential adverse impacts to polar bears are an increasing concern due to ongoing changes in their sea-ice habitat, their distribution, and the uncertain status of their populations (Sec. IV.A.1; Appendix D, Sec. D.4.b). For these reasons we review the effects the Proposed Action may have on polar bear populations. For purposes of this analysis, the multiple-sale EIS defines a potentially significant impact to polar bears as: "An adverse impact that results in an abundance decline and/or change in distribution requiring...one or more generations...for the indicated population to recover to its former status" (USDOI, MMS, 2003:Sec. IV.A.1).

Documented impacts to polar bears to date in the Beaufort Sea by the oil and gas industry appear minimal. Since 1968, there have been only two documented cases of lethal takes of polar bears associated with oil and gas activities in the Southern Beaufort Sea: one at an offshore drilling site in the Canadian Beaufort Sea (1968) and one bear at the Stinson site in the Alaska Beaufort Sea (1990). Another bear died on an offshore island in the Alaska Beaufort Sea (1988) after it ingested ethylene glycol, although the source was never determined. In contrast, 33 polar bears were killed in the Canadian Northwest Territories from just 1976-1986 due to encounters with industry (Angliss and Lodge, 2004; 71 *FR* 14,460).

IV.C.2.d(2(a) Updated Oil-Spill Effects. The MMS data on the chance of one or more spills has been updated and new OSRA tables have been prepared (Sec. IV.A.1.b and Appendix C). The new data do not affect the OSRA tables with "conditional" probabilities, which assume that a spill has occurred. The new data affects only the tables with "combined" probabilities, which include the chance of one or more large spills occurring and contacting a given point. The polar bear assessment in the multiple-sale EIS was based only on conditional probabilities (USDOI, MMS, 2003:Sec. IV.C.7.a(2)(b)2).

Potential adverse impacts to polar bears from oil and waste-product spills as a result of industrial activities in the Beaufort Sea are a major concern. Development of additional offshore production facilities and pipelines will increase the potential for large offshore spills. As far as is known, however, marine mammals have not been affected by oil spilled as a result of North Slope industrial activities to date, although at least one polar bear fatality has resulted from ingestion of industrial chemicals (Amstrup, Myers, and Oehme, 1989). With the limited background information available regarding large oil spills in the offshore arctic environment, the outcome of a large oil spill is uncertain.

Between 1977 and 1999, an average of 70 oil and 234 waste-product spills occurred annually on the North Slope oil fields, and between 1985 and 1998, five large terrestrial spills occurred on the North Slope (71 *FR* 14,456). In March, 2006, more than 200,000 gallons of oil (4,790 bbl) leaked onto the tundra as a result of an undetected leak in a corroded pipeline. As demonstrated by this spill, small, chronic leaks in underwater pipelines could result in large volumes of oil being released underwater without detection. The current leak-detection system installed at the Northstar facility, which is producing OCS oil, includes the LEOS leak-detection system that can detect very small leaks (0.3 bbl) within 24 hours (USDOI, MMS, 2002). If an undetected underwater spill occurred during the winter, the release of oil trapped under the ice during spring breakup could be equivalent to a large oil spill. For the Proposed Action, the chance of one or more large spills occurring, based on OSRA analysis, is 21% (Appendix C, Sec. C.6). This figure represents the chance of one or more large spills for the Proposed Action and alternatives based on the mean spill rate over the life of the project (Figs. C-5 through C-9). The chance of no spills occurring is 79%. The highest combined probability of one or more large oil spills occurring and contacting a land segment is <2% within 60 days.

Spilled oil can have dramatic and lethal effects on marine mammals, as has been shown in numerous studies, and a large oil spill could have major effects on polar bears and seals, their main prey (St. Aubin, 1990a,b). In polar bears, oiling can cause acute inflammation of the nasal passages, marked epidermal responses, anemia, anorexia, stress, renal impairment, and death. These effects may not become apparent until several weeks after exposure to oil. Oiling of the pelt causes serious thermoregulatory problems for marine mammals by reducing its insulation value. Skin damage and hair loss also can occur (Oritsland et al., 1981). Because bears frequently groom their fur when it is fouled, we can expect that a spill in the Beaufort Sea would result in contaminated bears ingesting oil, and thus becoming susceptible to both lethal and chronic, sublethal effects of hydrocarbon exposure. Spilled oil also can concentrate and accumulate in leads and openings that occur during spring breakup and autumn freezeup periods. Such mechanical concentration of spilled oil would increase the chance that polar bears and their principal prey would be oiled (Amstrup, Durner, and McDonald, 2000). Bears are known to be attracted to petroleum products and can be expected to actively investigate oil spills; they also are known to consume foods fouled with petroleum products (Derocher and Stirling, 1991). In fact, one subadult polar bear in Canada was observed drinking an estimated four liters of hydraulic oil from a pail left outside of a building (Derocher and Stirling, 1991).

Amstrup et al. (2000) calculated the number of polar bears potentially killed by a 5,912-bbl spill at the Liberty prospect using hypothetical oil spill scenarios created by MMS with modification of the OSRA model. Section IV.A.4 contains up-to-date information about MMS regulations and requirements that would help to minimize potential oil spills, such as the LEOS leak detection system that was installed as part of the Northstar pipeline monitoring system. Regardless, Amstrup et al. calculated a "worst case scenario" for a large oil spill, and assumed that all bears that contacted an oil spill would die. The number of oiled bears ranged from 0-25 bears during the open-water period (August 22-September 30) and 0-61 bears during the broken-ice period (October 1-November 9) (Amstrup, Durner, and McDonald, 2000; Durner and Amstrup, 2000). In most hypothetical oil spills they modeled, the median number of bear fatalities was fewer than 12, while the maximum number was 61. Oil-spill scenarios were only modeled out to 10 days due to the limits of the model's analytical power beyond that timeframe (Amstrup, Durner, and McDonald, 2000). However, it should not be assumed that the effects of an oil spill would last for only 10 days, or that beaches and barrier islands would not be fouled for a year or more. Also, the model only analyzed spills that originated from Liberty Island. Results likely would be much different if the model analyzed spills that originated in other areas (e.g., near Kaktovik or Barrow) and if modeled for longer than 10 days.

Due to the seasonal distribution of polar bears, the times of greatest impact from an oil spill are summer and autumn (Amstrup, Durner, and McDonald, 2000). This is important because distributions of polar bears are not uniform through time. In fact, nearshore densities of polar bears are two to five times greater in autumn than in summer (Durner and Amstrup, 2000), and polar bear use of coastal areas during the fall open-water period has increased in recent years in the Beaufort Sea. This change in distribution has been correlated with the distance to the pack ice at that time of year (i.e., the farther from shore the leading edge of the pack ice is, the more bears are observed onshore) (Schliebe et al., 2005). Furthermore, surveys flown in September and October 2000-2005 have revealed that 53% of the bears observed along the Alaskan Beaufort Sea coast have been females with cubs, and that 71% (1,100 of 1,547) of all bears observed were within a 30-km radius of the village of Kaktovik, on the edge of the Arctic National Wildlife Refuge (ANWR) (USDOI, FWS, pers. commun.).

Polar bears aggregate along the Beaufort Sea coastline in the fall in areas where marine mammals have been harvested and butchered by Alaskan Native hunters. Specific aggregation areas include Point Barrow, Cross Island, and Kaktovik (USDOI, FWS, 1999). In recent years, more than 60 polar bears have been observed feeding on whale carcasses just outside of Kaktovik (Miller, Schliebe, and Proffitt, 2006), and in the autumn of 2002, North Slope Borough and FWS biologists documented more than 100 polar bears that came ashore in and around Barrow (USDOI, FWS, pers. commun.). Polar bear concentrations also occur during the winter in areas of open water, such as leads and polynas, and areas where beach-cast marine mammal carcasses occur (USDOI, FWS, 1999).

Although there is a low probability that a large number of bears (i.e., 25-60) might be affected by a large oil spill, the impact of a large spill, particularly during the broken-ice period, would be potentially significant to the polar bear population (65 *FR* 16833). The number of polar bears affected by an oil spill could be substantially higher if the spill spread to areas of seasonal polar bear concentrations, such as the area near Kaktovik, in the fall, and would have a potentially significant impact to the Southern Beaufort Sea (SBS) polar bear population. In fact, the FWS calculated that the Potential Biological Removal (PBR) for the SBS stock, assuming an equal sex ratio for bears removed from the population, is 59 bears per year, of which no more than 30 may be females (Angliss and Lodge, 2004). A spill near Barrow, which would affect both the SBS and Chukchi/Bering Sea (CBS) stocks, could have a similar impact, particularly on the CBS stock, which likely already is in decline (Appendix D, Sec. D.4.b).

Current human harvest of the SBS stock is believed already to be at or near the maximum sustainable level; therefore, any mortality due to an oil spill would be additive. Sustainable quotas under the Polar Bear Management Agreement for the Southern Beaufort Sea, a voluntary agreement that limits the total harvest from the SBS population to within sustainable levels, are set at 80 bears per year, of which no more than 27 may be female (Brower et al., 2002). Recent harvest levels (2000-2005) from the SBS stock averaged 37 individuals in the U.S. and 25 individuals in Canada, for an average total reported harvest of 62 bears per year (17 female, 34 male, 11 unknown) (USDOI, FWS, unpublished data).

Coastal areas provide important denning habitat for polar bears, particularly along the ANWR. In fact, the coastal plain of ANWR may have as much as 38% more den habitat than the central coastal plain of northern Alaska (Durner et al., 2006). Amstrup (1993) reported that, between 1981 and 1992, polar bears denned more frequently in ANWR than expected, and Amstrup and Garner (1994) reported that 80% of maternal polar bear dens on land along the southern Beaufort Sea coast occurred in the northeast corner of Alaska and the adjacent Yukon Territory. Lentfer and Hensel (1980) suggested that the preponderance of maternal dens in this region may be due to the east-to-west pattern of coastal ice formation in the fall that allows pregnant bears access to terrestrial denning habitat sooner here than in other regions of the coast, although this area simply may have more suitable denning habitat than other areas (Durner et al., 2006). Other important terrestrial denning areas along the Beaufort Sea coast include barrier islands, such as Pingok, Cross, Cottle, Thetis, and Flaxman islands; as well as the Colville, Sadlerochit, and Niguanak River drainages; Point Barrow, Point Lonely, Oliktok Point, Atigaru Point, and Smith Bay (USDOI, FWS, 1999). Considering that 65% of confirmed terrestrial dens found in Alaska from 1981-2005 were on coastal or island bluffs (Durner et al., 2006), oiling of such habitats could have a negative impact on polar bears. In fact, the loss of a large portion of the productivity of the dens from ANWR could undermine recruitment of polar bears into the Beaufort Sea population (Amstrup, 2000).

Terrestrial denning areas for bears of the CBS polar bear stock are less well understood. Radio-telemetry studies conducted in Alaska indicate that all observed denning occurs north of Point Hope (USDOI, FWS, 1999). However, traditional ecological knowledge indicates that some denning occurs on St. Lawerence

Island and Little Diomede Island, as well as along the coast between Wales and Barrow (Kalxdorff, 1997). The highest density of denning known to occur in the Chukchi/Bering seas is on Wrangel Island, Russia, and along the northern coast of Chukotka (USDOI, FWS, 1999).

The southern Beaufort Sea polar bear population is unique in that approximately 50% of its maternal dens occur annually on the pack ice (Amstrup and Garner, 1994), which requires a high level of sea-ice stability for successful denning. Reproductive failure is known to occur in polar bears that den on unstable sea ice (Lentfer, 1975; Amstrup and Garner, 1994). If sea-ice extent in the Arctic continues to decrease (Sec. IV.A.1) and the amount of unstable ice increases, a greater proportion of polar bears may seek to den on land (Durner et al., 2006). Those that do not may experience increased reproductive failure, which would have population-level effects. As a result, land denning likely will become more important in the future, which further highlights the importance of protecting sensitive terrestrial denning habitat.

If an oil spill does occur, the chance of it contacting the coastline of ANWR specifically would be highest for any inshore spill in the eastern Alaskan Beaufort Sea (USDOI, MMS, 2003:Sec. IV.C.2.a(3)(b)(2)). The Kaktovik area (LS 47) has one of the highest chances of spill contact, up to 16% from either LA1-LA18 or P1-P13, assuming spills occur during the summer season and contact the coastline within 30 days (USDOI, MMS, 2003:Sec. IV.C.7.a(2)(c)(2)). Additionally, the chance of a spill contacting the coast anywhere between Brownlow Point and the Canadian border (LS's 43-51) within 30 days during the open-water period is as high as 49% (Table A2-87), and the chance of a spill contacting the coast near Barrow (LS's 24-27) is as high as 42% (Table A2-27). If a spill did contact the shoreline, spilled oil could persist in sediments for more than a decade (USDOI, MMS, 2003:Sec. IV.C.2.a(3)(b)(2)). The combined probability of one or more large oil spills occurring and contacting a land segment in the Beaufort Sea is <2% within 60 days.

The persistence of toxic subsurface oil and chronic exposures, even at sublethal levels, can have long-term effects on wildlife (Peterson et al., 2003). For example, as a result of the *Exxon Valdez* spill, oil persisted in surprising amounts and in toxic forms in coastal areas of south central Alaska and was sufficiently bioavailable to induce chronic biological exposures in animals for more than a decade, resulting in long-term impacts at the population level, particularly for species closely associated with shallow sediments (Peterson et al., 2003). Although it may be true that small numbers of bears may be affected by an oil spill initially, the long-term impact potentially could be much worse. Oil effects can be substantial over the long term through interactions between natural environmental stressors and compromised health of exposed animals, and through chronic, toxic exposure as a result of bioaccumulation (Peterson et al., 2003). Because polar bears are the apical predator of the arctic ecosystem and are also opportunistic scavengers of other marine mammals, and because their diet is composed mostly of high-fat sealskin and blubber, polar bears are biological sinks for lipophilic pollutants that biomagnify up the food chain (Norstrom et al., 1988). The highest concentrations of persistent organic pollutants in arctic marine mammals have been found in polar bears and seal-eating walruses (Norstrom et al., 1988; Andersen et al., 2001; Muir et al., 2000; Wiig et al., 2000). As such, polar bears would be very susceptible to the effects of bioaccumulation of contaminants associated with spilled oil, which would affect the bears' reproduction, survival, and immune systems (USDOI, MMS, 2004:Sec. IV.E.2.e(1)(c)). Sublethal, chronic effects of any oil spill can be expected to further suppress the recovery of polar bear populations due to reduced fitness of surviving animals. Sublethal doses of oil contaminants can cause delayed population impacts such as health, growth, reproduction, and reduced survival in generations born after the spill (Peterson et al., 2003). Additionally, reductions in ringed seal numbers resulting from an oil spill could result in reduced polar bear recruitment and survival.

As stated previously, oil spills in the Beaufort Sea associated with Sale 202 could affect both the SBS and CBS populations of polar bears, with the CBS population being arguably more vulnerable to oil-spill impacts. A major concern regarding a large oil spill is the impact it would have on the survival and recruitment rates of these polar bear populations. Both populations potentially would face synergistic impacts from human harvests, global climate change, increased shipping traffic, a declining prey base, drownings due to severe storm events, and increased levels of disease resulting from spending more time on land and concentrated at whale carcass sites. Though the CBS and SBS populations may be able to sustain the additional mortality caused by a large oil spill, the effect of numerous bear deaths (i.e., 25-60) may reduce substantially the population rates of recruitment and survival. Any bears lost to a large oil spill would be a portion of bears lost to all causes, as outlined above, and likely would exceed sustainable levels, affecting both bear productivity and subsistence use, and potentially causing a decline in the bear population (71 *FR* 14,458). In order for the bear population to be impacted in this manner, a large volume oil spill would have to take place, the probability of which is 21% over the life of the project according to the OSRA.

The dependence of polar bear life-history strategy on constantly high adult-survival rates, which is typical of *K*-selected species, causes polar bears to be particularly vulnerable to elevated levels of mortality. Being a *K*-selected species, polar bear populations are particularly sensitive to changes in survivorship, particularly with regard to the reproductive female portion of the population. In fact, the survival rate of adult females is the predominant factor affecting population growth rates of polar bears, although other factors also may be important, such as cub survival, litter size, and age of first reproduction (Taylor et al., 1987). However, the critical issue when considering the long-term effect of any mortality on polar bear populations is the effect on numbers of breeding females. Assuming a realistic rate of natural mortality of approximately 5% per year, the annual increment of adult females would be between 1.0% and 1.6% of the total population. This annual increment is the number of adult females which can be sustainably removed from the population (Taylor et al., 1987). Under *optimal conditions*, the sustainable yield of adult female polar bears typically is <1.6% of the total population (Taylor et al., 1987), which for a population of 1,800 would equate to <29 adult female polar bears per year. It should be noted that these projections are based on a "best case" scenario and are representative of a population in a favorable environment and not experiencing other detrimental effects (Taylor et al., 1987). These figures are in line with FWS calculations of the PBR for the SBS stock. Assuming an equal sex ratio for bears removed from the population, the PBR level for the SBS stock is 59 bears per year, of which no more than 30 may be females (Angliss and Lodge, 2004). However, recent information suggests that the SBS polar bear population may be smaller than previously estimated, which would mean that even fewer bears could be sustainably removed from the population. Researchers from the USGS state that:

> High recapture rates during capture/recapture studies in 2005 and 2006 suggest that the number of polar bears in the Beaufort Sea region may be smaller than previously estimated. Final analyses of these new population data will not be completed until early in 2007, but preliminary evaluations of ongoing data collection suggest that conservative management is warranted until final estimates are calculated (Amstrup and Regehr, pers. commun.).

Because populations pushed below their level of maximum sustained yield can become unstable due to stochastic environmental processes, long time periods can be required to recover from mass mortalities (Amstrup, 2000). Hence, recovery (recruitment) rates of polar bears from any mass mortalities would depend on environmental conditions (Taylor et al., 1987). The arctic environment undergoes large-scale fluctuations between and within years, which in turn affects polar bear reproductive success (Taylor et al., 1987). The life-history strategy of polar bears is consistent with that predicted for animals that experience fluctuations in recruitment due to an unpredictable environment. Although polar bears are well adapted to their environment, they also are in a delicate ecological balance with it and, thus, susceptible to chronic and synergistic effects, as outlined previously. Environmental instability affects the number of females available for breeding, and the number that actually produce offspring, by affecting their nutritional status and the survival rates of their cubs (Stirling, Andriashek, and Latour, 1975, Lentfer et al., 1980). Hence, there is not a steady rate of recruitment into the population. In fact, on average in Alaska, only 50-60% of polar bears survive to weaning at age 2½ (Amstrup, 2003), dependent on environmental variables.

Subadult polar bears are more vulnerable than adults to environmental effects (Taylor et al., 1987). Observations of density dependent and density independent effects on populations of other marine mammals indicate that environmental effects typically are manifest first as reductions in annual breeding success and reduced subadult survival rates (Eberhardt and Siniff, 1977). Subadult polar bears would be most prone to the lethal and sublethal effects of an oil spill due to their proclivity for scavenging (thus increasing their exposure to oiled marine mammals) and their inexperience in hunting. Subadults also are the age strata that most often become "problem bears." As problem bears, they have reduced expectations of survival. Problem bear mortality may be of increasing importance as northern development proceeds

(Taylor et al., 1987). Because of the greater maternal investment a weaned subadult represents, reduced survival rates of subadult polar bears have a greater impact on population growth rate and sustainable harvest than reduced litter production rates (Taylor et al., 1987). Likewise, adult females are especially important to population growth rates because reproductive maturity indicates survival through the vulnerable subadult period.

IV.C.2.e(2)(b) Updated Effects from Routine, Permitted Operations. The multiple-sale EIS concluded that "no significant effects are anticipated from routine permitted activities" as a result of proposed Lease Sales 186, 195, and 202 (USDOI, MMS, 2003:Sec. ES.1.e(1)). Though the projected amount of seismic activity has increased since the multiple-sale EIS was written, the effects from routine, permitted operations on polar bears are still expected to be about the same as described in that document.

IV.C.2.e(2)(c) Summary of Effects Analysis. The updated description of the environment summarized the recent changes in the polar bear habitat and population (Secs. IV.B.2.d(5) and IV.B.3). More polar bears are staying on the coast during autumn, particularly near Barter Island and Barrow where there are the remains of subsistence harvests. Also, more polar bears are in the water, where they are vulnerable to severe autumn storms (Monnet and Gleason, 2006).

The updated assessment concludes that the effects of routine, permitted activities, including seismic surveying, are expected to be the same, but concludes that the effects of accidental spills could be worse than previously concluded. We note that 200,000 gallons (gal [4,790 bbl]) of oil spilled onto the tundra as a result of an undetected leak in a corroded pipeline in March, 2006. As demonstrated by this spill, small chronic leaks in underwater pipelines could result in large volumes of oil being released underwater and under the ice cover without detection. One study concluded that the effects of a large oil spill, particularly during the broken ice period, would pose potentially significant risks to the polar bear population (Amstrup, Durner, and McDonald, 2000). See Section IV.A for additional information about MMS regulations and requirements that help minimize potential oil spills and for a description of the LEOS leak detection system that was installed as part of the Northstar pipeline monitoring system. In addition, corrosion protection and physical monitoring of pipelines (e.g., smart pigging to assess the integrity of pipelines) are used to prevent leaks from occurring in the first place.

Recent USGS population analysis indicates that the SBS polar bear population is reduced from previous estimates of ~1800. This means that the Maximum Sustained Yield (MSY), or the number of animals that can be sustainably removed from the population in any given year, also is reduced.

IV.C.2.e(3) Benefits of the Standard Mitigation. Potential impacts to polar bears are an increasing concern because of ongoing changes in their sea-ice habitat, their distribution, and the uncertain status of their populations (Sec. IV.A.1; Appendix D, Section D.4.b). For these reasons, it is reasonable to review the effectiveness of the mitigation measures currently in place for Sale 202.

Because of the widespread occurrence of marine mammals in Alaskan waters, including endangered species, and the increasing level of proposed offshore activities, MMS and other agencies are scrutinizing the potential for oil and gas related activities to involve incidental takes. The taking of small numbers of marine mammals is subject to the requirements of the MMPA and ESA. Incidental taking of marine mammals and endangered and threatened species is allowed only when the statutory requirements of the MMPA and/or the ESA are met.

Section 101(a)(5) of the MMPA (16 U.S.C. 1371(a)(5)) allows for the taking of small numbers of marine mammals incidental to a specified activity within a specified geographical area. Under the MMPA, OCS operators can apply to the FWS for an ITA for polar bears. Procedural regulations implementing the provisions of the MMPA are found in 50 CFR 18.27 for FWS and at 50 CFR 228 for NMFS. Lessees are encouraged to discuss proposed activities with the MMS and FWS to determine if there is a potential for incidental takes and the timing and process for obtaining either an IHA or Letter of Authorization (LOA). The regulatory process to obtain an LOA or IHA may require 1 year or longer.

The MMS regulations require operators to submit oil spill response plans (OSRP's) with proposals for exploration and/or development (CFR 250.203, 204, and 254). The OSRP's must identify methods to protect marine and shoreline resources (30 CFR 254.23), including polar-bear aggregations on shore. The OCS operator will be advised to review the FWS' *Oil Spill Response for Polar Bears in Alaska* at (http://www.fws.gov/Contaminants/FWS_OSCP_05/FWSContingencyTOC.htm) when developing spill-response tactics.

In the past, the response plans for the proposed lease area have relied on equipment that is stored near Prudhoe Bay. Portions of the proposed lease area near Barter Island and Barrow where polar bears congregate on the coast are remote from this response equipment. If there are proposed operations in these remote areas, MMS may require operators to provide additional response measures to protect polar bears. One such measure might be the prestaging of response equipment near Barter Island and/or Barrow. In the event of an oil spill, it is likely that polar bears would be hazed intentionally to keep them away from the spill area, reducing the likelihood of the spill impacting the population. Care must be taken during response operations, however, to avoid spill-response and/or hazing activities resulting in polar bears being pushed into oiled or inhabited areas.

Existing MMS and other agencies' regulations also provide mitigation. Three standard ITL's: ITL No. 4, Information on Bird and Marine Mammal Protection; ITL No. 9, Information on Polar Bear Interaction; and ITL No. 11, Information on Sensitive Areas to be Considered in Oil-Spill-Contingency Plans. ITL No. 4 advises lessees that they are subject to the MMPA and ESA during the conduct of their operations. ITL No. 4 also encourages lessees to "exercise particular caution when operating in the vicinity of species whose populations are known or thought to be declining and which are not protected under the ESA; such as the Pacific walrus." This ITL has been modified to also emphasize polar bears. ITL No. 4 also notes that disturbance at "major wildlife concentration areas" are of "particular concern", and that "maps depicting major wildlife concentration areas in the lease area are available from the RS/FO." The MMS will consult with the FWS to get updated information for polar bear so that it may base decisions on the most current information available. The ITL on polar bear interaction advises lessees to confer with the FWS and to conduct their activities in a way that limits potential encounters and interaction between lease operations and polar bears. ITL No. 11 has been expanded to include a statement that coastal aggregations of polar bears during the open water/broken ice period are particularly vulnerable to the effects of an oil spill, which lessees must account for in their OSRP's.

Indirect benefit also is gained from the MMS Bowhead Whale Aerial Survey Program (BWASP), because the program collects sightings of both bowhead whales and polar bears. The benefits of this program are summarized in the multiple-sale EIS (USDOI, MMS, 2003:Sec. II.H.2.e).

IV.C.2.e(4) Overall Conclusion – The Mitigated Effect. In Alaska, oil leasing and production are accompanied by stipulations and mitigation measures in addition to in-place regulations such as 30 CFR 250. The strength of those requirements and a realistic assessment of their effectiveness must be included in any risk analysis (Amstrup, Durner, and McDonald, 2000). Polar bears are part of a dynamic rather than a static system. Changes in their distributions and populations over the last 5 to 6 years indicate that adaptive management is required to adequately mitigate potential impacts to their populations (i.e. specific mitigation measures developed today may not be applicable 5, 10, or 20 years from now). Because FWS is the management agency responsible for polar bear management, they have the most current information about the status of polar bear populations, the issues facing them, and the most recent research findings applicable to them. Therefore, clear channels of communication with FWS must be established and maintained in order to mitigate effectively the possible oil-spill effects and to ensure that MMS decisions are based on the most current information available.

The MMS is aware of recent decreases in summer sea ice and changes in polar bear distribution and habitat use—particularly in their tendency to aggregate near Barter Island and Pt. Barrow in the autumn. Because any exploration, development, and production activities that take place in the Beaufort Sea likely will result in the taking of marine mammals, for which operators and their sub-contractors without a valid ITA would be liable under the MMPA, operators are strongly encouraged to obtain LOA's from FWS. An ITA would help mitigate impacts to polar bears and would help ensure that there would be no unmitigable adverse impacts to subsistence uses. By rule and by standard practice, the MMS provides the FWS an opportunity to review Exploration Plans (EP's) and Development and Production Plans (DPP's). If an operator chooses not to obtain an ITA, the MMS intends to meet with the FWS and the operator to discuss the operator's liability under the MMPA, as well as what type of mitigation, monitoring, and reporting requirements are appropriate, given the changing environment and most current status of the polar bear stock.

To adequately mitigate potential oil spill impacts, MMS must ensure that operators' OSRP's address protection of polar bears, in consultation with the FWS. As required by our regulations (30 CFR 250.204(g)), we will make copies of any DPP's available to the FWS and other appropriate Federal Agencies so that they will have an opportunity to review the DPP's and comment on them. We acknowledge that the MMS regulations with regard to the distribution of EP's are not similar (30 CFR 250.203(f). However, the Regional Supervisor Field Operations will make copies of EP's (and associated Oil-Spill-Congingency Pland [OSCP's]) available to the FWS and other appropriate Federal Agencies for review and comment to ensure that potential threats to polar bears are adequately addressed and mitigated, based on the most current knowledge regarding their habitat use, distribution, and population status. Requirements to prestage oil-spill-response equipment would help ensure adequate geographic spill response coverage. The MMS has acknowledged that there are difficulties in effective oil-spill response in broken ice conditions. The MMS advocates the use of nonmechanical methods of spill response, such as in-situ burning, during periods when broken ice would hamper an effective mechanical response. An in situ burn (ISB) has the potential to rapidly remove large quantities of oil and can be employed when broken-ice conditions may preclude mechanical response. Reducing the chance of oil spills in the first place and responding effectively to spills, as summarized in Section IV.A.4, plus discouraging polar bear congregations during the fall open-water period, all need to be part of the solution.

Increasing trends in polar bear use of terrestrial habitat in the fall are likely to continue. The MMS realizes that some OCS operations might pose a relatively high spill risk to polar bear aggregations and therefore to the polar bear population as a whole. In March, 2006, more than 200,000 gal (4,790-bbl) of oil spilled onto the tundra on the North Slope as a result of a leak in a corroded pipeline that went undetected for an extended length of time. As demonstrated by this spill, small, chronic leaks in underwater pipelines could result in large volumes of oil being released underwater without detection. If such an event occurred in offshore waters, the impacts to the polar bear population would be potentially significant. The risk of such an event is not negligible over the lifetime of proposed developments. If such a spill occurred during winter, the release of oil trapped under the ice during spring breakup would be equivalent to the catastrophic release of the same amount of oil (Amstrup, Durner, and McDonald, 2000). The continued use of new technology, such as the LEOS leak-detection system, can greatly enhance the ability to detect small leaks so they do not become large spills over time. The MMS regulations require spill prevention and equipment monitoring measures to reduce the likelihood of spills and improve the responses to them, as summarized in Section IV.A.4.

For the Proposed Action, the chance of one or more large spill occurring, based on OSRA analysis, is 21% (Appendix C, Sec. C.6). This figure represents the chance of one or more large (≥1,000 bbl) spills for the Proposed Action and alternatives based on the mean spill rate over the life of the project (Figs. C-5 through C-9). If a large oil spill does occur, there is as much as a 49% chance that the oil would contact Barter Island and/or the coast of the ANWR (LS's 43-51) within 30 days (Table A2-75). Similarly, there is as much as a 42% chance that an oil spill would contact the coast near Barrow (LS's 24-27) within 30 days (Table A2-27). The combined probability of one or more large oil spills occurring and contacting a land segment is <2% within 60 days.

To adequately protect polar bears and their habitat from the threat of a large oil spill, the mitigation measures currently in place must be adaptable to continued changes in polar bear distribution and habitat use, specifically along the coast of ANWR from Kaktovik to the Canadian border. Considering the distances involved and the vagaries of the weather along the Beaufort Sea coast, personnel and equipment based in Prudhoe Bay may be unable to respond to oil spills in the Barter Island area and points east in a timely and efficient manner. Equipment and trained crews need to be positioned to respond to a spill as soon as it is discovered. The same is true for the Barrow area, and is perhaps even more critical, considering the potential decline of the CBS polar bear population over the last 15 years (see Appendix D, Sec. D.4.b).

Standard ITL No. 11, Information on Sensitive Areas to be Considered in the Oil-Spill Contingency Plans, helps to moderate the spill risk to some polar bear habitat. The optional expansion of the ITL to the west to include the area from Brownlow Point to Barter Island would help to moderate the risk in particularly productive ringed seal habitat, and hence, also productive polar bear habitat (Sec. III.C.2) . According to the multiple-sale EIS, ITL No. 11:

> ...may provide some protection, at least in theory, for nonendangered marine mammal sensitive habitats that are listed in the ITL. The lessees are informed that these areas should be protected in the event of an oil spill. However, it is unlikely that oil-spill-protection and -cleanup measures would prevent a large spill from contacting these marine mammal habitats, if wind and ocean currents were driving the spill into these areas (USDOI, MMS, 2003:Sec. IV.C.7.a(2)(c)(2)).

However, depending on the location of the activity and time of year, prestaging oil spill response equipment in Barrow, Kaktovik, offshore facilities, or other locations could greatly reduce the chance that an oil spill would enter a sensitive area, such as Bernard Harbor, and oil polar bears there, and would also allow a quicker response to any spills which occur in the far eastern and western portions of the sale area.

The multiple-sale EIS stated that:

> The MMS encourages initiatives to train village oil-spill-response teams as a way of guaranteeing local participation in spill response and cleanup; this effort allows local Native communities to use their traditional knowledge about sea ice and the environment in the response process. Within the constraints of Federal, State, and local law, operators and Alaska Clean Seas would be encouraged to hire and train residents of the North Slope Borough and the Cities of Barrow, Nuiqsut, and Kaktovik in oil-spill response and cleanup (USDOI, MMS, 2003:Sec. IV.C.16.e(2)).

The multiple-sale EIS goes on to say that:

> Other potential mitigation available if activity occurs includes potential staging of oil-spill equipment at critical locations to support any necessary oil-spill-cleanup operations. This initiative would address response-readiness concerns of subsistence users. Also, the staging of boom material and other pertinent response equipment at Barrow, Cross Island, and Kaktovik would provide protection to critical whaling areas and shoreline. These measures could be included in the oil-spill-contingency plan or in the final Condition of Permit approval letter for a production project issued by the Regional Supervisor for Field Operations (USDOI, MMS, 2003:Sec. IV.C.16.e(2)).

These initiatives have been added to a proposed new ITL to ensure adequate geographic coverage and protection of polar bears within the sale area in the event of an oil spill (Sec. III.C.2). If operations occur in the vicinity of Kaktovik, Cross Island, or Barrow, the staging of boom material and other pertinent response equipment at Barrow, Cross Island, and Kaktovik may be included in the OSCP or in the final Condition of Permit approval letter for a production project issued by the RS/FO.

This review of new information modifies the multiple-sale conclusion that the effects from Sale 202 could result in the loss of perhaps 6-10 polar bears, with recovery of populations within about a year (USDOI, MMS, 2003:Sec. IV.C.7.a(2)(c)(2)). As a result of the new information considered here, we conclude that if an offshore oil spill occurred, a potentially significant impact to polar bears could result, particularly if areas in and around polar bear aggregations were oiled. This is because the biological potential for polar bears to recover from any perturbation is low due to their low reproductive rate (Amstrup, 2000). For the Proposed Action, the chance of a large spill occurring, based on OSRA analysis, is 21% (Appendix C, Sec. C.6). This figure represents the chance of one or more large spills for the Proposed Action and alternatives based on the mean spill rate over the life of the project (Figs. C-5 through C-9). The combined probability of one or more large oil spills occurring and contacting a land segment is <2% within 60 days.

The MMS regulations are designed to reduce such impacts by requiring specific mitigation measures for specific exploration and development activities associated with Lease Sale 202. However, prior to commencement of exploration, development, and production activities, proposed activities will be analyzed on a case-by-case basis and effective mitigation measures developed accordingly, based on the latest polar bear-population estimates, distribution information, other research results, and the location and timing of the activity.

Reducing the concentrations of polar bears onshore in the fall would be the most effective way to mitigate potential oil-spill impacts. This could be accomplished by removing the remains of Native-harvested whales from the beaches outside of Kaktovik and Barrow. However, the whale remains are on Native-owned lands; thus, that decision will have to be negotiated with the Native communities. The FWS and USGS scientists have been advocating this approach for some time and are very aware of the benefits of discouraging concentrations of polar bears on land in the fall. Discouraging congregations of polar bears on land during the fall open-water period, by properly disposing of Native-harvested whale carcasses, would substantially lower the potential impacts to polar bears and enhance the effectiveness of mitigation. If mitigation such as prestaging oil-spill-response equipment and training response crews in Kaktovik and Barrow were adopted, the level of effect on polar bears would be further moderated.

In summary, documented impacts to polar bears to date in the Beaufort Sea by the oil and gas industry appear minimal. Due primarily to increased concentrations of bears on parts of the coast, the relative oil-spill risk to the population has increased since preparation of the multiple-sale EIS. Close cooperation among MMS, the FWS and OCS operators, in addition to the standard stipulations and proposed new mitigation in Section III.C, will help to ensure that the level of effect does not increase. Therefore, our overall finding is that the Proposed Action with existing MMS operating regulations, the standard mitigation measures, and the proposed new ITL's in Section III.C.2, would moderate the spill risk.

IV.C.2.f. Other Marine Mammals. This section updates the assessment of potential effects on other marine mammals (pinnipeds and beluga and gray whales) as a result of the Proposed Action (Alternative VII). The section includes four subsections, which summarize the multiple-sale EIS and Sale 195 EA assessments that are being updated, update those effects, incorporate the benefits of the standard mitigation, and summarize the conclusion (i.e., the mitigated effect).

IV.C.2.f(1) Summaries of Multiple-Sale EIS and Sale 195 EA Assessments Updated by this EA for Sale 202. The Beaufort Sea multiple-sale EIS concludes the following about the effects of proposed Sale 202 on other marine mammals (USDOI, MMS, 2003:Sec. IV.C.7.b(2):

> The effects from activities associated with Alternative I for Sales 195 and 202 exploration and development are estimated to include the loss of small numbers of pinnipeds...beluga and gray whales (perhaps 100-200 ringed seals, probably fewer than 10-20 spotted and 30-50 bearded seals, fewer than 100 walruses...and fewer than 10 beluga and gray whales), with populations recovering within about 1 year.

The Sale 195 EA concluded that the new information on other marine mammals did not change the conclusion of no significant population-level effects due to the proposed lease sale (USDOI, MMS, 2004:Sec IV.C.1.e (1)). The EA also identified ringed seals and other ice-dependent pinnipeds as additional resources of primary concern due to the effects of arctic climate change (USDOI, MMS, 2004:Sec IV.F).

IV.C.2.f(2) Update of those Effects for the Proposed Action – Alternative VII. The following includes analyses of the updated effects due to large oil spills, and the updated effects due to disturbance, including disturbance due from seismic surveys.

IV.C.2.f(2)(a) Updated Oil-Spill Effects. The MMS data on the probability of spills has been updated, and new OSRA tables have been prepared (Sec. IV.A.1.b and Appendix C). The new data do not affect the OSRA tables with "conditional" probabilities, which assume that a spill has occurred. The new data affects only the tables with "combined" probabilities, which include the probability of a spill. The assessment for other marine mammals in the multiple-sale EIS was based only on conditional probabilities (USDOI, MMS, 2003:Sec. IV.C.7.a(2)(b)2) and would not change.

The review of new information in this EA does not change the conclusion reached in the multiple-sale EIS or the Sale 195 EA with respect to oil-spill effects. The multiple-sale EIS assessed the effects of a large oil spill of 1,500 bbl or 4,600 bbl as a result of proposed Sales 186, 195, and 202, concluding in Section IV.C.7.b(2) that a large oil spill could result in the potential loss of small numbers of pinnipeds and beluga and gray whales (perhaps 100-200 ringed seals, probably fewer than 10-20 spotted and 30-50 bearded seals, fewer than 100 walruses, and fewer than 10 beluga and gray whales), with populations recovering within about 1 year (USDOI, MMS, 2003:Sec. IV.C.7.b(2)).

Summary. The updated OSRA information does not change the conclusion of no significant population-level effects on other marine mammals due to spills from the Proposed Action.

IV.C.2.f(2)(b) Updated Effects Due to Routine, Permitted Operation. The multiple-sale EIS concluded that "no significant effects are anticipated from routine permitted activities" as a result of proposed Lease Sales 186, 195, and 202 (USDOI, MMS, 2003:Sec. ES.1.e(1)). Although the projected amount of seismic activity has increased since the multiple-sale EIS was written, the effects from routine, permitted operations still are expected to be about the same as described in that document. Recently, the NMFS concluded similarly in a draft Finding of No Significant Impact (FONSI) for a proposed seismic survey in the Beaufort Sea during 2006. The NMFS FONSI refers to the extensive mitigation and monitoring measures required under an IHA, concluding that the IHA "...will ensure that received sound pressure levels will be below the levels that may injure or kill marine mammals and reduce impacts to non-significant levels that will have a negligible impact on the affected populations of marine mammals (including...gray whales, beluga whales, ringed seals, bearded seals and spotted seals)."

IV.C.2.f(3) Benefits of the Standard Mitigation. The standard mitigation includes a measure for Orientation Programs. The benefits of this stipulation are explained in the multiple-sale EIS (USDOI, MMS, 2003:Sec. II.H.1.b). It requires all personnel involved in petroleum activities on the North Slope as a result of the proposed lease sale to be aware of the unique environment and social and cultural values of the area, which would include other marine mammals.

Mitigation also is provided by several ITL's, such as Information on Bird and Marine Mammal Protection and Information on Discharge of Produced Waters. The ITL on Marine Mammal Protection advises lessees that during the conduct of all activities, the lessee will be subject to the Marine Mammal Protection Act. Further, this ITL encourages lessees to "exercise particular caution when operating in the vicinity of species whose populations are known or thought to be declining and which are not protected under the ESA; such as, Pacific walrus." Disturbance of marine mammals could be determined to constitute a "taking" under the Act. The ITL on produced waters advises lessees that the State of Alaska prohibits discharges of produced water on State tracts within the 10-m-depth contour.

Indirect benefit also is gained from the MMS BWASP, because the program collects sightings of both bowhead whales and other marine mammals. The benefits of this program are summarized in the multiple-sale EIS (USDOI, MMS, 2003s:Sec. II.H.2.e).

Another measure—Industry Site-Specific Bowhead Whale-Monitoring Programs—would give indirect benefits. The benefits of this stipulation are summarized in the multiple-sale EIS (USDOI, MMS, 2003s:Sec. II.H.2.e), which explains that the stipulation provides site-specific information about the (disturbance) of bowhead whales that could occur from oil and gas activities from the proposed lease sales. Sightings of beluga whales also are documented. The information can be used to evaluate the threat of harm to the species and provides immediate information about the activities of whales and their responses to specific events.

Under Standard ITL No. 11, Information on Sensitive Areas to be Considered in the Oil-Spill Contingency Plans, area #7 should be expanded to include the area from Brownlow Point to Demarcation Point, as this is particularly productive ringed seal habitat, and the location of a polyna in the winter.

IV.C.2.f(4) Overall Conclusion – The Mitigated Effect. Our review of new information on pinnipeds and beluga and gray whales for this EA confirms the multiple-sale EIS conclusion that "no significant effects are anticipated from routine permitted activities" as a result of proposed Lease Sale 202; and that a large oil spill would affect "small numbers of pinnipeds and belugas and gray whales (perhaps 100-200 ringed seals, probably fewer than 10-20 spotted and 30-50 bearded seals, fewer than 100 walruses, and fewer than 10 beluga and gray whales)...with populations recovering within about 1 year" (USDOI, MMS, 2003:Sec. IV.C.7.b(2)). This EA concludes that no new impacts to pinnipeds and beluga or gray whales were identified for the proposed lease sale that were not already assessed in the multiple-sale EIS. In the context of new information that has become available since publication of the multiple-sale EIS, these conclusions remain consistent; thus, the updated potential level of effect on pinniped and beluga and gray whale populations is expected to be about the same as stated in the multiple-sale EIS.

IV.C.2.g. Fishes and Essential Fish Habitat. This section updates the assessment of effects on fishes and Essential Fish Habitat (EFH) as a result of the Proposed Action (Alternative VII). The section includes four subsections, which summarize the multiple-sale EIS and Sale 195 EA assessments that are being updated, update those effects, incorporate the benefits of the standard mitigation, and summarize the conclusion (i.e., the mitigated effect).

IV.C.2.g(1) Summaries of Multiple-Sale EIS and Sale 195 EA Assessments Updated by this EA for Sale 202. The Beaufort Sea multiple-sale EIS concludes the following about the effects of proposed Sale 202 on fishes (USDOI, MMS, 2003:Sec. IV.C.3.b):

> Noise and discharges from dredging, gravel mining, island construction and reshaping, pipeline trenching, and abandonment are likely to have no measurable effect on fish populations (including incidental anadromous species). While a few fish could be harmed or killed, most in the immediate area would avoid these activities and would be otherwise unaffected. Effects on most overwintering fish are likely to be short term and sublethal, with no measurable effect on overwintering fish populations.
>
> In the unlikely event of a large oil or diesel fuel spill, effects on arctic fishes (including incidental anadromous species) would depend primarily on the season and location of the spill; the lifestage of the fishes (adult, juvenile, larval, or egg); and the duration of the oil contact. Because of their very low numbers in the spill area, no measurable effects are likely on fishes in winter. Effects would be more likely to occur from an offshore oil spill moving into nearshore waters during summer, where fishes concentrate to feed and migrate. If an offshore spill did occur and contact the nearshore area, some marine and migratory fish may be harmed or killed. However, it likely would not have a measurable effect on fish populations, and recovery would be likely within 5-10 years. In general, the effects of fuel spills on fishes are likely to be less than those of crude oil spills.
>
> In the unlikely event of an onshore pipeline oil spill contacting a small waterbody supporting fish (for example, ninespine stickleback, arctic grayling, and Dolly Varden char) and that had restricted water exchange, it likely would kill or harm most of the fish within the affected area. Recovery would be likely in 5-10 years. However, because of the small amount of oil or diesel fuel likely to enter freshwater habitat, the low diversity and abundance of fish in most of the onshore area, and the unlikelihood of spills blocking fish migrations or occurring in overwintering areas or small waterbodies (containing many fish or fish eggs), an onshore spill of this kind is not likely to have a measurable effect on fish populations on the Arctic Coastal Plain.

The Beaufort Sea multiple-sale EIS concludes the following about the effects of proposed Sale 202 on EFH (USDOI, MMS, 2003:Sec. IV.C.4.c):

> The effects of an oil spill would be considered higher than in Sales 186 and 195 but still moderate, because in most cases salmon would recover within one generation. One year of salmon smolt would be affected and salmon populations likely would recover. Effects from disturbances and seismic activity in both the exploratory and development stages on freshwater and marine would be low, i.e., changes in abundance are limited to a population or portion of a populations (one stream, or in even or odd years for pink salmon) and/or for a short time period.

The Sale 195 EA concludes the following about the effects of that proposed sale on fishes and EFH (USDOI, MMS, 2004:Sec. IV.C.1.e (2)):

> In the unlikely event of a large oil or diesel fuel spill, effects on arctic fishes (including Pacific salmon) would depend primarily on the season and location of the spill; the lifestage of the fishes (adult, juvenile, larval, or egg) impacted; and the duration of the exposure. Impacts to local fish populations may include lethal and sublethal effects and require one to three generations for affected local populations to recover to their former status. Regional populations would not be substantially affected by the assumed oil spills. Fish populations exhibit considerable spatial and temporal variability with respect to their distribution and abundance in response to natural environmental factors. Natural environmental disturbances may complicate recovery rates by expediting or inhibiting growth, reproduction rates, trophic linkages, or habitat use. The interaction of natural disturbances and OCS impact-producing factors, such as a large oil spill, may substantially modify the anticipated effects of the Proposed Action.

IV.C.2.g(2) Update of those Effects for the Proposed Action – Alternative VII.

IV.C.2.g(2)(a) Updated Oil-Spill Effects. The MMS data on the probability of spills has been updated and new OSRA tables have been prepared (Sec. IV.A.1.b and Appendix C). The new data does not affect the OSRA tables with "conditional" probabilities, which assume that a spill has occurred. The new data affects only the tables with "combined" probabilities, which include the probability of a spill. The assessments for fishes and EFH in the multiple-sale EIS were not based on combined probabilities (USDOI, MMS, 2003:Secs. IV.C.3.a(2)(a) and IV.C.4.a(3)(b)), so the new combined probabilities do not change the assessments.

Oil-spill effects on fishes from activities associated with the exploration, development, and production of oil and gas in the Beaufort Sea could come from spilled oil, seismic surveys, vessel traffic, drilling discharges, shore facilities, construction activities, pipelines, and offshore platforms. Potential effects resulting from these activities are described in the following section.

Fishes of greatest concern, due to their distribution, abundance, rarity, trophic relationships, or vulnerability, are: (1) the diadromous fishes that are abundant seasonally in the nearshore zone, especially arctic cisco, arctic char, least cisco, and broad whitefish; (2) fish species narrowly dependent on conditions in the Stefansson Sound Boulder Patch (e.g., the kelp snailfish); (3) cryopelagic fishes such as the arctic cod, an abundant and trophically important fish; (4) intertidal/estuarine/nearshore spawning and/or rearing fishes (e.g., pink salmon, capelin, and Pacific herring), and (5) Pacific salmon and their essential fish habitat. Some of these species also are important because they figure prominently in subsistence (e.g., arctic char, ciscoes, whitefishes, arctic cod, rainbow smelt, capelin, and salmon).

IV.C.2.g(2)(a)1) Effects of Oil Spills: Petroleum is a complex substance composed of many constituents. These constituents vary in structural complexity, volatility, and toxicity to organisms. A more detailed discussion of these differences, plus modes of release and factors affecting concentrations of oil in the water column, is found in Section IV.A.1 and USDOI, MMS (2003).

IV.C.2.g(2)(a)2) General Effects: There are two general ways that oil spills adversely affect the abundance of a population: through direct mortality or through indirect impacts on reproduction and survival (Hilborn, 1996). In each case, the impacts might be followed by recovery to pre-impact levels or by a long-term change in abundance. Additionally, long-term habitat change or a change in competitive or predation pressure could result in a long-term change in the distribution or abundance of a species.

Oil spills have been observed to have a range of effects on fish (see Rice, Korn, and Karinen, 1981; Starr, Kuwada, and Trasky, 1981; Hamilton, Starr, and Trasky, 1979; and Malins, 1977 for more detailed discussions). The specific effect depends on the concentration of petroleum present, the time of exposure, and the stage of fish development involved (eggs, larva, and juveniles are the most sensitive). If sublethal concentrations are encountered over a long-enough periods, fish mortality is likely to occur. Sublethal effects are likely and include changes in growth, feeding, fecundity, survival, and temporary displacement.

Oil spills can more specifically affect fish resources in many ways, including the following:

1. cause mortality to eggs and immature stages, abnormal development, or delayed growth due to acute or chronic exposures in spawning or nursery areas; this may occur repeatedly if generation after generation continue to spawn and/or rear offspring in contaminated areas;
2. impede the access of migratory fishes to spawning habitat because of contaminated waterways;
3. alter behavior;
4. displace individuals from preferred habitat;
5. constrain or eliminate prey populations normally available for consumption;
6. impair feeding, growth, or reproduction;
7. contaminate organs and tissues and cause physiological responses, including stress;
8. reduce individual fitness and survival, thereby increasing susceptibility to predation, parasitism, zoonotic diseases, or other environmental perturbations;
9. increase or introduce genetic abnormalities within gene pools, and
10. modify community structure that benefits some fish resources and detracts others.

Concentrations of petroleum hydrocarbons are acutely toxic to fishes a short distance from and a short time after a spill event (Malins, 1977; Kinney, Button, and Schell, 1969). The death of adult fish has occurred almost immediately following some oil spills (the *Florida* and *Amoco Cadiz*; Hampson and Sanders, 1969; Teal and Howarth, 1984). The majority of adult fish are able to leave or avoid areas of heavy pollution and, thus, avoid acute intoxication and toxicity. Evidence indicates that populations of free-swimming fish are not injured by oil spills in the open sea (Patin, 1999). In coastal shallow waters with slow water exchange, oil spills may kill or injure pelagic or demersal fish.

Lethal effects to adults may pose less threat to populations than damage to eggs and larvae or changes in the ecosystem supporting populations (e.g., Teal and Howarth, 1984). Floating eggs, and juvenile stages of many species can be killed when contacted by oil (Patin, 1999), regardless of the habitat.

The contact of aquatic organisms with oil most often results in the appearance of oil odor and flavor in their tissues (Patin, 1999). In the case of commercially valued fishery resources, this certainly means the loss of their value and corresponding fisheries losses. Experimental studies show that the range of water concentrations of oil causing the taint in fish, crustaceans, and mollusks is very wide. Usually, these concentrations vary between 0.01 and 1.0 milligrams per liter (mg/L), depending on the oil type; composition; form (dissolved, slick, emulsion); duration and conditions of exposure; kind of organism; and other factors (Patin, 1999). Migratory fishes (e.g., salmon or herring) tainted by oil in one location may move well beyond the recognized boundaries of an oil spill, thereby become available for harvesting elsewhere. Patin (1999) drew the following conclusions of various studies devoted to the tainting of commercial organisms in oil-polluted areas:

- The contact of commercial fish and invertebrates with oil during accidental oil spills practically always leads to accumulation of oil hydrocarbons in their tissues and organs (usually within the ranges of 1-100 milligrams per kilogram [mg/kg]). In most cases, the organisms acquire an oil odor and flavor. This fact is the main reason for closing fisheries in the affected area.
- Species reared in coastal mariculture/aquaculture facilities can be exposed to severe impacts of accidental oil spills. Observations showed that several months after the spill, salmon cultivated at facilities still had elevated concentrations of oil hydrocarbons in their tissues and suffered diseases and increased mortality (Patin, 1999, citing MLA, 1993a).

While tainting of fisheries resources in some regions may not pose a real threat to consumers (e.g., the North Sea), fish tainting can be a real problem especially for coastal fishing and aquaculture (Patin, 1999).

The most serious concerns arise regarding the potential sublethal effects in fisheries resources, including commercially valued species, when exposed to chronic contamination within their habitats (Patin, 1999). It is striking that the toxicity of oil pollution to aquatic populations has been seriously underestimated by standard short-term toxicity assays, and the habitat damage that results from oil contamination has been correspondingly underestimated (Ott, Peterson, and Rice, 2001). Research studies show that intertidal or shallow benthic substrates may become sources of persistent pollution by toxic polycyclic aromatic hydrocarbons (PAH's) following oil spills or from chronic discharges (Rice et al., 2000). Fish sublethal responses include a wide range of compensational changes (Patin, 1999). These start at the subcellular level and first have a biochemical and molecular nature. Recent research, mostly motivated by the *Exxon Valdez* oil spill, has found (1) PAH's are released from oil films and droplets at progressively slower rates with increasing molecular weight leading to greater persistence of larger PAH's; (2) eggs from demersally spawning fish species accumulate dissolved PAH's released from oiled substrates, even when the oil is heavily weathered; and (3) PAH's accumulated from aqueous concentrations of <1 ppb can lead to adverse sequelae (i.e., a secondary result of disease or injury) appearing at random over an exposed individual's lifespan (Rice et al., 2000). These adverse effects likely result from genetic damage acquired during early embryogenesis caused by superoxide production in response to PAH's. Therefore, oil poisoning is slow acting following embryonic exposure, and adverse consequences (e.g., prematurely truncated lifespan, impaired reproductive potential, unnatural physical or behavioral limitations) may not manifest until much later in life. The frequency of any one symptom usually is low, but cumulative effects of all symptoms may be considerably higher (Rice et al., 2000). For example, if chronic exposures persist, stress may manifest sublethal effects later in a form of histological, physiological, behavioral, and even populational responses, including impairment of feeding, growth, and reproduction (Patin, 1999). Chronic stress and poisoning also may reduce fecundity and survival through increased susceptibility to predation, parasite infestation, and zoonotic diseases. These can affect the population abundance and, subsequently, community structure. For more information summarizing the various adverse effects (both individual and population level) to fish fauna or their habitats, see Tables 29 and 30 of Patin (1999).

IV.C.2.g(2)(a)3) Oil Spill Impacts to Fish Populations-Lessons from the Exxon Valdez Oil Spill. Oil-spill impacts to Alaskan fishes are best known for populations of Pacific salmon and Pacific herring that were impacted by the *Exxon Valdez* oil spill in 1989. Because Pacific salmon and Pacific herring occur in the Alaskan Beaufort Sea, although much less abundant than in southcentral Alaska, studies of the impacted populations are useful to elucidate the population level impacts that an oil spill may have on arctic populations.

Salmon are able to detect and avoid hydrocarbons in the water (Weber et al., 1981), although some salmon may not avoid oiled areas and become temporarily disoriented but eventually returning to their home stream (Martin, 1992). Adult salmon remain relatively unaffected by oil spills and are able to return to natal streams and hatcheries, even under very large oil-spill conditions, as evidenced by pink and red salmon returning to Prince William Sound and red salmon returning to Cook Inlet after the *Exxon Valdez* oil spill. When oil from the *Exxon Valdez* spill entered Cook Inlet, the Alaska Department of Fish and Game closed the sockeye salmon commercial fishery in Cook Inlet. This evidently resulted in overescapement of spawning fish in the Kenai River system for the third consecutive year. Overescapement in 1987 was due to a previous spill and, in 1988, there was a naturally high escapement. Fisheries managers observed what appeared to be a decline in salmon smolt. Although the mechanism for the apparent decline in smolt abundance is uncertain, the result of overescapement and too many salmon fry to be supported by the available prey may be the cause. The extent of the decline was speculative. Managers originally predicted that adult salmon returns in 1994 and 1995 would be below escapement goals, but the 1994 returns were three times that forecasted. Escapement goals were met for 1995, and commercial fisheries were operating. The *Exxon Valdez* Oil Spill Trustee Council listed pink and red salmon as recovered in 2002, 13 years after the spill.

Many fish species are most susceptible to stress and toxic substances during the egg and larval stages than at the adult stage. Intertidal areas contaminated by spilled oil may persist for years and represent a persistent source of harmful contaminants to aquatic organisms. Contamination of intertidal spawning-stream areas for pink salmon caused increased embryo mortality and possible long-term developmental and genetic damage (Bue, Sharr, and Seeb, 1998). The embryo, a critical stage of salmon development, is vulnerable because of its long incubation in intertidal gravel and its large lipid-rich yolk, which will accumulate hydrocarbons from chronic, low-level exposures (Marty, Heintz, and Hinton, 1997; Heintz, Short, and Rice, 1999). Pink salmon (often intertidal spawners) embryos in oiled intertidal stream areas of Prince William Sound continued to show higher mortality than those in unoiled stream areas through 1993, more than 4 years after the oil spill, but appeared to recover in 1994 (Bue, Sharr, and Seeb, 1998).

Experiments conducted by Heintz, Short, and Rice (1999) demonstrate that aqueous-total PAH concentrations as low as 1 ppb derived from weathered *Exxon Valdez* oil can kill pink salmon embryos localized downstream from oil sources. Their study also found a 25% reduction in survival during incubation of brood fish exposed to 18 ppb. Other studies examining egg and fry survival showed no difference between oiled and unoiled locations (Brannon et al., 1993) except in two cases—one that showed higher mortality at an unoiled stream, and another that showed higher mortality at the high-tide station of an oiled stream. These studies did not measure PAH's in stream water or in salmon embryos, were statistically underpowered, and were insufficient in duration to test for the manifestation of adverse effects from low-level PAH exposures (Murphy et al., 1999). Results published by Murphy et al. (1999) and Heintz, Short, and Rice (1999) contradict other scientists' conclusions that PAH concentration in spawning substrate after the spill was too low to adversely affect developing salmon (i.e., Brannon et al., 1995; Maki et al., 1995; Brannon and Maki, 1996).

Several studies demonstrated indirect and chronically adverse effects of oil to intertidal fish at levels below the water-quality guidelines of 15 ppb. Experiments conducted by Heintz, Short, and Rice, (1999) demonstrate that between the end of chronic exposure to embryonic salmon and their maturity, survival was reduced further by another 15%, resulting in the production of 40% fewer mature adults than the unexposed population. They concluded the true effect of the exposure on the population was 50% greater than was concluded after evaluating the direct effects. Additional research found that fewer exposed fish from one experimentally exposed egg brood survived life at sea and returned as mature adults compared to unexposed fish (Heintz et al., 2000). Moreover, Heintz et al. (2000) experimental data show a dependence of early marine growth on exposure level; unexposed salmon increased their mass significantly more than salmon exposed to crude oil as embryos in eggs. Heintz et al. (2000) concluded that exposure of embryonic pink salmon to PAH concentrations in the low parts per billion produced sublethal effects that led to reduced growth and survival at sea. Studies, therefore, indicate that examination of short-term consequences underestimate the impacts of oil pollution (Heintz et al., 2000; Rice et al., 2000; Ott, Peterson, and Rice, 2001).

Carls et al. (2005) studied cytochrome P4501A (CYP1A) induction pink salmon embryos exposed to crude oil and linked adverse effects at the cellular, organism, and population levels. (Cytochrome 4501A is a particular group of mono-oxygenase enzymes that mediates oxidation of petroleum hydrocarbons and other xenobiotics, thereby facilitating their excretion [Wiedmer et al., 1996, citing Jimenez and Stegeman 1990].) Carls et al. (2005) found that CYP1A induction (i.e., an exposure that introduces one to something previously unknown) indicates that long-term damage is probable, leading to reduced survival. In similar exposures to PAH with pink salmon embryos, earlier studies found both short- and long-term effects, including poor adult returns when embryos were exposed to similar dose levels (Carls et al., 2005, citing Marty et al. 1997; Heintz, Short, and Rice, 1999; Heintz et al., 2000). Specifically, depressed fry growth and significantly reduced marine survival were observed after exposure of pink salmon embryos to $<5.2 \mu g\ l^{-1}$ aqueous TPAH concentrations (Carls et al., 2005, citing Heintz et al. 2000). Tests confirm that long-term consequences can be expected from low exposure doses to embryos. Theirs and other studies demonstrate that CYP1A induction in embryos is linked to reduced marine survival and, therefore, population-level effects.

Reduced growth potential in the marine environment, caused by toxic action in oil-exposed embryos, is probably the key functional change that leads to the distinct survival disadvantage and fewer returning adult spawners (Carls et al., 2005). Rapid fry growth after emigration to the marine environment is important to escape mortality from size-selective predation (Carls et al. 2005, citing Parker 1971, Healey 1982, Hargreaves and LeBrasseur, 1985), thus, placing oil-exposed fish at a disadvantage. In oil-exposure tests with pink salmon embryos followed by released fry, reduced marine survival of pink salmon adults has been directly observed in 3 different brood years (1993, 1995, and 1998; Carls et al., 2005, citing Heintz et al., 2000). Depressed marine survival was consistently correlated with depressed growth rate 4-10 months after emergence and was a more sensitive measure of significant response in 1995 fish than growth rate.

Carls et al. (2005) determined that the model of activity demonstrated by their study is consistent with a similar cascade of effects described in Prince William Sound after the *Exxon Valdez* oil spill. In juvenile pink salmon in marine water, CYP1A was induced by oil, and growth slowed (Carls et al., 2005, citing Carls et al., 1996, Wertheimer and Celewycz 1996, Willette 1996). Geiger et al. (1996, as cited by Carls et al., 2005) estimated that approximately 1.9 million wild pink salmon failed to return as adults in 1990 because poor growth, reduced survival (about 28% of the potential wild-stock production in the southwest portion of Prince William Sound). Pink salmon embryos incubating in the intertidal reaches of streams were exposed to PAH from oil-coated intertidal sediment; CYP1A was induced and survival was significantly reduced through 1993 (Carls et al., 2005, citing Bue et al. 1996, 1998, Wiedmer et al., 1996, Craig et al., 2002, Carls et al., 2003). Gieger et al. (1996, as cited by Carls et al., 2005) estimated that 60,000-70,000 pink salmon failed to return as adults in 1991 and 1992, respectively, as a result of toxic exposure. Hence, the laboratory study is consistent with these field data.

Exposure to PAH during the earliest stages of development may increase significantly the risk of damage to developing embryos, consistent with the general observation that early lifestages are highly vulnerable to pollutants (Carls et al., 2005, citing, e.g., Moore and Dwyer, 1974) "...leading to immediate, secondary, and delayed effects." Carls et al. (2005) reported some macroscopic abnormalities that were positively correlated with TPAH exposure. Abnormalities that were positively correlated with exposure were ascites (the abnormal accumulation of serous fluid in the abdominal cavity), bulging eyes, malformed head, short opercular plates, external hemorrhaging, mouth or jaw malformation, and deformed caudal fin. Unusual pigmentation and tumors were negatively correlated with exposure, probably because embryos with these developmental problems were less likely to survive oil exposure (Carls et al., 2005). Permanent multiple defects are likely to have lasting consequences, such as poorer growth and marine survival (Carls et al., 2005, citing, e.g., Heintz et al., 2000).

Carls et al. (2005) expect that their observations may be generalized to all fish; CYP1A induction has been observed in many species and in many of the same tissues (Carls et al., 2005, citing, e.g., Sarasquete and Segner, 2000, Stememan et al., 2001). Carls et al. (2005) concluded that: (1) induction of CYP1A is statistically correlated with adverse effects at cellular, organism, and population levels in pink salmon and can be used to predict these responses; (2) exposure of pink salmon embryos and larvae to oil caused a variety of lethal and sublethal effects; and (3) the combined results from a series of embryo-larval exposure experiments spanning 5 brood years are consistent and demonstrate that CYP1A induction is related to a variety of lethal and sublethal effects, including abnormalities, reduced growth and diminished marine survival.

Short et al. (2003) concluded that habitat damage resulting from oil contamination is underestimated by acute toxicity assays. They describe that nearshore substrates oiled by spills may become persistent pollution sources of toxic PAH's. Their findings from *Exxon Valdez* oil-spill research include: (1) PAH's are released from oil films and droplets at progressively slower rates with an increasing molecular weight leading to greater persistence of larger PAH's; (2) eggs from demersally spawned fish species accumulate dissolved PAH's released from oiled substrates, even when the oil is heavily weathered; and (3) PAH's accumulated by embryos from aqueous concentrations of <1 nanogram per liter (ng/L) can lead to adverse sequelae appearing at random over the lifespan of an exposed cohort, probably as a result of damage during early embryogenesis. They conclude that oil is, thus, a slow-acting poison, and that toxic effects may not manifest until long after exposure. Several highly pertinent points quoted from Short et al. (2003) include:

- Fish and oil do not mix...the threat is not from acutely toxic concentration that result in immediate fish kills, but in the more subtle effects of low-level oil pollution to sensitive life stages.

Incubating eggs are very sensitive to long-term exposure to PAH concentrations because they may sequester toxic hydrocarbons from low or intermittent exposures into lipid stores for long periods and because developing embryos are highly susceptible to the toxic effects of pollutants (citing Mary et al., 1997; Carls et al., 1999; Heintz et al., 1999, 2000). PAH's in weathered oil can be biologically available for long periods and very toxic to sensitive life stages. The result is that fewer juvenile fish survive, so that recruitment from the early life stages is reduced and adult populations may not be replaced at sustainable levels. Eventually, adult populations may gradually decline to extinction.

- Streams and estuaries sustain the vulnerable early developmental life stages of many fish species...Herring spawn their eggs in areas of reduced salinities, salmon early life stages use both stream and estuary for much of the first year of life, and the juveniles of many marine species use the estuaries for nursery grounds. The very qualities of these natal and rearing habitats that provide protection from predators also make both the habitat and, by extension, the species vulnerable to pollution. The sediments of salmon streams and many nearshore estuaries are capable of harboring oil for extended periods with slow release.
- Habitats used by demersally spawning fish such as salmon, herring, and capelin are particularly vulnerable to the effects of oil coming ashore on beaches and the spawning gravels of streams.
- Fish natal and rearing habitats are clearly vulnerable to oil poisoning from chronic discharges under the current regulatory framework. Oil discharges into these habitats are covered by water quality standards based on acute LC50 results for more tolerant life stages, which may seriously underestimate cumulative adverse effects, even when presumably conservative safety factors of 0.01 are applied. These water quality standards need to be revised if we are to protect these habitats.
- Chronic pollution seldom results in floating fish carcasses. Instead, there is continued habitat contamination, erosion of populations, and when coupled over time with other events such as hard winters, other habitat loss, increased in predators or fishing, decreases in food availability at a critical life stage, etc. may eventually result in population extinctions in high impact environments. Species with life history strategies that rely on streams or estuaries for reproduction are most vulnerable.
- In the absence of further laboratory study with other fish species, we (Short et al.) suggest a toxicity threshold of approximately 1 ng/L of aqueous PAH's for habitats where fish eggs and larvae rear, derived from studies on sensitive early life stages of pink salmon and Pacific herring. We (Short et al.) recommend that government standards for dissolved aromatic hydrocarbons should be revised to reflect this threshold for protection of critical life stages and habitats of fish.

Some Pacific herring stocks of the Gulf of Alaska were impacted appreciably by past oil spills. The *Exxon Valdez* oil spill occurred a few weeks before Pacific herring spawned in Prince William Sound. A considerable portion of spawning habitat and staging areas in Prince William Sound were contaminated by oil. Adult herring returning to spawn in Prince William Sound in 1989 were relatively unaffected by the spill and successfully left one of the largest egg depositions since the early 1970's. Total herring-spawn length for 1989 was 158 km, with 96% in unoiled areas, 3% in areas of light to very light oiling, and only 1% in areas characterized as moderate to heavy oiling (Pearson, Mokness, and Skalski, 1993). About half of the egg biomass was deposited within the oil trajectory, and an estimated 40-50% sustained oil exposure during early development (Brown et al., 1996). Other researchers estimated that more than 40% of the areas used by the Prince William Sound stocks for spawning and more than 90% of the nearshore nursery areas were exposed to spilled crude oil (Biggs and Baker, 1993).

McGurk and Brown (1996) tested the instantaneous daily rates of egg-larval mortality of Pacific herring at oiled and nonoiled sites; they found that the mean egg-larval mortality in the oiled areas was twice as great as in the nonoiled areas, and larval growth rates were about half those measure in populations from other areas of the North Pacific Ocean. Norcross et al. (1996) collected Pacific herring larvae throughout Prince William Sound in 1989 following the *Exxon Valdez* oil spill. They found deformed larvae both inside and outside of areas considered as oiled. Many larvae exhibited symptoms associated with oil exposure in laboratory experiments and other oil spills. These included morphological malformations, genetic damage, and small size. Growth was stunted during developmental periods. Brown et al. (1996) noted the resulting 1989 year-class displayed sublethal effects in newly hatched larvae, primarily premature hatch, low weights, reduced growth, and increased morphologic and genetic abnormalities. In newly hatched larvae, developmental aberration rates were elevated at oiled sites, and in pelagic larvae genetic damage was greatest near oiled areas of southwestern Prince William Sound. Brown et al. (1996) estimated that oiled areas produced only 0.016 X 10^9 pelagic larvae compared with 11.82 X 10^9 nonoiled areas. Kocan et al. (1996) exposed Pacific herring embryos to oil-water dispersions of Prudhoe Bay crude oil in artificial seawater and found that genetic damage was the most sensitive biomarker for oil exposure, followed by physical deformities, reduced mitotic activity, lower hatch weight, and premature hatching.

Herring populations are dominated by occasional, very strong year classes that are recruited into the overall population (http://www.oilspill.state.ak.us/facts/status_herring.html). The 1988 prespill year-class of Pacific herring was very strong in Prince William Sound and, as a result, the estimated peak biomass of spawning adults in 1992 was very high. Despite the large spawning biomass in 1992, the population exhibited a density-dependent reduction in size of individuals, and in 1993 there was an unprecedented crash of the adult herring population. The 1989-year class was a minority of the 1993 spawning assemblage, one of the smallest cohorts observed in Prince William Sound, and it returned to spawn with an adult herring population reduced by approximately 75%, apparently because of a widespread epizootic. A viral disease and fungus may have been the immediate agents of mortality or a consequence of other stresses, such as a reduced food supply and increased competition for food. Recently, Carls, Marty, and Hose (2002) published a synthesis of the toxicological impacts of the *Exxon Valdez* oil spill on Pacific herring. They compared and reinterpreted published data from industry and government sources as relating to Pacific herring in Prince William Sound that were affected by the *Exxon Valdez* spill and a 75% collapse in the adult population in 1993. They concluded:

> Significant effects extended beyond those predicted by visual observation of oiling and by toxicity information available in 1989. Oil-induced mortality probably reduced recruitment of the 1989 year class into the fishery, but was impossible to quantify because recruitment was generally low in other Alaskan herring stocks. Significant adult mortality was not observed in 1989; biomass remained high through 1992 but declined precipitously in winter 1992-1993. The collapse was likely caused by high population size, disease, and suboptimal nutrition, but indirect links to the spill cannot be ruled out.

Demersal marine fishes, particularly those associated with nearshore waters, are known to be impacted by oil spills, as evident from the *Exxon Valdez* spill. Demersal fishes may at times inhabit the benthos or pelagic waters. Vertical changes in depth may be responses to factors such as light conditions and foraging opportunities. For example, Pacific sand lance inhabit the water column nearshore during the day but at night, they bury themselves in soft bottom sediments. They also are known to overwinter by burying in sediments, with a preference for fine or coarse sand substrate. This makes them particularly vulnerable to oil spills impacting nearshore areas.

Demersal fishes inhabiting oil-polluted areas may suffer similar lethal and sublethal effects (e.g., egg mortality, developmental aberrations, reduced survival, etc.) as reported for pelagic finfishes, although not necessarily of the same magnitude. For example, Moles and Norcross (1998) found that juvenile yellowfin sole, rock sole, and Pacific halibut experienced reduced growth following 30-90 days of exposure to sediments laden with Alaska North Slope crude oil. Changes in fish health bioindicators after 90 days—i.e., increases in fin erosion, liver lipidosis, gill hyperplasia, and gill parasites—coupled with decreases in macrophage aggregates, occurred at hydrocarbon concentrations (1,600 micrograms per gram [mg/g]) that reduced growth 34-56% among the demersal fishes. Moles and Norcross (1998) concluded that: (1) chronic hydrocarbon pollution of nearshore nursery sediments could alter growth and health of juvenile flatfishes; and (2) recruitment of juveniles to the fishery may decline because of increased susceptibility to predation and slower growth.

Rockfish (yelloweye, quillback, and copper) examined for histopathological lesions and elevated levels of hydrocarbons in their bile after the *Exxon Valdez* oil spill indicated significant differences between oiled and control locations (Hoffman, Hepler, and Hansen, 1993). Additionally, at least five rockfish examined were killed by exposure to oil. While the authors noted no population-level effect in these species, these data indicate spilled oil reached and exposed demersal fishes to both sublethal and lethal toxic effects.

Although rockfishes are not members of the Beaufort Sea demersal fish assemblage, they illustrate the potential impacts of an oil spill to demersal fish populations in the Arctic.

Some demersal or pelagic species are sensitive to oiled substrates, and may be displaced from preferred habitat that is oiled as a result of a spill. Other species may not be sensitive to contaminants and use contaminated sites, thereby prolonging their exposure to contaminants. Pinto, Pearson, and Anderson (1984) found that sand lance avoided sand contaminated with Prudhoe Bay crude oil in an experimental setting. Moles, Rice, and Norcross (1994) exposed three species of juvenile Alaskan demersal finfishes (rock sole, yellowfin sole, and Pacific halibut) to laboratory chambers containing contaminated mud or sand offered in combination with clean mud, sand, or granule. The fishes were able to detect and avoid heavily oiled (2%) sediment but did not avoid lower concentrations of oiled sediment (0.05%). Oiled sediment was favored over unoiled sediment, if the unoiled sediment was of the grain size not preferred by that species. Oiled sand or mud was always preferred over unoiled granule. The authors concluded that the observed lack of avoidance at concentrations likely to occur in the environment may lead to long-term exposure to contaminated sediment following a spill.

Hydrocarbon exposure in demersal fishes often results in an increase in gill parasites (Khan and Thulin, 1991; MacKenzie et al., 1995). Moles and Wade (2001) experimentally tested adult Pacific sand lance's susceptibility to parasites when exposed to oil-contaminated sediments for 3 months. They found that sand lance exposed to highly oiled substrates had the greatest mean abundance of parasites per fish. Chronic exposure to harmful pollutants such as hydrocarbons coupled with increased parasitism degrades individual fitness and survival.

Most recently, Peterson et al. (2003) describe the long-term ecosystem response to the *Exxon Valdez* oil spill. Peterson et al. (2003) state:

> The ecosystem response to the 1989 spill of oil from the Exxon Valdez into Prince William Sound, Alaska, shows that current practices for assessing ecological risks of oil in the oceans and, by extension, other toxic sources should be changed. Previously, it was assumed that impacts to populations derive almost exclusively from acute mortality. However, in the Alaskan coastal ecosystem, unexpected persistence of toxic sub-surface oil and chronic exposures, even at sublethal levels, have continued to affect wildlife. Delayed population reductions and cascades of indirect effects postponed recovery. Development of ecosystem-based toxicology is required to understand and ultimately predict chronic, delayed, and indirect long-term risks and impacts.
>
> ...uncertainties do little to diminish the general conclusions: oil persisted beyond a decade in surprising amounts and in toxic forms, was sufficiently bioavailable to induce chronic biological exposures, and had long-term impacts at the population level. Three major pathways of induction of long-term impacts emerge: (i) chronic persistence of oil, biological exposures, and population impacts to species closely associated with shallow sediments; (ii) delayed population impacts of sublethal doses compromising health, growth, and reproduction; and (iii) indirect effects of trophic and interaction cascades, all of which transmit impacts well beyond the acute-phase mortality.

Peterson et al. (2003) describe long-term responses of a variety of wildlife and fish resources impacted by the *Exxon Valdez* oil spill; those specifically pertinent to fish resources are quoted below:
Chronic exposures of sediment-affiliated species:

- Chronic exposures enhanced mortality for years;
- After the spill, fish embryos and larvae were chronically exposed to partially weathered oil in dispersed forms...(citing Murphy et al., 1999)
- Laboratory experiments showed that these multiringed polycyclic aromatic hydrocarbons (PAH's) from partially weathered oil at concentrations as low as 1 ppb are toxic to pink salmon eggs exposed for the months of development and to herring eggs exposed for 16 days (citing Marty, Heintz, and Hinton, 1997; Heintz et al. 2001)
- This process explains the elevated mortality of incubating pink salmon eggs in oiled rearing streams for at least 4 years after the oil spill. (citing Bue, Sharr, and Seeb, 1998)

Sublethal exposures leading to death from compromised health, growth, or reproduction:

- Oil exposure resulted in lower growth rates of salmon fry in 1989 (citing Rice et al., 2001), which in pink salmon reduce survivorship indirectly through size-dependent predation during the marine phase of their life history (citing Willette et al., 2000)
- After chronic exposure as embryos in the laboratory to < 20 ppb total PAH's, which stunted their growth, the subsequently marked and released pink salmon fry survived the next 1.5 years at sea at only half the rate of control fish (citing Heintz et al., 2001)
- In addition, controlled laboratory studies showed reproductive impairment from sublethal exposure through reducing embryo survivorship in eggs of returning adult pink salmon that had previously been exposed in 1993 to weathered oil as embryos and fry (Heintz et al., 1999)
- Abnormal development occurred in herring and salmon after exposure to the Exxon Valdez oil (citing Carls et al., 2001; Marty, Heintz, and Hinton, 1997)

Cascades of indirect effects:

- Indirect effects can be as important as direct trophic interactions in structuring communities (citing Schoener, 1993)
- Cascading indirect effects are delayed in operation because they are mediated through changes in an intermediary.
- Perhaps the two generally most influential types of indirect interactions are (i) trophic cascades in which predators reduce abundance of their prey, which in turn releases the prey's food species from control (citing Estes et al., 1995) and (ii) provision of biogenic habitat by organisms that serve as or create important physical structure in the environment (citing Jones et al., 1994)
- Current risk assessment models used for projecting biological injury to marine communities ignore indirect effects, treating species populations as independent of one another (citing Peterson 2001; Rice et al., 2001)
- Indirect interactions lengthened the recovery process on rocky shorelines for a decade or more (citing Peterson 2001)
- Expectations of rapid recovery based on short generation times of most intertidal plants and animals are naive and must be replaced by a generalized concept of how interspecific interactions will lead to a sequence of delayed indirect effects over a decade or longer (citing Peterson 2001)
- Indirect interactions are not restricted to trophic cascades or to intertidal benthos. Interaction cascades defined broadly include loss of key individuals in socially organized populations, which then suffer subsequently enhanced mortality or depressed reproduction.
- Ecologists have long acknowledged the potential importance of interaction cascades of indirect effects. Now synthesis of 14 years of *Exxon Valdez* oil spill studies documents the contributions of delayed, chronic, and indirect effects of petroleum contamination in the marine environment (Table 1 of old and new paradigms).
- Old paradigm in oil ecotoxicology – oil toxicity to fish: oil effects solely through short-term (~4 day) exposure to water-soluble fraction (1- to 2-ringed aromatics dominate) through acute narcosis mortality at parts per million concentrations.
- New paradigm in oil ecotoxicology – oil toxicity to fish: long-term exposure of fish embryos to weathered oil (3- to 5- ringed PAH's) at ppb concentrations has population consequences through indirect effects on growth, deformities, and behavior with long-term consequences on mortality and reproduction.

The studies referenced above demonstrate that when oil contaminates natal habitats, the immediate effects in one generation may combine with delayed effects in another to increase the overall impact on the affected population, thereby causing a change in distribution and/or decrease in their abundance lasting for multiple (e.g., 3 or more) generations.

Based on the information presented above, the recovery status of injured fish resources tracked by the *Exxon Valdez* Oil Spill Trustee Council (Trustee Council) was reviewed. The Trustee Council considers recovery essentially to be "a return to conditions that would have existed had the spill not occurred" and is considered herein to equate to a return of the affected population(s) to their former status. Pacific herring, as of 2005, are not recovering; this equates to five generations since the *Exxon Valdez* spill (i.e., spring 1989). Pink salmon were listed as "not recovering" until 1997, at which time they were regarded as "recovering." Pink salmon were listed as "recovered" as of 2002, as were also sockeye salmon. Therefore, 6.5 generations passed since the spill before pink salmon were recovered. This information further supports the long-term effects of crude oil on herring and salmon described by Carls et al. (2002); Short et al. (2003); Peterson et al. (2003), and others noted above, as well as capturing the lingering and indirect effects of the *Exxon Valdez* oil spill.

Information regarding impacts from the *Exxon Valdez* spill on populations of pink salmon and Pacific herring are relevant to this assessment, because these and other fish species (e.g., capelin and Pacific sand lance) inhabit the Beaufort and Chukchi Sea and may spawn on intertidal or nearshore substrates along the coast, and because the biological responses of these species to PAH's and oil are likely representative for other fishes.

IV.C.2.g(2)(a)4) Local Population-Level Responses. Life history strategies such as those of capelin and pink salmon make them highly susceptible to an oil spill affecting their spawning, nursery, or summer feeding or migration areas. An oil spill at a particular stream or beach may lead to Types I, II, III, IV, and/or V response patterns (Munkittrick and Dixon, 1989) by capelin, pink salmon, or other estuarine/nearshore fish populations. The patterns represent population changes and describe responses to exploitation, recruitment failure, the presence of multiple stressors, food limitation, and niche shifts. Response patterns are described briefly below.

Type I Response (Exploitation): The best understood response pattern is the characteristic compensatory response of a previously unexploited fish population to adult removal (Munkittrick and Dixon, 1989, citing Colby, 1984). The removal of a significant number of adults results in a relative increase in the amount of food and habitat available for those surviving. This relative increase theoretically leads to an increased growth rate and fecundity, as well as an earlier age at maturation (Munkittrick and Dixon, 1989, citing McFarlane and Franzin, 1978 and Trippel and Harvey, 1987). Due to the shift in the age-structure of the population, the mean age of the population declines.

A Type I response should be found whenever a sudden decrease in the population size has occurred, and not just in response to the human harvest of a standing crop. Type I responses have been documented in response to increased mortality associated with predation of fish by harbor seals (Munkittrick and Dixon, 1989, citing Power and Gregoire, 1978); parasitization by *Ligula intestinalis* (Munkittrick and Dixon, 1989, citing Burrough and Kennedy, 1979); and the chronic effects of atmospheric metal deposition (Munkittrick and Dixon, 1989, citing McFarlane and Franzin, 1978).

Type II Response (Recruitment Failure): A Type II response also is characterized by an increased growth rate in response to a decreased population size. The response differs from a Type I pattern, in that there is an increase in the mean age of the population due to prolonged increases in egg mortality or recruitment failure (Munkittrick and Dixon, 1989, citing Colby, 1984). The response can be due to deterioration of spawning or nursery habitat, or to stressor-induced spawning failures, and is typical of a population approaching extinction.

Type III Response (Multiple Stressors): In the absence of contaminants, a Type III response is reflective of the persistence of marginal, adverse conditions for a prolonged period of time. Food-supply problems are associated with a decline in growth rate and fecundity. The increase mean age can be related to a decline in reproduction and recruitment, the size-selective mortality of young fish, or to a prolonged decline in habitat or food supply.

Type III responses also have been associated with contamination events and are suggestive of multiple stressors. Generally, factors associated with recruitment failure are responsible for increasing the mean age, while food-availability problems prevent a characteristic compensatory response.

Type IV Response (Limitation): This pattern is evident where a fish population has reached the carry capacity of a system. The response is initiated by a decline in food and habitat availability, and the population does not show an increase in the mean age. The response often is associated with an increased population size due to predator removal or overstocking, or to a decline in habitat availability. A decline in food availability should result in decreased growth rate, condition factor and fecundity, and an increase in the age at maturity. The persistence of conditions will result in a gradual increase in mean age, characteristic of the Type III response.

Type V Response (Niche Shift): A Type V response is characterized by a decline in fecundity of the fish without concomitant changes in condition or mean age. This response typically is seen when a portion of the population is eliminated, and a stressor prevents the population from regaining its former abundance. It also can be seen when there is a gradual change in food availability, or when the introduction of a competing species results in a niche shift.

IV.C.2.g(2)(b) Aspect of Habitats and Life Histories Vulnerable to Effects of Oil.

IV.C.2.g(2)(b)1) Habitats: Fishes occupying different habitats may be differentially susceptible (i.e., vulnerable) to exposure to hydrocarbons. This variation in vulnerability combined with individual sensitivities determines the potential for effect. Determining effects on a particular species also can be complicated by variation in location and feeding habits of different lifestages within the species. In comparing fishes that use different habitats, pelagic species appear more sensitive to oil than demersal fishes; however, they may be less vulnerable because they spend less time in estuarine areas, where spilled oil tends to accumulate and persist (Rice et al., 1976), or in close association with shallow, soft-bottomed habitats, which are extensive in the Beaufort Sea. Fishes that rely on epibenthic organisms in the nearshore zone could be affected if their prey were contaminated by oil or killed; see discussions of Effects of Oil on Other Biological Resources (USDOI, MMS, 2003).

In the Beaufort Sea, three fish habitats can be considered more vulnerable to effects from oil-related activities: the intertidal/estaurine/nearshore brackish ecotone, the Boulder Patch community, and ice-cover habitat.

Fish use estuarine habitats for part of all of their lifecycle, or migrate through estuaries between their feeding and breeding areas (Costello, Elliott, and Thiel, 2002; Elliott 2002, citing McHugh 1967 and Haedrich, 1983). The young of many marine fish use estuaries and shallow coastal waters as nursery grounds, and some freshwater fish use estuarine habitats as feeding areas. Wyman and Stevenson (2001) define an estuary as "coastal waters where seawater is measurably diluted with freshwater; a marine ecosystem where freshwater enters the ocean. The term usually describes regions near the mouths of rivers and includes bays, lagoons, sounds, and marshes."

The estuarine/nearshore brackish ecotone in the Beaufort Sea appears to have a greater abundance of fishes than marine waters. During the open-water season, diadromous fishes extensively use the estuarine/nearshore brackish ecotone as feeding, migrating, and rearing areas. Most of these fishes overwinter and spawn in freshwater habitats. Within the estuarine/nearshore brackish ecotone, fish tend to be concentrated along the mainland and island shorelines rather than in lagoon centers of offshore. Details of variation in extent of coastal distributions, onshore-offshore distribution, and seasonal shifts in distribution are given in Section IV.B.4.d. Several marine species also use the nearshore zone, with some moving in seasonally or sporadically to feed. Some marine species continue to inhabit, feed, and reproduce in the nearshore zone during winter. The intertidal/estuarine/nearshore zone in the Beaufort Sea would be among the areas considered more vulnerable to effects from oil-related activities.

Particular areas of concern are: (1) intertidal/estaurine substrates and adjacent waters that may serve as spawning and rearing habitat; and (2) the major river deltas, which are the areas of greatest species diversity and that also harbor some overwintering fishes. Among these rivers and their associated deltas, the Colville figures prominently as an area of high species diversity and the river with the most extensive overwintering habitat for diadromous fishes in the Alaskan Beaufort Sea. Other major rivers include the Sagavanirktok, Meade, Ikpikpuk, Kuparuk, and Canning.

The community associated with the Boulder Patch also is vulnerable to effects from oil-related activities, in large part due to its uniqueness and restricted extent. Three fish species have been reported in the Boulder Patch community: the kelp snailfish, the fourhorn sculpin, and the fish doctor (Dunton, Reimnitz, and Schonberg, 1982; Craig, 1984). Of these, the kelp snailfish probably is most dependent on the environment and/or community of the Boulder Patch, because it apparently requires hard substrate on which to lay its eggs. The other two species apparently are not so environmentally limited. Thus, the kelp snailfish could be vulnerable to effects from oil-related activities.

Ice cover is habitat to the early life-history stages of cryopelagic fishes, notably the arctic cod, an important fish to the food web of the Beaufort Sea. Oil spills impacting the undersurface of ice cover have the potential for lethal and sublethal impacts to developing cryopelagic fishes exposed to oil under ice cover. Oil spilled on ice in winter and not subsequently cleaned up before ice cover breaks up and melts during warmer months may be released along melting ice edges, and developing cryopelagic fishes may be exposed to oil.

IV.C.2.g(2)(b)2) Life Histories: Several aspects of fish life histories may make arctic fish populations vulnerable to effects from spilled oil. In particular, growth, recruitment, and/or reproduction could be adversely affected because of the following:

- Eggs and larvae of fishes are more sensitive to oil than other life-history stages, and those of some species may be more vulnerable due to ecological conditions, such as location.
- Oil may increase the already high mortality of larvae in the plankton by increasing the length of time in the plankton or by decreasing planktonic food.
- Recruitment or survival of fishes could be reduced by oil adversely affecting the spawning of adults, the development of early life history stages repeated across generations, movement and feeding patterns of adults or juveniles, or overwintering juveniles or adults.

IV.C.2.g(2)(b)3) Species-Specific Effects: This section considers, consecutively, effects on diadromous species; marine pelagic species; demersal species; capelin, a marine species that spawns along the coast; and Pacific salmon and their essential fish habitat. Trophic effects also are considered.

Adult fish generally are unlikely to suffer great mortality as a result of an oil spill; however, diadromous fishes in the estuarine/nearshore, brackish water ecotone might be adversely affected by having their access to feeding, overwintering, or spawning grounds impeded. Effects of an oil spill could include increased swimming activity; decreased feeding; interference with movements to feeding, overwintering, or spawning areas; impaired homing abilities; and death of some adult or juvenile fishes. Fish also may suffer increased physiological stress when making the adjustment from fresh to brackish or marine water and vice versa that later result in mortality. Adverse effects are more likely for fishes that make extensive migrations from natal streams (e.g., arctic cisco); for fishes with high fidelity to natal streams (e.g., arctic char); and for fishes that overwinter in nearshore environments (such as the major river deltas, e.g., rainbow smelt).

Larvae, eggs, and juvenile fishes generally are more sensitive to oil spills than are adult fishes. In particular, species with floating eggs (e.g., arctic cod) or eggs and larvae in more vulnerable positions (e.g., eggs and developing larvae of pink salmon or capelin on or proximate to contaminated substrates in the intertidal and/or shallow subtidal) could suffer extensive mortality (dependent on the amount and type of oil spilled, the areal extent of the spill, etc.). In the Beaufort Sea, nearshore demersal eggs or larval fishes spending time in coastal areas are the fish most vulnerable to adverse effects of spilled oil. These vulnerable categories include pink salmon, capelin, fourhorn sculpin, and snailfish, which can have great bursts of abundance in nearshore areas (e.g., Morrow, 1980, citing Andriyashev, 1954, and Westin, 1970).

IV.C.2.g(2)(b)3)a) Diadromous Fishes. Diadromous fishes of importance because of abundance, life history, or use in domestic and commercial fisheries are arctic cisco, least cisco, arctic char, and broad whitefish. A number of diadromous species in the region have complicated life-history patterns that are not fully understood. For the most part, diadromous fishes in the Beaufort Sea, unlike Pacific salmon, spend the major part of their lives in freshwater rivers and lakes but undertake seasonal migrations to coastal regions in the ice-free season to feed or overwinter. The details of foraging migrations of the more abundant diadromous fishes appear to vary not only among species but among life-history stages of the same species. These differences in migratory habits lead to spatial and temporal differences in the relative abundance of different species and life stages in the nearshore zone (Bond, 1987; Cannon and Hachmeister, 1987). Thus, an oil spill contacting the nearshore environment might affect various species and age classes of anadromous fishes as they move to feeding, overwintering, or spawning grounds. Because most diadromous fishes make spawning runs and outmigrations over a period of time, it is unlikely that an entire year-class would be lost as it moved toward a spawning steam or migrated out of a stream. Even if fish were held up because a delta area was contacted by oil, it is unlikely that the major river deltas would be entirely contacted, given the broad expanses of the deltas, outflow, and the estimated size of a ≥1,000 bbl spill. The Mackenzie River Delta covers about 210 km of coastline, the Colville about 32 km, and the Sagavanirktok and Canning about 16 km each. It is most likely that few channels of these rivers would be affected and, thus, only a portion of the spawning run or a portion of the variously aged fish in a population would be affected.

Effects on diadromous species while they are dispersed in the nearshore zone are expected to be moderate. However, if they are contacted while concentrated or aggregated in delta regions, high effects are possible. For arctic cisco, if a significant number of spawning-year fish or age-0 fish were affected, the effects are expected to be high. Because oil spills are more likely to affect diadromous species while they are dispersed in the nearshore rather than during the shorter timeframe in which they are aggregated, a moderate effect is most likely for these species.

IV.C.2.g(2)(b)3)b) Marine Pelagic Species. Fish populations having basically pelagic distributions are expected to be little affected by spills (with the exceptions of pink salmon, capelin, and the cryopelagic species); most of them are thought to have broad distributions in the proposed sale area. Even if larvae, which generally are more sensitive, are affected, only a portion of those in the ichthyoplankton would be harmed; and the effects would be difficult to determine, given the high natural mortality of fish larvae and the natural variability of recruitment from year to year. If some adults were killed, recruitment into the population might not be affected, because for marine fish species having planktonic larvae, there is little correlation between the size of the adult population and recruitment. Effects on recruitment would be particularly difficult to assess in the Beaufort Sea, because very few studies of offshore fishes have been made. Effects might be most noticeable if predators of these pelagic fishes decline in abundance or fail to reproduce, but the cause of such an effect might not be apparent. In general, effects of a single spill ≥1,000 bbl are not expected to exceed moderate for pelagic fishes.

IV.C.2.g(2)(b)3)c) Marine Demersal Species. Demersal fishes in oceanic waters are not expected to be affected by oil spills, as the likelihood of oil reaching the sea bottom in the oceanic province in any appreciable amounts or over an extensive area is very small, especially given that more than one spill ≥1,000 bbl is unlikely to occur in the Beaufort Sea. However, demersal coastal fishes inhabiting shallow, soft-bottomed areas could be affected by a spill, if the water column is mixed and oil comes to contaminate sediments and/or in the shallows, with the possible exception of arctic cisco (Moulton, Fawcett, and Carpenter, 1985; Craig and Haldorson, 1981). Because some species have broad distributions in the Sale 202 area, and effects of spills are expected to be relatively localized and unlikely to affect the deeper benthos, effects on the regional populations of demersal fishes are expected to be moderate.

Arctic Cod: For arctic cod, a species that is patchy in distribution, has floating eggs, and associates with ice cover during early life-history stages, it may be extremely difficult to determine the effect of an oil spill. Adult arctic cod have been reported to suffer 50% mortality (LC_{50}) at concentrations of 1,569 ppm ±0.004 oil over an 8-day period (USDOC, NOAA, NMFS, NWAFC, 1979, as cited by Starr, Kawada, and Trasky, 1981).

The abundance of arctic cod sometimes is very high in coastal surface waters. Jarvela and Thorsteinson (1999) found annual mean densities of arctic cod in the 0- to 2-m depth interval of their study area as 50.6 per 1,000 cubic meters (m^3) in 1990, and 1.8 per 1,000 m^3 in 1991. They compare their findings to others, stating:

Mean densities of age-0 arctic cod in the surface waters during 1990 and 1991 were within the range of previously reported late summer-fall values, both within the study area and elsewhere in the North American Arctic. In Prudhoe Bay area, estimated densities were $14.2 \cdot 1000\ m^{-3}$ in 1979 (Tarbox and Moulton, 1980) and $15.5 \cdot 1000\ m^{-3}$ in 1988 (Houghton and Whitmus, 1988). In Simpson Lagoon, monthly mean surface densities ranged between 0 and $82 \cdot 1000\ m^{-3}$ in 1977 and 1978 (Craig and Griffiths, 1978; Craig et al., 1982).

Jarvela and Thorsteinson (1999) also noted: (1) the size composition of individual catches indicates that arctic cod generally were segregated into discrete size or age groups; (2) a few large catches of arctic cod and capelin during the later period constituted most of the annual catch in each year; and (3) the densities of all species except capelin declined from 1990 to 1991. (Capelin exhibited the opposite trend.)

Although arctic cod can be extremely abundant in nearshore lagoonal areas, the importance of nearshore versus offshore environments to the lifecycle is not known (Craig et al., 1982). Although it is known that juvenile arctic cod associate with floating ice, it is unknown to what degree this association contributes to the development and survival of young fishes later recruiting to the breeding population. If early life-history stages of arctic cod were concentrated in nearshore environments, in patches in the open ocean, or under floating ice, they certainly would be more vulnerable to effects from an oil spill impacting such habitats. Even though arctic cod are vulnerable to effects from oil spills because they have floating eggs, are cryopelagic, and prone to segregating into discrete size or age groups, the effect of one spill ≥1,000 bbl on this species is expected to be moderate.

Capelin: Capelin spawn in coastal sandy areas in the Beaufort Sea in June, July, and August. They are highly specific with regard to spawning conditions, thus making them highly vulnerable to an oil spill affecting their spawning habitat. At spawning grounds, capelin segregate into schools of different sexes. The general pattern seems to be that ripe males await opportunities to spawn near the beaches, while large schools, mainly composed of relatively inactive females, remain for several weeks off the beaches in slightly deeper water (i.e., staging area). As these females ripen, individuals proceed to the beaches to spawn. Thus, most males remain in attendance near the beaches and join successive small groups of females that spawn and depart from the area. Capelin spawn at about 2 years of age, and many individuals die after spawning (mainly males; Jangaard, 1974).

Capelin eggs are demersal and attach to gravel on the beach or on the sea bottom. The incubation period varies with temperature, and hatching has been demonstrated to occur in about 55 days at 0 °C, 30 days at 5 °C, and 15 days at 10 °C. Hatching of capelin eggs has been shown to be negatively affected by concentrations of 10-25 mg/L (100-250 ppb) of crude oil (Johannessen, 1976). Based on the long-term toxicology studies stemming from the *Exxon Valdez* oil spill previously discussed, capelin spawning on substrates contaminated by spilled oil expose their eggs and larvae to PAH's that would likely result in acute and chronic lethal and sublethal effects that decrease capelin abundance and delay recovery of the affected population(s) for three or more generations. Direct and indirect adverse impacts affecting one or more generations of capelin are likely to change vital rates; changed vital rates within populations are modeled to significantly affect population dynamics (Koons, Rockwell, and Grand, 2006).

Newly hatched capelin larvae soon assume a pelagic existence near the surface, where they remain until winter cooling sets in, when they move closer to the sea bottom until waters warm again in spring. Jarvela and Thorsteinson (1999) noted that coastal waters of the Beaufort Sea appear to be an important habitat for age-0 capelin throughout the summer, whereas older fish seem to be present for comparatively brief periods during spawning runs. However, their study was not designed to investigate actual spawning sites. An oil spill occurring in coastal waters after a spawning event likely would adversely impact newly hatched capelin, resulting in acute mortality of much or most of the affected population's cohort. Should the oil spill subsequently impact the spawning substrates of the affected population, significant adverse impacts likely would result.

Summer is a period of intensive feeding activity in coastal waters. Feeding activity in capelin, for example, is highly seasonal. Feeding intensity increases in the prespawning season in late winter and early spring, but it declines with the onset of spawning migration. Feeding ceases altogether during spawning season. Survivors of spawning resume feeding several weeks postspawning and proceed at high intensity until early winter, when it ceases. An oil spill occurring in coastal waters during summer likely would adversely impact feeding activity of capelin. Some larval and juvenile capelin not experiencing acute mortality as a result of exposure to oil may directly or indirectly have their feeding inhibited and starve later (e.g., during the winter), because they were unable to consume sufficient sustenance during the summer to carry them over to the next feeding period (e.g., the following summer).

Figure 2 model the effects of an oil spill impacting spawning substrates used by fishes such as capelin and pink salmon. If an oil spill occurred and decimated a year-class of young from one area, the effects likely would adversely influence successive generations' ability for recovery. Additionally, if a large oil spill impacts a spawning beach habitually used by capelin, two scenarios are possible. One scenario is that capelin may not detect contaminated substrate and spawn there for successive generations. Eggs deposited in the proximity of the contaminated substrate over a series of years likely would be exposed to oil (PAH's) retained in the substrate, as PAH's in weathered oil can be biologically available for long periods and very toxic to sensitive lifestages, subsequently leading to lethal and sublethal effects to those offspring of successive generations. It is likely that the affected population would decline and require three or more generations to return to their former status. The likely results are that fewer juvenile capelin survive, so that recruitment from the early lifestages is reduced and adult populations decline and may not be replaced at sustainable levels. Eventually, the affected adult population(s) gradually may decline to extinction. A second scenario is that the capelin detect oil at the spawning site and choose not to spawn there. It is not known what such a behavioral response may have on the dynamics of the population; however, the spawning site likely would be unavailable for use for multiple generations, depending on the sensitivity of the capelin to detecting contaminated substrates and how long the oil persists in the localized habitat. Also unknown are the distribution and abundance of spawning sites used by capelin in the Alaskan Arctic. The type of sandy gravel beach used by capelin occurs over most of the Beaufort Sea coastline. Effects on capelin are expected to be potentially adverse at any beach location contacted by a large spill and could last for three or more generations before recovery to their former status at those locations; however, the loss of capelin to the overall regional capelin population would be insignificant.

IV.C.2.g(2)(c) Pacific Salmon and Essential Fish Habitat: The new information reviewed above concerning impacts of the *Exxon Valdez* oil spill demonstrates potential long-term adverse impacts to pink salmon. Therefore, pink salmon and their EFH are reassessed in light of the new information reported.

Pink Salmon. Pink salmon are widely distributed over the northern Pacific Ocean and Bering Sea; they also occur to a lesser degree in arctic waters. Pink salmon are the most abundant salmon species in the Beaufort Sea, although their abundance is negligible compared to waters in western and southern Alaska (Craig and Halderson, 1986; Fechhelm and Griffiths, 2001). Their abundance generally increases from east to west along the Alaskan Beaufort Sea coast.

Most pink salmon spawn within a few miles of the coast, and spawning within the intertidal zone or the mouth of streams is very common. Small spawning runs of pink salmon occur in the Sagvanirktok and Colville rivers, although not predictably from year to year. Available data suggest that pink salmon are more abundant in even-numbered years (e.g., 1978, 1982) than in odd-numbered years (e.g., 1975, 1983), as is the general pattern for this species in western Alaska (Craig and Halderson, 1986, citing Heard, 1986). This pattern may be a manifestation of the distinctive life cycle of the pink salmon (i.e., they spawn at 2 years of age and die following spawning). Among the few pink salmon collected in the Sagavanirktok River and delta were several spawned-out adults. Bendock (1979) noted pink salmon spawning near the Itkillik River and at Umiat. Two male spawners were caught near Ocean Point just north of Nuiqsut (Fechhelm and Griffiths, 2001, citing McElderry and Craig, 1981). In recent years, "substantial numbers" of pink salmon have been taken near the Itkillik River as part of a fall subsistence fishery (Fechhelm and Griffiths, 2001, citing George, pers. commun.). Pink salmon also are taken in the subsistence fisheries operating in the Chipp River and Elson Lagoon just to the east of Point Barrow (Fechhelm and Griffiths, 2001, citing George, pers. commun.). Craig and Halderson (1986) propose that pink salmon spawn successfully and maintain small but viable populations in at least some arctic drainages; continued occurrences of pink salmon in arctic drainages indicates their suggestion is credible.

Schmidt, McMillan, and Gallaway (1983) describe the life cycle of pink salmon:

> Eggs are laid in redds [nests] dug in gravel. The eggs hatch during the winter however the alevins remain in the gravel, until the yolk sac is absorbed, emerging later in spring. After emerging from the gravel, the fry begin moving downstream. They remain in the estuary for up to a month prior to moving offshore. Little is known of the movements undertaken during the 18 months the salmon spend at sea. It is likely the North Slope populations move westerly towards the Chukchi Sea and upon maturing at the age of 2 years, the salmon then return to their natal streams to spawn in the fall.

Little information is available regarding the feeding activity of pink salmon in the Alaskan Beaufort Sea region. Young-of-the-year probably do not feed significantly during the short period spent in natal streams but feed on copepods and other zooplankton in the estuary (Schmidt et al., 1983). As the fish grow, larger prey species become important, including amphipods, euphausiids, and fishes (Schmidt et al., 1983, citing Morrow, 1980 and Scott and Crossman, 1973). Craig and Halderson (1986) state that most (adult) pink salmon caught in Simpson Lagoon had not fed recently (88% empty stomachs, n=17). The only available information on marine feeding is from Kasegaluk Lagoon, where stomachs of 17 captured adult salmon contained mostly fish, with some amphipods and mysids (Craig and Halderson, 1986, citing Craig and Schmidt, 1985). In that study, the single most important prey species was arctic cod.

An oil spill impacting the Beaufort Sea coast may adversely impact spawning and/or rearing habitat used by pink salmon. An oil spill contaminating intertidal spawning substrate likely would result in acute and chronic direct and indirect adverse impacts that decreases the affected population's abundance and delays their recovery, requiring three or more generations to recover to their former status in the local area impacted by the oil spill. Although pink salmon are not abundant in the Beaufort Sea, the loss of pink salmon from a single location would not adversely change the overall regional population of pink salmon. Affected population(s) at the site of an oil spill may be extirpated, as PAH's in weathered oil can be biologically available for long periods and very toxic to sensitive lifestages. If an oil spill were to reach a pink salmon spawning area, fewer juvenile pink salmon may survive, potentially resulting in lower recruitment from the early lifestages. Adult populations at that location may not be replaced to preoil spill numbers. However, the overall effect on the regional population of pink salmon would be small and the effects to regional population would be insignificant.

Pink salmon populations at the site of an oil spill also may be adversely affected indirectly through effects on food sources, but these effects are extremely difficult to study or predict. Because no evidence suggests significant biomagnification of oil through trophic linkages (Varanasi and Malins, 1977; Cimato, 1980), adult fish may be little affected by tainted food. However, larval or juvenile salmon may be affected by decreased feeding opportunities, slower growth rates, and increased predation.

Trophic effects could occur indirectly through contamination of sediments in the nearshore zone or the shallow subtidal zone. In shallow depths <2 m (which freeze to the bottom each year), contaminated sediments might affect the seasonal immigration of epibenthic invertebrates, which constitute the major prey of salmon in the nearshore zone during the open-water season. If sediments in depths >2 m were contaminated, both immigration and recruitment of epibenthic invertebrates could be affected, adversely affecting their salmon predators. Effects to the benthos would be expected to be fairly localized; and because food does not appear to be limiting to fishes in the nearshore zone (Craig and Halderson, 1981; Moulton, Fawcett, and Carpenter, 1985), adverse trophic effects to salmon are expected to be moderate.

Section IV.A.2 describes the oil-spill-risk analysis used for this assessment should an oil spill occur. For purposes of analysis, one large spill of 1,500 bbl or 4,600 bbl was assumed to occur and was analyzed in the Beaufort multiple-sale EIS, Sale 195 EA and is analyzed this EA. The chance of one or more large spills total is 21% for the Proposed Action and alternatives based on the mean spill rate over the life of the project (USDOI, MMS, 2003:Tables C-5 through C-9). Table C-9 shows the chance of one or more large spills total for the Proposed Action and alternatives using spill rates at the 95% confidence interval. For the Proposed Action and alternatives, the percent chance of one or more large spills occurring total ranges from

14-29% using the spill rates at the 95% confidence interval over the life of the project. The combined probability of one or more large oil spills occurring and contacting a land segment is <2% within 60 days.

Appendix A-1 of the multiple-sale EIS (USDOI, MMS 2003) describes the many facets of oil-spill assessment pertaining to the proposed leasing actions. Maps A-3a and A-3b show the location of the 66 land segments dividing the Beaufort Sea coastline for analytical purposes. Land segments and the geographic place names within the land segments are shown in Table A.1-2b. Conditional probabilities of one large spill contacting any of the various land segments are reported in a suite of tables contained in Appendix A-1 of the multiple-sale EIS. There are numerous instances and probabilities whereby oil may contaminate intertidal/estuarine substrates and waters that may be used as spawning and/or rearing habitat to either pink salmon or capelin populations. The PAH's in weathered oil contaminating such spawning sites are expected to be biologically available for long periods and very toxic to sensitive lifestages. The result is that fewer juvenile pink salmon or capelin would survive, so that recruitment from the early lifestages is reduced and adult populations may not be replaced at sustainable levels for more than three generations. Depending on the demography of affected population(s), eventually, adult populations may gradually decline to extinction.

Based on the information reviewed (e.g., Carls et al. 2002; 2005; Peterson et al. 2003; and Short et al. 2003), a large oil spill impacting intertidal/estuarine spawning and rearing habitats used by capelin or other fishes is likely to result in significant adverse effects on local populations requiring three or more generations to recover to their former status. A large oil spill impacting spawning and rearing habitat used by early life-history stages of pink salmon is likely to result in significant adverse effects on local populations requiring three or more generations to recover to their former status. Depending on the demography of the affected population(s), the population may not recover and become extinct. Furthermore, locally significant adverse effects may adversely affect adjacent population units, depending on metapopulation structure and interactions among and between large marine ecosystems, the magnitude of which is unknown due to the lack of information regarding metapopulations. Additionally, other leasing related activities associated with the Proposed Action (e.g., seismic surveys, exploratory drilling, construction and operation of production facilities and infrastructure, vessel traffic, permitted discharges, and small chemical spills, including oil) all can contribute additive and/or synergistic lethal and sublethal impacts that remove individuals (mainly early life-history stages) from the population, and depress recruitment to the breeding age cohorts, pre- and postoccurrence of a large oil spill impacting fish resources (e.g., capelin, pink salmon) of the Beaufort Sea.

Lethal effects, or sublethal effects reducing reproductive fitness or survival, of rare and/or highly aggregated species (e.g., capelin, pink salmon), may be more consequential to their respective populations via Allee effects. The Allee effect is a phenomenon in biology used to describe the positive relation between population density and the per capita growth rate. In other words, for smaller populations, the reproduction and survival of individuals decreases. This effect usually saturates or disappears as populations get larger. The effect may be due to any number of causes. In some species, reproduction—finding a mate in particular—may be increasingly difficult as the population density decreases. Less fish reproduction lends to further decrease populations. Other species may use strategies (such as schooling in fish) that are more effective for larger populations, but also make them potentially more susceptible to greater impacts as individuals are concentrated. Continuance of leasing-related exploration and development activities in the years (e.g., seismic surveys or additional small oil spills) following a large oil spill impacting fish resources (e.g., capelin or pink salmon) likely would contribute to the Allee effect and delay the recovery of affected populations to their former status well past the three-generation threshold for recovery. Additional indirect effects that also may delay recovery of affected populations include the potential influence of a disease or parasite loads, as evident from the *Exxon Valdez* oil spill case.

Summary: Based on the new information reviewed (e.g., Carls et al. 2002; 2005; Peterson et al. 2003; and Short et al. 2003), a large oil spill impacting intertidal/estuarine spawning and rearing habitats used by capelin, pink salmon, or other fishes potentially could result in adverse effects on local populations requiring potentially three or more generations to recover to their former status, but the effects to the overall regional population of capelin, pink salmon, and other fish are expected to be insignificant.

IV.C.2.g(3) Updated Effects from Routine, Permitted Operations. Permitted activities include seismic exploration. The effects of projected 2006 seismic-survey activity were updated recently in the seismic-survey PEA (USDOI, MMS, 2006a). The PEA is available on the MMS web site at: http://www.mms.gov/alaska/ref/pea_be.htm. All of the information about the potential effects on fish will not be repeated here. The following is the conclusion from the PEA about the potential effects of seismic-survey activity on fish and essential fish habitat.

Many fish species are likely to hear airgun sounds as far as 2.7-63 km (1.6-39 mi) from their source, depending on water depth. Fish responses to seismic sources are species specific and may differ according to the species lifestage. Immediate mortality and physiological damage to eggs, larvae, fry, adult, and juvenile marine fishes is unlikely to occur, unless the fish are present within 5 m of the sound source (although more likely 1 m). The potential for physical damage is related to the characteristics of the sound wave, the species involved, lifestage, distance from the airgun array, configuration of array, and the environmental conditions. Damage to tissue may not be immediately apparent.

Behavioral changes to marine fish and invertebrates may include balance problems (but recovery within minutes); disoriented swimming behavior; increased swimming speed; tightening schools; displacement; interruption of important biological behaviors (e.g., feeding, mating); shifts in the vertical distribution (either up or down); and occurrence of alarm and startle responses. Some fishes may be displaced from suitable habitat for hours to weeks. Thresholds for typical behavioral effects to fish from airgun sources occur within the 160-decibel (dB) to 200-dB range.

Potential impacts from vessel noise, anchor or cable deployment and recovery, and fuel spills are regarded as negligible adverse but not significant impacts to fish/fishery resources and EFH. Commercial fisheries in the region are not expected to be impacted. There is a potential for impacts to migration, spawning, or subsistence fishing.

There is relatively little information concerning the distribution and abundance of populations of fish resources from which to determine whether exposure to seismic-airgun emissions would result and subsequently lead to a decline in abundance and/or change in distribution.

The MMS also considered the issue of basing its assessment on limited or lacking information on specific fish resources in arctic Alaska. However, a review of the available science and management literature shows that at present, there are no empirical data to document potential impacts reaching a population-level effect. The experiments conducted to date have not contained adequate controls in place to allow us to predict the nature of a change or that any change would occur. The information that does exist has not demonstrated that seismic surveys would result in significant impacts to marine fish or related issues (e.g., impacts to migration/spawning, rare species, subsistence fishing).

Recently, the NMFS concluded similarly in a FONSI for a proposed seismic survey in the Beaufort Sea during 2006. The NMFS FONSI states specifically that:

> Adult fish near seismic operations are likely to avoid the immediate vicinity of the source due to hearing the sounds at greater distances, thereby avoiding injury. The PEA indicates that impacts, if they were to occur, would add an incremental degree of adverse, but not significant, impacts to fish resources
>
> The action area has been identified and described as EFH for 5 species of Pacific salmon (pink (humpback), chum (dog), sockeye (red), chinook (king) and coho (silver)) occurring in Alaska. The issuance of this proposed incidental harassment authorization is not anticipated to have any adverse effects on EFH....

The NMFS reviewed the draft PEA and concluded similarly, stating that further EFH consultation is not necessary for proposed 2006 seismic surveys in the Beaufort Sea and Chukchi Sea (USDOI, MMS, 2006a:Sec. VI).

Based on the above assessment, the MMS concludes that seismic surveys would have adverse but not significant impacts on fish/fishery resources and EFH. Seismic-survey and support vessels would not be allowed to anchor, and seismic cables and arrays would not be towed within the vicinity of known fragile biocenoses.

IV.C.2.g(4) ***Benefits of the Standard Mitigation.*** The effects on fishes and EFH would be moderated slightly by two stipulations and ITL's. Stipulation No. 1, Protection of Biological Resources, lowers the potential adverse effects to the Boulder Patch kelp community and other unique biological communities that may be identified during oil and gas exploration or development activities and provides additional protection. It also would provide protection to fish (including the migration of fish) within or outside of the Boulder Patch from potential disturbance associated with oil and gas exploration, development, and production. The benefits of Stipulation No. 3, Transportation of Hydrocarbons, are summarized in the multiple-sale EIS (USDOI, MMS, 2003:Sec II.H.1.c). Nearshore resources such as fish near river deltas probably would benefit the most from it. The U.S. spill rate from pipelines is lower than the rate from barges, and this stipulation requires pipeline when feasible. Specifically, pipelines will be required: (a) if pipeline rights-of-way can be determined and obtained; (b) if laying such pipelines is technologically feasible and environmentally preferable; and (c) if, in the opinion of the lessor, pipelines can be laid without net social loss, taking into account any incremental costs of pipelines over alternative methods of transportation and any incremental benefits in the form of increased environmental protection or reduced multiple-use conflicts.

Information to Lessees. The mitigation for fishes also includes ITL No. 5, Information to Lessees on River Deltas, which advises lessees that certain river deltas of the Beaufort Sea coastal plain (such as the Kongakut, Canning, and Colville) have been identified by the FWS as special habitats for bird nesting and fish overwintering areas, as well as other forms of wildlife. Shore-based facilities in these river deltas may be prohibited by the permitting agency. The ITL No. 11, Sensitive Areas to be Considered in Oil-Spill-Contingency Plans, advises lessees that certain areas are especially valuable for their concentrations of fishes and other biota or cultural resources, and should be considered when developing oil-spill-contingency plans. Identified areas and time periods of special biological and cultural sensitivity include the Boulder Patch in Stefansson Sound, June-October; the Colville River Delta, January-December; and the Sagavanirktok River delta, January-December. These areas are among areas of special biological and cultural sensitivity to be considered in the oil-spill-contingency plan required by 30 CFR 250.300.

IV.C.2.g(5) ***Overall Conclusion – The Mitigated Effect.*** New information modifies the conclusion in the Beaufort Sea multiple-sale EIS about the effects of proposed Sale 202 on fishes and EFH (USDOI, MMS, 2003:Sec. IV.C.4.c). The multiple-sale EIS concluded that the effects of seismic on fish would be "low." This updated assessment concludes that, based on the new information reviewed, a large oil spill impacting intertidal/estuarine spawning and rearing habitats used by capelin, pink salmon, or other fishes potentially would result in adverse effects on local populations, potentially requiring three or more generations to recover to their former status; but the effects to the overall regional population of capelin, pink salmon, and other fish are expected to be insignificant.

IV.C.2.h. Additional Resources. This section updates the assessment of effects on other resources as a result of the Proposed Action (Alternative VII). The other resources include local air quality, archaeological resources, terrestrial mammals, vegetation and wetlands, and lower trophic-level organisms. The section includes four subsections, which summarize the multiple-sale EIS and Sale 195 EA assessments that are being updated, update those effects, incorporate the benefits of the standard mitigation, and summarize the conclusion (i.e., the mitigated effect).

IV.C.2.h(1) Summaries of Multiple-Sale EIS and Sale 195 EA Assessments Updated by this EA for Sale 202. The Beaufort Sea multiple-sale EIS concludes the following about the effects of proposed Sale 202 on air quality (USDOI, MMS, 2003:Sec. IV.C.15.b(5):

Effects on onshore air quality from air emissions likely would be only a very small percent of the maximum allowable Prevention of Significant Deterioration Class II increments. The concentrations of criteria pollutants in the onshore ambient air would remain well within the air-quality standards.

Consequently, there likely would be only a minimal effect on air quality with respect to standards. Principally, because of the distance of emissions from land, the other effects of air-pollutant concentrations at the shore due to exploration and development and production activities or accidental emissions would not be sufficient to harm vegetation. A light, short-term coating of soot over a localized area could result from oil fires.

The multiple-sale EIS concludes the following for archaeological resources (Sec. IV.C.13.c(4)):

> The effect of exploration and development activities on possible archaeological resources would be essentially the same as discussed under effects common to all alternatives, except that activities would be more dispersed. In the exploration phase, some drilling could take place in deeper water, using floating drilling platforms or ships.... No impact is expected to prehistoric archaeological resources from activities in water depths greater than 50 meters. In the development phase, floating drilling and production platforms and possibly subsea production well-head assemblies would have the same disturbance effect to the seafloor as in the exploration phase: anchor dragging and digging the glory hole. The effect of gravel islands or bottom-founded production systems would be the same as discussed under effects common to all alternatives, compression and skirt penetration of sediments. The effect of oil-spill cleanup activities depend on the size of the spill and would probably be limited to the Near Zone, but the response area would be larger and more difficult for response personnel to access, potentially exposing unknown archaeological resources to risk of damage. Onshore and offshore archeological surveys and analyses would be conducted and would identify potential archaeological resources, which will be avoided or possible effects would be mitigated.

Although the above conclusion states that no impact is expected to prehistoric archaeological resources from activities in water depths >50 m, we now believe that the depth range should be ">20 m," because archaeological resources would be disturbed in the 20- to 50-m depth range where ice gouges the seafloor.

The multiple-sale EIS concludes the following for terrestrial mammals (Sec. IV.C.8.b(2)):

> The effects of Alternative I for Sales 195 and 202 on caribou, muskoxen, grizzly bears, and arctic foxes are expected to include local displacement within about 1-2 kilometers (0.62-1.2 miles) along the onshore pipelines, with this local effect persisting during construction activities. Brief disturbances (a few minutes to a few days) of groups of caribou and muskoxen could occur along the pipeline corridor during periods of high ice-road and air traffic, but these disturbances are not expected to affect caribou, muskoxen, grizzly bear, and arctic fox movements and distribution. If an oil spill occurred in the Beaufort Sea, it likely would result in the loss of no more than a small number of caribou (perhaps 10 to a few hundred), fewer than 10 individual muskoxen, grizzly bears, and arctic foxes, with recovery expected within about 1 year.

The multiple-sale EIS concludes the following for lower trophic-level organisms (Sec. IV.C.2.b):

> Permitted drilling discharges are estimated to adversely affect less than 1% of the benthic organisms in the sale area. The organisms likely would recover within a year. Platform and pipeline construction is estimated to adversely affect less than 1% of the immobile benthic organisms in the sale area. Recovery likely would occur within 3 years. Unusual kelp communities could be protected from construction effects by required benthic surveys. The communities likely would colonize and benefit slowly from some new gravel islands. In the unlikely event that a large oil spill occurs, it is estimated to have lethal and sublethal effects on less than 1% of the planktonic organisms and (assuming a winter spill) less than 5% of the epontic organisms in the sale area. Recovery of plankton likely would occur within a week (2 weeks in embayments). Also, a large spill of refined fuel oil likely would have lethal and sublethal effects on less than 1% of the benthic invertebrates in shallow areas. Recovery likely would occur within a month (within a year where water circulation is significantly reduced). A summer spill from the Eastern Deferral area and Kaktovik Subsistence-Whaling Deferral area combined is estimated to have a 49% probability of contacting the coastline of the Arctic National Wildlife Refuge within

30 days. Deferral of leasing in these two areas combined would not eliminate the risk to the Refuge's coastline but would lower the maximum risk by about 25%.

The Sale 195 EA concludes the following about the effects of proposed Sale 202 on air quality and other resources (USDOI, MMS, 2004:Sec. IV.C.1.e (3)):

> The conclusion in the multiple-sale EIS is still appropriate for air quality, vegetation and wetlands, and terrestrial mammals. With regard to lower trophic-level organisms, in the unlikely event of a large oil spill there would be lethal and sublethal effects on a small percentage of the planktonic or epontic (under-ice) organisms in the proposed sale area, and recovery would occur within 2 weeks. Some of the oil probably would drift to shore where a small percentage of the oil probably would become buried in the sediments and persist for more than a decade in spite of cleanup responses.

IV.C.2.h(2) Update of those Effects for the Proposed Action – Alternative VII.

IV.C.2.g(2)(a) Updated Oil-spill Effects. The MMS data on the probability of spills has been updated, and new OSRA tables have been prepared (Sec. IV.A.1.b and Appendix C). The new data does not affect the OSRA tables with "conditional" probabilities, which assume that a spill has occurred. The new data affects only the tables with "combined" probabilities, which include the probability of a spill. The assessments for air quality, lower-trophic-level organisms, terrestrial mammals, and vegetation and wetlands in the multiple-sale EIS were based only on conditional probabilities (USDOI, MMS, 2003:Secs. IV.C.2.a(3)(b)2), -8.a(2)(b)2), and -9.a(2)(a)) and would not change.

A spill of 1,500 bbl or 4,600 bbl still could affect an estimated 29-49 km of shoreline (USDOI, MMS, 2003:IV-138 and Table IVA-6a and 6b), leading to no change in the level of effect on these resources.

IV.C.2.g(2)(b) Updated Effects from Routine, Permitted Operations. Archaeological resources in the Beaufort Sea region that may be impacted by the Proposed Action, primarily from ocean-bottom cable (OBC) seismic surveys, include historic shipwrecks, aircraft, and inundated prehistoric sites offshore. For an extensive discussion of potential impacts see the seismic-survey PEA (USDOI, MMS, 2006a), which is available on the MMS web site at: http://www.mms.gov/alaska/ref/pea_be.htm.

The PEA concluded that OBC seismic surveys potentially could impact both prehistoric and historic archaeological resources in waters inshore of the 20-m isobath, and in deeper water if cables are laid from shallow to deep water as part of one program. Associated activities such offshore seismic-exploration activities projected for the 2006 open-water season and beyond could disturb these resources and their in situ context. Assuming compliance with existing Federal, State, and local archaeological regulations and policies and the application of MMS' Geological and Geophysical (G&G) Permit Stipulation 6 (regarding the discovery of archaeological resources) and its Notice to Lessees, NTL 05-A03, Archaeological Survey and Evaluation for Exploration and Development Activities, most impacts to archaeological resources in shallow offshore waters of the Beaufort Sea Planning Area would be avoided. Therefore, no impacts or only minor impacts to archaeological resources are anticipated. Without compliance with Federal, State, and local regulations and the application of MMS's G&G Permit Stipulation 6 and Notice to Lessee (NTL) 05-A03, greater potential impacts to prehistoric and historic archaeological resources would be anticipated.

IV.C.2.h(3) Benefits of the Standard Mitigation. Two stipulations would moderate the level of effects on the additional resources.

Stipulation No. 1, Protection of Biological Resources, lowers the potential adverse effects to lower trophic-level organisms in the Boulder Patch kelp community and other unique biological communities that may be identified during oil and gas exploration or development activities and provided additional protection. It also would provide protection to vegetation and wetlands, terrestrial mammals, fish (including the migration of fish) within or outside of the Boulder Patch from potential disturbance associated with oil and gas exploration, development, and production. Secondly, the benefits of Stipulation No. 3, Transportation of Hydrocarbons, are summarized in the multiple-sale EIS (USDOI, MMS, 2003:Sec. II.H.1.c). It would reduce the risk of spill effects on coastal organisms, including lower trophic-level organisms. The U.S.

spill rate from pipelines is lower than the rate from barges, and this stipulation requires pipeline when feasible. Specifically, pipelines will be required: (a) if pipeline rights-of-way can be determined and obtained; (b) if laying such pipelines is technologically feasible and environmentally preferable; and (c) if, in the opinion of the lessor, pipelines can be laid without net social loss, taking into account any incremental costs of pipelines over alternative methods of transportation and any incremental benefits in the form of increased environmental protection or reduced multiple-use conflicts.

The level of effects would be moderated also by ITL's.

The mitigation for lower trophic-level organisms also includes the ITL on Sensitive Areas to be Considered in Oil-Spill-Contingency Plans, which advises lessees that certain areas are especially valuable for their concentrations of fishes and other biota or cultural resources, and should be considered when developing oil-spill-contingency plans. Identified areas and time periods of special biological and cultural sensitivity include the Boulder Patch kelp community in Stefansson Sound during June-October. This area is among several areas of special biological and cultural sensitivity to be considered in the OSCP required by 30 CFR 250.300.

The mitigation for archaeological resources includes the NTL about Archaeological and Geological Hazards Reports and Surveys, which provides the lessee with information about the requirements to protect potential prehistoric and historic archaeological sites. The ITL clause provide no mitigation; however, it does enlighten lessees and their contractors to the existence of regulations, and that reports and surveys will be required as part of their exploration and development plans when they are submitted. The existing laws and regulation provide mitigation for archaeological sites through the identification of potential sites and recommend avoidance when possible.

IV.C.2.i. Environmental Justice. Alaskan Inupiat Natives, a recognized minority, are the predominant residents of the NSB, the area potentially most affected by the Beaufort Sea multiple sales. Effects on Inupiat Natives could occur because of their reliance on subsistence foods, and exploration and development may affect subsistence resources and harvest practices. Potential effects could be experienced by the Inupiat communities of Barrow, Nuiqsut, and Kaktovik within the NSB. The sociocultural and subsistence activities of these Native communities could be affected by oil spills and seismic noise effects. The Environmental Justice Executive Order includes consideration of potential effects to Native subsistence activities. Potential effects focus on the Inupiat communities On the North Slope.

IV.C.2.i(1) Demographics.

IV.C.2.h(1)(a) Race. Minority, low-income populations in the NSB and the Northwest Arctic Borough (NWAB) are relevant to the Environmental Justice analysis. The 2000 Census counted 7,385 persons resident in the North Slope Borough; 5,050 identified themselves as American Indian and Alaskan Native for a 68.38% indigenous population. Inupiat Natives are the majority population of the region, as well as a defined minority population. It is the only minority population allowed to conduct subsistence hunts for marine mammals in the region, and, in potentially affected Inupiat communities, there are no substantial numbers of "other minorities." Additionally, "other minorities" would not be allowed to participate in subsistence marine mammal hunts and, therefore, would not constitute a potentially affected minority population (North Slope Borough, 1999).

Because of the North Slope homogenous Inupiat population, it is not possible to identify a "reference" or "control" group within the potentially affected geographic area, for purposes of analytical comparison, to determine if the Inupiat are affected disproportionately. This is because a nonminority group does not exist in a geographically dispersed pattern along the potentially affected area of the North Slope.

IV.C.2.i(1)(b) Income. The U.S. average median household income in 2000 was $42,148, and the U.S. average per-capita income was $29,469. The Alaskan average median household income in 2000 was $50,746, and the Alaska average per-capita income was $29,642. The average NSB median household income ($63,173) was above State and national averages, but the average per-capita income ($20,540) was below the State and national averages. The median household incomes in all subsistence-based communities in the NSB were above State averages except Nuiqsut ($48,036), and all were above national averages. Per-capita incomes in all these communities were below State and national averages.

The thresholds for low income in the region were household incomes below $57,500 in the NSB. Poverty-level thresholds were based on the U.S. Census Bureau, Census 2000 Survey; low income is defined by the U.S. Census Bureau as 125% of poverty level. Subsistence-based communities in the region qualify for Environmental Justice analysis based on their racial/ethnic minority definitions alone. Nevertheless, the figures indicate that low income commonly also correlates with Native subsistence-based communities in the region (USDOC, Bureau of the Census, 2000, 2002). The 2000 Census "Tiger" files (files from the U.S. Census' Topologically Integrated Geographic Encoding and Referencing [TIGER] database) identify no nonsubsistence-based coastal communities in the North Slope with median incomes that fall below the poverty threshold.

IV.C.2.i(1)(c) Consumption of Fish and Game. As defined by the NSB Municipal Code, subsistence is "an activity performed in support of the basic beliefs and nutritional need of the residents of the borough and includes hunting, whaling, fishing, trapping, camping, food gathering, and other traditional and cultural activities" (State of Alaska, DNR, 1997). This definition gives only a glimpse of the importance of the practice of the subsistence way of life in Inupiat culture, but it does underscore that it is a primary cultural and nutritional activity on which Native residents of the North Slope depend.

IV.C.2.i(2) Update of those Conclusions for the Proposed Action. The multiple-sale EIS (USDOI, MMS, 2003) assessed the effects of an accidental spill of 1,500 bbl or 4,600 bbl as a result of proposed Sales 186, 195, and 202 on Environmental Justice, concluding in Section IV.C.16 that: If a spill occurred, oil-spill contact in winter could affect polar bear hunting and sealing. During the open-water season, a spill could affect bird hunting, sealing, and whaling, as well as netting of fish in the ocean. Only the tainting or the potential contamination of the bowhead whale would be considered significant although, given the recent tendency of polar bears to aggregate onshore, unmitigated effects on polar bears could be significant as well; effects on seal populations would be less. In the unlikely event that a large oil spill occurred and contaminated essential whaling areas, major effects could occur when impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together. Such effects would represent disproportionate high adverse effects to Alaskan Natives in Beaufort Sea coastal communities.

As defined by the Sale 202 OSRA, combined probabilities express the percent chance of one or more oil spills greater than or equal to 1,000 bbl occurring and contacting a certain ERA or land segment over the production life of the Beaufort Sea multiple-sale. For combined probabilities, the oil-spill model estimates a chance ≤0.5-2% that an oil spill would occur from a platform or a pipeline (LA1-LA18 or P1-P13, respectively) and contact subsistence-specific ERA's 2 (Point Barrow/Plover Islands), 3 (Thetis and Jones Islands), 42 (Barrow Subsistence Whaling Area), 69 (Harrison Bay/Colville Delta); 74 (Cross island), and 83 (Kaktovik) and LS 27 (Kurgorak Bay/Dease Inlet) within 360 days (Tables C-15 and C-21).

After publication of the multiple-sale EIS and the Sale 195 EA, Environmental Justice effects from additional development around the Alpine Field as described in the Alpine Satellite Development Plan Final EIS (USDOI, BLM, 2004) and a proposed lease sale in the Northeast NPR-A as described in the Northeast NPR-A Final Amended IAP/EIS were assessed (USDOI, BLM, 2005).

Sections 4F.4.4 and 4F.4.4.3 of the Alpine Satellite Development Plan assess the effects of increased oil field development in the area on Environmental Justice. The conclusion states:

> The most prevalent impacts found are the potential direct and indirect impacts related to subsistence harvest and use. Other impacts identified as potentially disproportionate include spill impacts and potential water quality, air quality, and aircraft noise impacts.
>
> Impacts on subsistence harvest and uses would arise from impacts on the availability of subsistence species in traditional use areas or a decrease in subsistence hunting success. The reduction in subsistence hunting success in turn reduces the availability of Native foods to the

community. Since the Native community is the only community that depends to a significant degree on Native foods, this impact, to the extent that it occurs, falls disproportionately on the Native population. Also, as discussed in Section 4F.4.3, displacement of subsistence hunters from traditional subsistence use areas by oil industry facilities also means greater time spent traveling longer distances to other subsistence use areas. It could also mean that local hunters from Nuiqsut could come in competition with hunters from other villages when they use the same traditional subsistence use areas.

The analysis of spill impacts shows that very small and small spills are unlikely to have long-term, extensive impacts that would affect water quality, habitat, or subsistence species. Larger spills that are more likely to have impacts that are more extensive have a very low probability of occurrence. Spill impacts, to the extent that they occur, would be episodic, not continuous. Local residents have shown a propensity to avoid resources from areas where spills have occurred because of a lack of confidence that subsistence resources have not been contaminated. This lack of confidence could affect subsistence use for a period beyond the time when any resources affected from spills would actually persist.

As discussed in the water quality section (Section 4F.2.2), impacts on water quality can occur as a result of spills or construction-induced erosion.

Air quality in Nuiqsut already meets NAAQS for all criteria pollutants. Short-term episodes of elevated particulate concentrations have been observed at Nuiqsut and are caused by wind-borne dust. Emissions from natural gas flaring (incidental) and equipment operation are not expected to contribute to the chronic exposure of local residents to particulates.

Low-level aircraft noise is expected to be limited to areas surrounding facility airstrips. However, helicopter operations, which are typically at lower altitudes, can range over a larger area as these aircraft move between different facility locations. Subsistence hunters have reported the interruption of hunts in progress by low-flying aircraft, especially helicopters.

For a discussion of mitigation measures that would reduce environmental justice effects, see the subsistence-harvest patterns effects discussion of subsistence based mitigation for the Alpine Satellite Development Plan.

Section 4.6.14.4 of the Northeast National Petroleum Reserve-Alaska Final Amended Integrated Activity Plan/EIS (NPR-A IAP/EIS) assesses the effects of increased oil development in the area on Environmental Justice. The conclusion summary states:

> Several lease sales have already taken place in the Planning Area. Exploration programs, consisting of seismic testing and drilling using ice pads, are ongoing. Residents of Barrow, Nuiqsut, and Atqasuk have noted some effects from these activities on subsistence (SRBA 2003a, b). One effect included the redistribution of caribou, wolves, and wolverines in response to seismic activity and cat trains operating in the National Petroleum Reserve - Alaska (SRBA 2003a, b). These effects would continue under the final Preferred Alternative, and would be somewhat greater than under the No Action Alternative. Most effects of disturbance would still be short term, but the extent and magnitude would likely increase. Effects from oil spills would depend greatly on the size, location, and season of the spill. Small spills on gravel pads would have little or no environmental justice effects. A major spill into a watercourse, on the other hand, could have long term serious effects on Iñupiat subsistence activities. While any major spill would have serious consequences, the worst, from an environmental justice standpoint, would be one that occurred in a key harvest area or near a community, particularly Nuiqsut or areas used by Barrow residents in the northwest portion of the Planning Area.

For a discussion of mitigation measures that would reduce environmental justice effects, see the subsistence-harvest patterns effects discussion of subsistence based mitigation for the Northeast NPR-A Final Amended IAP/EIS.

Since 1995, subsistence restoration resulting from the *Exxon Valdez* oil spill has improved by taking a more comprehensive approach by partnering with local communities and by linking scientific methodologies with traditional knowledge (Fall et al., 1999; Fall and Utermohle, 1999).

The MMS is very sensitive to its responsibilities to evaluate the consequences of its activities in terms of environmental justice. By definition, OCS activities take place primarily offshore (with onshore support activities) and thus most directly affect coastal communities. Most Alaskan coastal communities are rural and predominantly Native (a defined ethnic minority), and many contain at least subpopulations with low incomes. That is, any OCS activity in Alaska is likely to significantly affect a specific local minority (and possibly poor [low-income]) population.

For these reasons, the MMS socioeconomics studies agenda has emphasized the documentation of subsistence use, and the potential impacts of OCS activities on such uses, along with the more general characterization of rural (Native and non-Native) social organization and the incorporation of local and traditional knowledge. A series of comprehensive studies has focused most heavily on communities on the North Slope (the area of most onshore and offshore oil and gas activity). In addition, MMS has funded projects to synthesize local and traditional knowledge. Specific environmental justice issues are discussed in more depth in the discussions for subsistence and sociocultural systems.

The MMS has especially recognized the extreme importance of whales and whaling on the North Slope, and has conducted a bowhead whale aerial survey annually since 1987. The MMS also funded a *Bowhead Whale Feeding Study* for the area near Kaktovik in the mid-1980's, as well as currently (1998-2001). A newly-funded study, *Quantitative Description of Potential Impacts of OCS Activities on Bowhead Whale Hunting and Subsistence Activities in the Beaufort Sea*, is ongoing. The MMS also is funding a study of Cross Island whaling to monitor potential effects of the Northstar development as part of the ongoing Arctic Nearshore Impact Monitoring in the Development Area (ANIMIDA) project. North Slope whalers (and to a more limited extent, AEWC and NSB staff) have had a role in formulating and implementing this project. The MMS has also funded a large number of biological studies on other marine resources.

Perhaps more importantly, MMS has recognized the importance of local consultation, and the important role that the NSB and other local organizations and institutions can play in the development and evaluation of specific actions.

Further, MMS now routinely includes Native representation on the Scientific Review Boards for its major projects, and tries to conduct at least occasional Information Transfer Meetings (discussing the findings of recently concluded and ongoing studies and proposed efforts) near those communities most likely to be affected. The most recent such meeting was held in Anchorage in October 2005.

In Alaska initiatives researching contaminants in subsistence foods include a 1999 report by the Alaska Native Health Board: *Alaska Pollution Issues*. After assessing the risks from radionuclides, persistent organic pollutants, heavy metals, polychlorinated biphenyls, dioxins, and furans, the Health Board report concluded that the "benefits of a traditional food diet far outweigh the relative risks posed by the consumption of small amounts of contaminants in traditional foods" (Alaska Native Health Board, 1999). A 1998 report, *Use of Traditional Foods in a Healthy Diet in Alaska: Risks in Perspective*, by the Alaska Department of Health and Social Services essentially came to the same conclusion as the Native Health Board report. It did suggest that Alaska has a critical need to examine human biomarkers of polychlorinated biphenyl exposure and that more studies on polychlorinated biphenyl concentrations in the serum of Alaskan Natives is needed. Such information would be the most relevant in determining polychlorinated biphenyl exposure through the subsistence food chain. A comprehensive statewide screening study was advocated (Egeland, Feyk, and Middaugh, 1998).

In 2001, The Alaska Native Health Board released the *Alaska Pollution Issues Update* report. The report was the first real attempt in Alaska to combine contaminant levels in subsistence foods, actual subsistence food consumption levels by Alaskan Natives, and Food and Drug Administration, and the Environmental Protection Agency action levels to develop actual health advisories. Its overall conclusion was that:

> ...a small number of traditional foods contain contaminants with concentrations that are over the Food and Drug Administration action level, but most have levels below the action level. With the wide margin built in, for establishing the Food and Drug Administration action level, the results should be reassuring to consumers of traditional foods. To determine definitively if these low levels are harmful only ongoing research that measures contaminant levels in Native populations will provide the answer (Alaska Native Health Board, 2002).

One overarching way MMS has tried to address Native concerns has been to include local Inupiat Traditional Knowledge in the text of lease-sale and production EIS's. This process was followed for Sale 170 during 1997, and for all succeeding EA's and EIS's since that time.

Summary. Effects on Inupiat Natives could occur because of their reliance on subsistence foods, and because seismic noise from exploration activities and potential oil spills would affect subsistence resources and harvest practices. The EIS defines "significant" effects on environmental justice as disproportionate, high adverse impacts to low-income and minority populations. Potential effects could be experienced by the Inupiat communities of Barrow, Atqasuk, Nuiqsut, and Kaktovik. Potential significant impacts to subsistence resources and harvests and consequent significant impacts to sociocultural systems would indicate significant environmental justice impacts—disproportionate, high adverse effects on low-income, minority populations in the region. Any potential effects to subsistence practices from ongoing seismic surveys are expected to be mitigated substantially, though not eliminated, through conflict avoidance agreements between the AEWC and the oil industry.

Disproportionate high adverse effects to Alaskan Natives are not expected to occur from Beaufort Sea multiple-sale seismic activity, exploration drilling, or oil spills. Any potential effects on subsistence resources and subsistence harvests are expected to be mitigated substantially, although not eliminated. Potential long-term impacts on human health from contaminants in subsistence foods and climate change effects on subsistence resources and practices would be expected to exacerbate overall potential effects on low-income, minority populations.

Conclusion. The definitions and conclusions about Environmental Justice remain appropriate in the context of the new information that has become available since publication of the multiple-sale EIS and the Sale 195 EA. The conclusion about disproportionate high adverse impacts to low income and minority populations as a result of an oil-spill that was reached for Sale 202 in the multiple-sale EIS does not change in the context of the new information.

IV.C.3. Summary of Section IV.C. The following is a summary of, specifically, the updated assessment of the effects of the Proposed Action - Alternative VII for Lease Sale 202 in light of the new environmental information. The likelihood of one or more large oil spills occurring and contacting a land segment still is very low (e.g., <2% within 60 days). Due primarily to increased concentrations of polar bears on parts of the coast, the relative oil-spill risk to the population has increased since preparation of the multiple-sale EIS (Sec. IV.C.2.e). The existing MMS operating regulations, the standard mitigating measures, and the following proposed new ITL's, described fully in EA Section III.C.2, would moderate the spill risk to polar bears:

> Proposed New Information to Lessees for protection of polar bears, entitled Planning for Protection of Polar Bears. It states in part that lessees are advised to consult with the U.S. Fish and Wildlife Service (FWS) and local Native communities while planning their activities and before submission of their Oil-Spill Contingency Plans.
>
> Revisions to Standard Information to Lessee Clauses
> Standard ITL No. 4, entitled Bird and Marine Mammal Protection. The revision in part adds polar bears to the list of species that have been proposed for listing under the Endangered Species Act.
>
> Standard ITL No. 11, entitled Sensitive Areas to Be Considered in the Oil-Spill Contingency Plans (OSCP's). The revision explains in part that coastal aggregations of polar bears during the open

water/broken ice period are particularly vulnerable to the effects of an oil spill, which lessees must account for in their OSCP's.

The levels of effect on other resources, including subsistence, marine and coastal birds, local water quality, bowhead whales, fish and Essential Fish Habitat, and other organisms, were similar to those levels in the multiple-sale EIS (USDOI, MMS, 2003). Therefore, no new significant impact was identified for the proposed lease sale that was not already assessed in the multiple-sale EIS.

IV.D. Updated Effects of Other Alternatives.

This section updates the assessments of Alternatives I through VI. The level of effect with Alternative II - No Sale would be lower for all resources. The other alternatives would not alter the level of effect for all resources; they would alter the effects for subsistence-harvest patterns and sociocultural resources. However, the Eastern Deferral - Alternative VI would alter the level of effects on bowhead whales, and polar bears.

IV.D.1. Alternative I – The Area of Call. This alternative is similar to the Proposed Action, except that it would include no deferrals; leasing would be deferred in none of the subsistence whaling areas. The level of effect on subsistence-harvest patterns would be slightly higher than for the Proposed Action, which would defer leasing in two subsistence areas. However, the overall conclusion in the multiple-sale EIS that significant oil-spill effects on subsistence-harvest patterns could occur from a large oil spill remains the same for proposed Sale 202.

IV.D.2. Alternative II – No Sale. This alternative would cancel proposed Sale 202 and defer leasing until after 2007 as part of the next 5-year schedule. The level of effect on all resources would be lower than for the Proposed Action. However, the level of effect would not drop to negligible because of existing OCS and State leases in the area and because of plans for further State and OCS leasing.

IV.D.3. Alternative III - Barrow Subsistence Whaling Deferral. This alternative is similar to the Proposed Action, except that it would not offer for lease only the subarea within which Barrow residents conduct subsistence whaling; leasing would be deferred in only one of the three Beaufort Sea subsistence-whaling areas. The level of effect on subsistence-harvest patterns would be slightly higher than for the Proposed Action, which would defer leasing in two subsistence areas.

Specifically, effects on subsistence resources and practices are expected to be about the same as the Preferred Alternative for Sale 202. Changes in noise and oil-spill effects to bowhead whales from this deferral as compared to the Preferred Alternative likely would be reduced, but this reduction would be difficult to measure. Subsistence whalers have indicated that this deferral is too small and does not defer areas near Barrow that protect the bowhead whale migration route from seismic sound disturbance; that protect subsistence staging, pursuit, and butchering areas; and that protect critical whale feeding and calving areas. Given the increasing levels of seismic survey activity expected in the Chukchi and Beaufort seas, enlarging the Barrow Deferral should be considered. Additionally, stakeholders object to the name of this deferral, because it is not the one originally proposed by Barrow subsistence whalers and the AEWC but a smaller one conceived by MMS based solely on subsistence-strike data. We suggest this deferral be called simply the Barrow Deferral.

This alternative is not expected to reduce noise, disturbance, and oil-spill effects on seals, polar bears, and gray and beluga whales from air and vessel traffic, drill platforms, or reduce habitat effects from platform and offshore pipeline installation in this area, and effects are expected to be the same as for the Preferred Alternative. However, potential risks of oil-spill contact to the Barrow subsistence whaling area (ERA 42) would be reduced with the partial removal of the highest conditional risk, a 64% chance of contact to this area from launch area LA2. Spill-contact risks to other habitat areas would not be reduced under this alternative for Sale 202.

Even though effects on sociocultural systems with Alternatives III would be essentially the same as described the Preferred Alternative, effects on sociocultural systems in Barrow are expected to be reduced, because no exploration or production activities would occur in this deferral area, potentially reducing sources for chronic noise and disturbance effects on a portion of Barrow's traditional subsistence-whaling area. Because effects to subsistence-harvest patterns are expected to be reduced in Barrow under this alternative, subsequent effects reductions to sociocultural systems also would be expected.

Alternative III would reduce the potential for effects on prehistoric or historic resources in the deferral areas. The potential for encountering shipwrecks during offshore operations would be greatly reduced because of the high potential for possible shipwrecks to occur in the general area offshore Barrow. There would be less potential disturbance in the adjacent land areas, which otherwise might have experienced construction activities related to pipeline infrastructure or a staging area.

The draft seismic-survey PEA concluded that OBC seismic surveys potentially could impact both prehistoric and historic archaeological resources in waters inshore of the 20-m isobath or in deeper water, if cables are laid from shallow to deep water as part of the seismic-survey program. Assuming compliance with existing Federal, State, and local archaeological regulations and policies and the application of MMS's G&G Permit Stipulation 6 and its NTL 05-A03, most impacts to archaeological resources in shallow offshore waters of the Beaufort Sea Planning Area would be avoided. Therefore, no impacts or only minor impacts to archaeological resources are anticipated. Without compliance with Federal, State, and local regulations and the application of MMS stipulations and NTL's, greater potential impacts to prehistoric and historic archaeological resources would be anticipated.

IV.D.4. Alternative IV – Nuiqsut Subsistence Whaling Deferral. This alternative is similar to the Proposed Action, except that it would not offer for lease only a subarea within which Nuiqsut residents conduct subsistence whaling to the northeast of Cross Island; leasing would be deferred in only one of the three Beaufort Sea subsistence-whaling areas. The level of effect on subsistence-harvest patterns would be slightly higher than for the Proposed Action, which would defer leasing in two subsistence areas. Specifically, effects on subsistence resources and practices are expected to be about the same as the Preferred Alternative. Differences in chronic noise and disturbance effects on bowhead whales, subsistence whaling, and other subsistence resources and practices in Nuiqsut are expected to be reduced because no exploration or production activities would occur in this deferral area. Effects from oil spills would not be diminished, because LA12 and P12 would not be excluded from the OSRA scenario. As a result, the effects from noise, disturbance, and oil spills associated with Alternative IV are expected to be somewhat less than under the Preferred Alternative. Reductions in effect from this deferral compared to the Preferred Alternative would be difficult to measure.

Given the increasing levels of seismic-survey activity expected in the Chukchi and Beaufort seas, enlarging the Nuiqsut Deferral should be considered. In lieu of such a deferral, it has been suggested that leasing incentives could be discontinued in the areas off Cross Island most critical to Nuiqsut whaling. Additionally, stakeholders object to the name of this deferral, because it is not the one originally proposed by Nuiqsut subsistence whalers and the AEWC but a smaller one conceived by MMS based solely on subsistence strike data. We suggest this deferral be called simply the Cross Island Deferral.

Even though effects on sociocultural systems with Alternative IV would be essentially the same as described under the Preferred Alternative, effects on sociocultural systems in Nuiqsut likely would be reduced, because no exploration or production activities would occur in this deferral area, potentially reducing sources for chronic noise and disturbance effects on subsistence whaling. Effects from oil spills would not be diminished, because LA12 and P12 would not be excluded from the OSRA scenario. Because effects to subsistence-harvest patterns are expected to be reduced under this alternative, subsequent effects reductions to sociocultural systems also would be expected.

A previous paragraph in this section refers to the discontinuation of leasing incentives in the Nuiqsut subsistence whaling area. The rationale for leasing incentives is summarized in Section III.D; it is partly to encourage additional industry activities in remote areas, leading to commercial production. So, the exclusion of leasing incentives from the Nuiqsut subsistence area would allow the previous rate of development to continue, would be an alternative to the Nuiqsut Subsistence Whaling Deferral, and would address in part the comments from the AEWC (Appendix A) and Senator Murkowski (Sec. III.E.3).

IV.D.5. Alternative V – Kaktovik Subsistence Whaling Deferral. This alternative is similar to the Proposed Action, except that it would not offer for lease only a subarea within which Kaktovik residents conduct subsistence whaling; leasing would be deferred in only one of the three Beaufort Sea subsistence whaling areas. The level of effect on subsistence-harvest patterns would be slightly higher than for the Proposed Action, which would defer leasing in two subsistence areas. Specifically, effects on subsistence resources and practices are expected to be about the same as the Preferred Alternative. Differences in noise and oil-spill effects to bowhead whales from this deferral alternative compared to the Preferred Alternative are not likely to be measurable. Even though noise and oil-spill effects on subsistence resources and practices with Alternative V would be essentially the same as described for the Preferred Alternative, effects on subsistence-harvest patterns in Kaktovik are expected to be reduced, because no exploration or production activities would occur in this deferral area, potentially reducing sources for chronic noise and disturbance effects on subsistence whaling in the western half of Kaktovik's traditional subsistence-whaling area.

Given the increasing levels of seismic survey activity expected in the Chukchi and Beaufort seas, enlarging the Kaktovik Deferral should be considered. Additionally, stakeholders object to the name of this deferral, because it is not the one originally proposed by Kaktovik subsistence whalers and the AEWC but a smaller one conceived by MMS based solely on subsistence-strike data. We suggest this deferral be called simply the Kaktovik Deferral.

Even though effects on sociocultural systems with Alternative V would be essentially the same as described under the Preferred Alternative, effects on sociocultural systems in Kaktovik are expected to be reduced, because no exploration or production activities would occur in this deferral area, potentially reducing sources for chronic noise and disturbance effects on a portion of Kaktovik's traditional subsistence-whaling area. Because effects to subsistence-harvest patterns are expected to be reduced in Kaktovik under this alternative, subsequent effects reductions to sociocultural systems also would be expected.

IV.D.6. Alternative VI - Eastern Deferral. This alternative is similar to the Proposed Action, except that it would not offer for lease a subarea within which bowheads feed. As explained in the multiple-sale EIS, this alternative would decrease slightly the level of effects for bowhead whales and polar bear. The level of effect on subsistence-harvest patterns, sociocultural systems, marine and coastal birds, water quality, air quality, archaeology, terrestrial mammals, and lower trophic-level organisms would not be lowered; and new information does not change those conclusions.

IV.D.6.a. Subsistence-Harvest Patterns and Sociocultural Systems. Leasing would be deferred in none of the three Beaufort Sea subsistence-whaling areas. The level of effect on subsistence-harvest patterns would be slightly higher than for the Proposed Action, which would defer leasing in two subsistence areas. Specifically, effects on subsistence resources and practices are expected to be about the same as the Preferred Alternative. Differences in oil-spill and noise effects to bowhead whales from this deferral as compared to the Preferred Alternative are not likely to be measurable. This alternative potentially could reduce oil-spill effects on subsistence resources from Barter Island east to Demarcation Bay and on important Kaktovik subsistence-harvest areas. If oil exploration and development were deferred under this alternative, potential oil-spill contact to offshore habitats for seals, polar bears, and beluga whales from Barter Island east to Herschel Island would be reduced somewhat. Potential oil-spill risks to habitats west of Beaufort Lagoon would remain unchanged.

Potential reductions in oil-spill contact would reduce effects on important subsistence resources and important Kaktovik subsistence harvest areas from Barter Island east to Demarcation Bay. Because effects to subsistence-harvest patterns are expected to be reduced under this alternative, subsequent effects reductions to sociocultural systems also would be expected.

IV.D.6.b. Bowhead Whales. Leasing would be deferred in an area where bowheads have been observed frequently to feed. The likelihood of a large spill in the area would be decreased slightly if leasing were deferred, but the spill risk would not be eliminated because of existing leases in the area, State leasing in the area, and non-OCS related ship traffic. The level of effect on bowheads would be slightly lower than for the Proposed Action. A slightly lower level of effect would be consistent with the conclusion in the multiple-sale EIS that no significant impacts to this endangered species are expected due to activities associated with proposed Sale 202.

IV.D.6.c. Polar Bear. The assessment of the effects of the Proposed Action –Alternative VII—on polar bear explained that, if an oil spill does occur, the chance of it contacting the coastline of ANWR specifically would be highest for any inshore spill in the eastern Alaskan Beaufort Sea (USDOI, MMS, 2003:Sec. IV.C.2.a(3)(b)(2)). The Kaktovik area (LS 47) has one of the highest chances of spill contact, up to 16% from either LA1-LA18 or P1-P13, assuming spills occur during the summer season and contact the coastline within 30 days (USDOI, MMS, 2003:Sec. IV.C.7.a(2)(c)(2)). The Eastern Deferral would reduce the likelihood of a spill contacting this prime polar bear habitat.

IV.D.7. Environmental Justice Summary for All Alternatives.

Disturbance and noise effects could affect subsistence resources and the subsistence bowhead whale hunt in the communities of Barrow, Nuiqsut, and Kaktovik periodically, but no resource or harvest area is expected to become unavailable and no resource population would experience an overall decrease if such noise and disturbance effects are effectively mitigated by conflict avoidance agreements. Our analysis indicates that disturbance and noise from Alternatives III, IV, V, and VI would not be substantial sources of potential environmental justice effects. Our analysis does indicate that Environmental Justice-related effects from Sale 202 to these Native villages would occur in the event of a large oil spill.

Sale-specific Environmental Justice effects would derive from potential noise, disturbance, and oil-spill effects on subsistence resources, subsistence-harvest patterns, and sociocultural systems. The only substantial source of potential Environmental Justice-related effects to Native villages from Alternatives III, IV, V, and VI would occur in the event of a large oil spill, which could affect subsistence resources. In the event that a large oil spill occurred and contaminated essential whaling areas, major effects could occur when impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together. Such major disruptions to subsistence resources and practices would be considered disproportionately high adverse effects on Alaskan Natives. Any potential effects on subsistence resources and subsistence harvests are expected to be mitigated substantially, though not eliminated.

IV.D.8. Summary of Effects of the Alternatives.

The effects of the alternatives would be similar to the effects of the Proposed Action with two exceptions. One exception is that the Eastern Deferral would reduce slightly the level of effect on subsistence-harvest patterns, bowhead whales and polar bear. The other exception is that the other deferrals would reduce the level of effects on subsistence-harvest patterns. A similar reduction of subsistence effects in the Nuiqsut subsistence area could be achieved by the exclusion of leasing incentives from this area.

IV.E. Updated Cumulative Effects of Proposed Sale 202.

The following section contains updated information on the cumulative scenario and on the resource-specific effects.

IV.E.1. Cumulative Scenario.

The AEWC asserted in a recent letter (Appendix A) that "MMS did not contemplate cumulative effects at the level of intensity that is likely to result from the combination of Sale 195, National Petroleum Reserve-Alaska (NPR-A), Liberty, and even state lease sales...." Therefore, we have reviewed carefully the scenario for cumulative effects. The cumulative-effects scenario for Sale 202 has changed with regard to spill risk and the assumed level of future seismic exploration. The level of other operations is similar to the level that was assumed in the multiple-sale EIS. We believe that this is still an optimistic projection of future activities because decades of leasing and exploration have yet to result in new developments in either NPR-A or Beaufort Sea OCS areas. Development on State lands has occurred, but most activities are associated with (or contained in) existing fields, with the exception of the Alpine filed on the Colville River delta.

The mean number of spills, including all past, present, and reasonably foreseeable reserves and resources, was estimated in the multiple-sale EIS. The estimate, using an assumed spill rate of 0.23 spills per billion barrels, was 0.66 spills (USDOI, MMS.2003:Table V-12). The spill rate has been updated in this EA; as explained in Section IV.A.3, "our best estimate of the spill rate for large spills...is that there may be 0.53 oil spills (95% confidence interval 0.35-0.73) per billion barrels produced." The increase in the spill rate from 0.23-0.53 per billion barrels means that the assumed cumulative number of spills has approximately doubled. In spite of the doubling, the most likely cumulative number of spills is close to one.

Cumulative effects on seismic-survey activity were summarized recently in the seismic-survey PEA (USDOI, MMS, 2006a). The PEA contains new projections of seismic activity (Table 1). The projections are for seismic surveys in both the OCS and State waters and in the Beaufort and Chukchi seas. The effects of the 14 seismic surveys in the Beaufort OCS waters were assessed in Section IV.C. This section assesses the effects of 35 surveys—14 surveys in the Beaufort OCS, 3 surveys in Beaufort State waters, and 18 surveys in the Chukchi Sea. The projection includes 13 high-resolution site-clearance surveys, which would be conducted in a small area over a short period of time.

Assuming still that each of the 35 2D/3D surveys would cover roughly six OCS blocks (9 mi^2 or 24 km^2), the total estimated amount of seismic exploration for the Beaufort Sea is 315 mi^2 (approximately 840 km^2). The total time for the 13 high-resolution site-clearance surveys is estimated to range from 26-65 days.

IV.E.2. Resource-Specific Cumulative Effects. The cumulative effects on the resources are discussed in the same order in which the resources were described: subsistence-harvest patterns, marine and coastal birds, water quality, other resources (including bowheads and polar bears), and environmental justice.

Available evidence indicates that the total extent of arctic sea ice has declined over the past several decades; however, these declines are not consistent across the Arctic (Gloersen and Campbell, 1991; Johannessen, Miles, and Bjorgo, 1995; Maslanki, Serreze, and Barry, 1996; Parkinson et al., 1999; Vinnikov et al., 1999). Warming trends in the Arctic (Comiso, 2003) appear to be affecting thickness of multiyear ice in the polar basin (Rothrock, Yu, and Maykut, 1999) and perennial sea-ice coverage (declines 9% per decade) (Comiso, 2002a,b).

The presence, thickness, and movement of sea ice contribute significantly to ambient noise levels. The presence of sea ice also affects the timing, nature, and possible locations of human activities such as shipping; research; barging; whale hunting; oil- and gas-related exploration (e.g., seismic surveys and drilling); military activities; and other activities that introduce noise into the marine environment. Because of sea ice and its effects on human activities, ambient noise levels in the Beaufort and Chukchi seas can vary dramatically between seasons and sea-ice conditions. The presence of ice also impacts which marine species are present, another factor that affects ambient noise levels.

If climate warming continues, it is likely that changes in the acoustic environment also will occur in many parts of the waters off of Alaska due to increased human use of the seasonally ice-covered waters (Tynan and DeMaster, 1997; Brigham and Ellis, 2004). Climate warming potentially could affect the acoustic environment in ways including: (a) increased noise and disturbance related to increased shipping and other vessel traffic, and possibly related to increased development; (b) expansion of commercial fishing and/or changes in areas where intensive fishing occurs; (c) decreases in ice cover; (d) potential changes in subsistence-hunting practices; and (e) changes in the distribution of marine mammal species (MacLeod et al., 2005).

IV.E.2.a. Subsistence-Harvest Patterns and Sociocultural Systems.

IV.E.2.a(1) Subsistence-Harvest Patterns. Cumulative effects on subsistence-harvest patterns include effects from Sale 202 exploration and development and other past, present, and reasonably foreseeable projects on the North Slope. The Proposed Action for Sale 202 exploration and development itself could affect subsistence resources because of potential oil spills; noise and traffic disturbance; or disturbance from construction activities associated with ice roads, pipelines, and landfalls. Noise and traffic disturbance might come from building, installing, and operating production facilities and from supply efforts. See Section IV.C.1.b, Effects on Subsistence-Harvest Patterns, for a more detailed discussion of effects on subsistence resources and harvest patterns.

For subsistence-harvest patterns, the multiple-sale EIS concludes specifically that:

> Cumulative effects on subsistence-harvest patterns include effects from Sale 186 exploration and development and other past, present, and reasonably foreseeable projects on the North Slope with one or more important subsistence resources becoming unavailable or undesirable for use for 1-2 years, a significant adverse effect. Sources that could affect subsistence resources include potential oil spills, noise and traffic disturbance, and disturbance from construction activities associated with ice roads, production facilities, pipelines, gravel mining, and supply efforts. The communities of Barrow, Nuiqsut, and Kaktovik would potentially be most affected, with Nuiqsut potential being the most affected community because it is within an expanding area of oil exploration and development both onshore (Alpine, Alpine Satellite, and Northeast and Northwest National Petroleum Reserve-Alaska) and offshore (Northstar and Liberty). In the unlikely event that a large oil spill occurred and contaminated essential whaling areas, major additive significant effects could occur when impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together. Because the likelihood of a large oil spill is unlikely, attaining a level of significant effect is also unlikely. The placement of a drilling structure or production island near the bowhead whale migration corridor that operated over the life of a field (15-20 years) would represent a far more significant effect because of potential long-term noise disturbance to migrating whales. We expect that mitigation would be developed to prevent any long-term disruption to migrating whales from industrial noise. (USDOI, MMS, 2003:Sec. V.C.11.b(3))

After publication of the multiple-sale EIS, the effects of a proposed lease sale in the Northwest NPR-A were assessed (USDOI, BLM and MMS, 2003). The NPR-A assessment summarizes the effects of an offshore spill on subsistence resources and subsistence-harvest patterns:

> Any actual or perceived disruption of the bowhead whale harvest from oil spills and any actual or perceived tainting anywhere during the bowhead's inmigration, summer feeding, and fall migration could disrupt the bowhead hunt for an entire season, even though whales still would be available. Tainting concerns also would apply to polar bears, seals, fish, and birds. Biological effects on other subsistence resources might not affect species' distributions or populations, but disturbance could force hunters to make more frequent and longer trips to harvest enough resources in a given season. For beluga whales, more traditionally flexible hunting patterns could reduce the effects of noise and disturbance. Hunters can take belugas in ice leads and open water at various times from early May to late July. This seasonal flexibility could constitute possible mitigation against noise and disturbance effects. In the unlikely event that a large oil spill were to occur, it could cause potential short-term (but significant) adverse effects to long-tailed ducks and king and common eider populations. Subsistence-bird resources might only experience short-term, local disturbance, but such disturbance could cause waterfowl to avoid productive subsistence-hunting sites. For the spring subsistence-waterfowl harvest, cumulative loss of habitat from development activities and population losses from oil spills could significantly disrupt harvests. An onshore pipeline spill that contacted rivers and streams could kill many fish and affect these fish populations. Although polar bears are most often hunted opportunistically by North Slope subsistence hunters while in pursuit of more-preferred subsistence resources, a

potential loss of polar bears from oil-spill effects could reduce their availability locally to subsistence users. (USDOI, BLM and MMS, 2003:Sec. IV.F.8.n)

After publication of the multiple-sale EIS and the Sale 195 EA, the effects of additional development around the Alpine Field, as described in the Alpine Satellite Development Plan Final EIS (USDOI, BLM, 2004), and a proposed lease sale in the Northeast NPR-A, as described in the Northeast NPR-A Final Amended IAP/EIS were assessed (USDOI, BLM, 2005).

The Alpine Satellite Development Plan assesses the effects of increased oil field development in the area on subsistence resources and harvests. The conclusion to the cumulative analysis states:

> Development has already caused increased regulation of subsistence hunting, reduced access to hunting and fishing areas, altered habitat, and intensified competition from non-subsistence hunters for fish and wildlife (Haynes and Pedersen 1989).
>
> Additive impacts that could affect subsistence resources include potential oil spills, seismic noise, road and air traffic disturbance, and disturbance from construction activities associated with ice roads, production facilities, pipelines, gravel mining, and supply efforts. Based on potential cumulative, long-term displacement and/or functional loss, habitat available for caribou may be reduced or unavailable or undesirable for use. Changes in population distribution due to the presence of oilfield facilities or activities may affect [the] availability for subsistence harvest[s] in traditional subsistence use areas. The communities of Barrow, Atqasuk, Nuiqsut, and Anaktuvuk Pass would be most affected.
>
> Overall, impacts to subsistence harvest[s] and use[s] may have synergistic impacts with community health, welfare, and social structure. To the extent that subsistence hunting success is reduced in traditional use areas near Nuiqsut because of the presence of oilfield facilities and activities, subsistence hunters will need to travel to more distant areas to harvest sufficient resources in order to meet community needs. Greater reliance on more distant subsistence use areas will result in greater time spent away from the community for some household members and competition for resources with members of other communities. These changes in subsistence patterns may result in stress within households, family groups, and the community. (USDOI, BLM, 2004:Sec. 4G.7.3.4)

The Northeast NPR-A Final Amended IAP/EIS assesses the effects of increased oil development in the area on local subsistence practices. The conclusion to the cumulative analysis states:

> Exploration and development activities on the North Slope have greatly impacted subsistence activities, as noted during public scoping testimony. In the Planning Area, exploration and development could originate from Inigok, Point Lonely, and the Umiat vicinity, and could encompass important subsistence harvest areas for moose, fish, caribou, and furbearers, affecting subsistence users in Nuiqsut, Atqasuk, Barrow, and Anaktuvuk Pass. Subsistence hunters traveling in nearly every direction from Nuiqsut would have to pass through some kind of development en route to subsistence harvest areas. Iñupiat hunters are reluctant to use firearms near oil production facilities and pipelines, so subsistence users would be unlikely to harvest subsistence resources in these areas. Aircraft have interfered with hunts by scaring game away from hunters, and the increase in air traffic by fixed-wing aircraft and helicopters would make this worse and over a much greater area if development goes forward. This issue has been raised several times by residents of Nuiqsut, who have also noted that oil and gas development is impacting traditional use areas and their ability to pass on knowledge of subsistence resources in these area, and use of these resources, to their children.
>
> Development along the north side of Teshekpuk Lake, outside the area closed to leasing, could deflect or divert caribou hunted in and near the area by Nuiqsut, Barrow, and Atqasuk residents in the summer and winter (SRBA 2003b). Numbers of animals available for harvest could be reduced through the slow destruction of species by habitat loss, predation, climate change, and

disease. Diverting animals from their usual and accustomed locations, or building facilities in proximity to those locations, could compel resource harvesters to travel further to avoid development areas. Harvest of subsistence resources in areas further from the communities would require increased effort, risk, and cost on the part of subsistence users. Increasing the areas open for leasing and exploration would lead to development in previously closed areas, leading to concentrating subsistence harvest efforts in the undeveloped areas and increasing the potential for conflict over harvest areas within a community.

> Climate change and the associated effects of anticipated warming of the climate regime in the Arctic could significantly affect subsistence harvests and uses if warming trends continue...(NRC 2003, ACIA 2004). Every community in the Arctic is potentially affected by the anticipated climactic shift and there is no plan in place for communities to adapt to or mitigate these potential effects. The reduction, regulation, and/or loss of subsistence resources would have severe effects on the subsistence way of life for residents of Nuiqsut, Atqasuk, Barrow, and Anaktuvuk Pass. If the loss of permafrost, and conditions beneficial to the maintenance of permafrost, arise as predicted, there could be synergistic cumulative effects on infrastructure, travel, landforms, sea ice, river navigability, habitat, availability of fresh water, and availability of terrestrial mammals, marine mammals, waterfowl and fish, all of which could necessitate relocating communities or their population[s], shifting the population[s] to places with better subsistence hunting and causing a loss or dispersal of community (NRC 2003, ACIA 2004). (USDOI, BLM, 2005:Sec. 4.7.7.12)

The recent seismic-survey PEA (USDOI, MMS, 2006a) provides and updated cumulative effects discussions for the Beaufort Sea region. The seismic PEA is available on the MMS web site at: http://www.mms.gov/alaska/ref/pea_be.htm.

IV.E.2.a(2) Cumulative Effects on Subsistence in the Context of Climate Change. A factor of increasing concern is the potential for adverse effects on subsistence-harvest patterns and subsistence resources from global climate change. The Council on Environmental Quality (CEQ) bases its guidance on the National Environmental Policy Act (NEPA) regulations, which mandate that all "reasonably foreseeable" environmental impacts of a proposed Federal action must be considered in the NEPA assessment. The CEQ considers that there is adequate scientific evidence (e.g., in the *Second Assessment Report* by the Intergovernmental Panel on Climate Change [IPCC]) indicating that climate change is a "reasonably foreseeable" impact of greenhouse gas emissions (CEQ, 1997; IPCC, 2001).

Permafrost thawing is expected to continue to damage roads and buildings and contribute to eroding coastlines and increase building and maintenance costs. The cost of shifting buildings, broken sewer lines, buckled roads, and damaged bridges already has caused $35 million worth of damage in Alaska annually. In Kotzebue, the local hospital had to be relocated, because it was sinking into the ground (ARCUS, 1997). Sea-level rise and flooding threaten buildings, roads, and power lines along low coastlines in the Arctic and, combined with thawing permafrost, can cause serious erosion. Kaktovik's 50-year-old airstrip has begun to flood because of higher seas and may need to be moved inland (Kristof, 2003). Shore erosion in Shishmaref, Kivalina, Wainwright, and Barrow in Alaska and Tuktoyaktuk at the mouth of the Mackenzie River in Canada has become increasingly severe in recent years, as sea-ice formation occurs later, allowing wave action from storms to cause greater damage to the shoreline. Eventually, some of these communities will be forced to relocate.

The duration of ice-road usefulness in the Arctic already has diminished and has led to an increased need for more permanent gravel roads. However, gravel roads are more prone to the effects of permafrost degradation, thermocarst, and consequent settling that increases maintenance costs (Nelson, 2003a,b). Gravel roads also contribute to the fragmentation of landscapes and habitats that through time can lead to reduced species' productivity. Such an impact on species is a threat to subsistence livelihoods.

Continuing sea-ice melting and permafrost thawing could threaten subsistence livelihoods. Typically, peoples of the Arctic have settled in particular locations because of their proximity to important subsistence food resources and dependable sources of water, shelter, and fuel. Northern peoples and subsistence practices will be stressed to the extent that settlements are threatened by sea-ice melt, permafrost loss, and sea-level rise; traditional hunting locations are altered; subsistence travel and access difficulties increase; and game patterns shift and their seasonal availability changes.

Large changes or displacements of resources are likely, leaving little option for subsistence communities: they must quickly adapt or move (Langdon, 1995; Callaway, 1995; *New Scientist*, 2002; Parson et al., 2001; AMAP, 1997; *Anchorage Daily News*, 1997; Weller, Anderson, and Nelson, 1998; IPCC, 2001). Great decreases or increases in precipitation could affect local village water supplies, shift the migration patterns of land mammals, alter bird breeding and molting areas, affect the distribution and abundance of anadromous and freshwater fishes, and limit or alter subsistence access routes (particularly in spring and fall) (AMAP, 1997). Changes in sea ice could have dramatic effects on sea mammal migration routes and this, in turn, would impact the harvest patterns of coastal subsistence communities and increase the danger of hunting on sea ice (Callaway et al., 1999; Bielawski, 1997). Between 1980 and 2000, three sudden ice events caused Barrow whalers to abandon their spring whaling camps on the ice lead (George et al., 2003; National Assessment Synthesis Team, 2000; Groat, 2001).

If the present rates of climate change continue, changes in diversity and abundance to arctic flora and fauna still could be significant; but at the same time, these impacts "cannot be reliably forecast or evaluated" and:

> ...positive effects such as [1] extended feeding areas and seasons in higher latitudes, [2] more productive high latitudes, and [3] lower winter mortality may be offset by negative factors that alter established reproductive patterns, breeding habitats, disease vectors, migration routes, and ecosystem relationships (IPCC, 2001).

Climate change impacts on Alaska's North Slope have become a growing concern among the coastal subsistence-based communities there. During the 2005 NSB mayoral election, the winning candidate, Edward Itta, identified climate change as the biggest threat to subsistence:

> Recent changes in the climate have the ice moving greater distances from shore. This not only means that hunters and whalers have to go out farther and use more fuel, it's becoming more dangerous...The window of opportunity for seal hunting and whaling is getting shorter and shorter. (Stapleton, 2005)

Because polar marine and terrestrial animal populations would be particularly vulnerable to changes in sea ice, snow cover, and alterations in habitat and food sources brought on by climate change, rapid and long-term impacts on subsistence resources (availability), subsistence-harvest practices (travel modes and conditions, traditional access routes, traditional seasons and harvest locations), and the traditional diet could be expected over the lifetime of Sale 202 development (IPCC, 2001; NRC, 2003).

IV.E.2.a(3) Sociocultural Systems. Cumulative effects on sociocultural systems include effects of Sale 202 exploration, development, and other past, present, and reasonably foreseeable projects on the North Slope. Cumulative effects on sociocultural systems would come from changes to subsistence-harvest patterns, social organization and values, and other issues, such as stress on social systems.

For sociocultural systems, the multiple-sale EIS concludes that:

> In this cumulative analysis, effects on social institutions (family, polity, economics, education, and religion) could result from industrial activities, changes in population and employment, and changes in subsistence-harvest patterns. These effects would be similar to those described in Section IV.C under Effects Common to All Alternatives, but the level of effects would increase because collectively, activities would be more intense. More air traffic and non-Natives in the North Slope region could increase interaction and, perhaps, conflicts with Native residents. In the past, non-Native workers have stayed in enclaves, which kept interactions down. However, recent activity in the Alpine field has brought non-Natives directly into the Native village of Nuiqsut, and this has added stresses in the community. Already, these workers have made demands on the village for more electrical power and health care. This potential remains for the communities of Barrow and Kaktovik.

> Increases in population growth and employment could cause long-term disruptions to (1) the kinship networks that organize the Inupiat communities' subsistence production and consumption, (2) extended families, and (3) informally derived systems of respect and authority (mainly respect of elders and other leaders in the community). Cumulative effects on social organization could include decreasing importance of the family, cooperation, sharing, and subsistence as a livelihood, and increasing individualism, wage labor, and entrepreneurship. Long-term effects on subsistence-harvest patterns also could be expected. Chronic disruption could affect subsistence task groups and displace sharing networks, but it would not tend to displace subsistence as a cultural value.
>
> At the same time, revenues from NSB taxation on oil development produce positive cumulative impacts that include increased funding for infrastructure, higher incomes (that can be used to purchase better equipment for subsistence), better health care, and improved educational facilities. We may see increases in social problems, such as rising rates of alcoholism and drug abuse, domestic violence, wife and child abuse, rape, homicide, and suicide. The NSB already is experiencing problems in the social health and well-being of its communities, and additional development, including offshore oil development on the North Slope, would further disrupt them. Health and social-services' programs have tried to respond to alcohol and drug problems with treatment programs and shelters for wives and families of abusive spouses, in addition to providing greater emphasis on recreational programs and services. These programs, however, sometimes do not have enough money, and NSB city governments cannot help as much now that they get less money from the State. Based on experiences after the *Exxon Valdez* spill, Native residents employed in cleanup work could stop participating in subsistence activities, have a lot of money to spend, and tend not to continue working in other lower paying community jobs. Because Nuiqsut is relatively close to oil development activities on the North Slope, cumulative effects chronically could disrupt sociocultural systems in the community--a significant effect; however, overall effects from these sources are not expected to displace ongoing sociocultural systems, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources. This potential exists for the communities of Barrow and Kaktovik as Beaufort Sea areawide leasing, exploration, and development proceed on- and offshore. In the unlikely event that a large oil spill occurred and contaminated essential whaling areas, major additive effects could occur when impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together.

After publication of the multiple-sale EIS, the effects of a proposed lease sale in the Northwest NPR-A were assessed (USDOI, BLM and MMS, 2003). Sections IV.F.8.o of the NPR-A assessment summarizes the effects of an offshore spill on sociocultural systems:

> In the unlikely event that a large oil spill were to occur and contaminate essential whaling areas, major additive, significant effects on sociocultural systems could occur when impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together.... The additive stress created by the fear of an oil spill becomes a distinct impact-producing agent within the human environment.... Also, cleanup activities could generate many cleanup and response jobs. Based on the *Exxon Valdez* spill experience, Alaska Native residents employed in cleanup work could stop participating in subsistence activities, have a lot of money to spend, and tend not to continue working in other, lower-paying community jobs. In the case of a large spill, these dramatic changes could cause tremendous social upheaval (Human Relations Area Files, Inc., 1994; Alaska Department of Fish and Game, 1995b; Impact Assessment, Inc., 1990c, 1998).

After publication of the multiple-sale EIS and the Sale 195 EA, the effects of additional development around the Alpine Field as described in the Alpine Satellite Development Plan Final EIS (USDOI, BLM, 2004) and a proposed lease sale in the Northeast NPR-A as described in the Northeast NPR-A Final Amended IAP/EIS were assessed (USDOI, BLM, 2005).

Section 4G.7.1.2 of the Alpine Satellite Development Plan assesses the effects of increased oil field development in the area on sociocultural systems. The conclusion to the cumulative analysis states:

> Overall, both additive and synergistic impacts to the socio-cultural characteristics of North Slope communities associated with Alternative A – CPAI [ConocoPhillips Alaska, Inc.] Development Plan and past, present, and reasonably foreseeable future development may occur. Changes to community structure, cultural values and community health and welfare, predate oil and gas development on the North Slope. However, change in community socio-cultural characteristics has continued during the period of oil development. As the area impacted by oil development in the future increases, especially in proximity to local communities, cumulative impacts are likely to increase. For example, Nuiqsut, Barrow, Atqasuk, and Anaktuvuk Pass are currently dependent on subsistence caribou harvest from the CAH [Central Arctic Herd] and TLH [Teshekpuk Lake Herd]; additional future development may have additive impacts to subsistence harvest from these herds leading to synergistic impacts on subsistence-harvest patterns (including disruption of community activities and traditional practices for harvesting, sharing, and processing subsistence resources), social bonds, and cultural values.

Section 4.7.7.13 of the Northeast NPR-A Final Amended IAP/EIS assesses the effects of increased oil development in the area on sociocultural systems. The conclusion reads:

> Both additive and synergistic impacts to sociocultural characteristics of North Slope communities are associated with oil and gas exploration and development on the North Slope. Because of the primary dependence of Anaktuvuk Pass, Atqasuk, Barrow, and Nuiqsut residents on the subsistence caribou harvest from CAH, TLH, and WAH [Western Arctic Herd] caribou, bowhead whaling offshore, and continued healthy fish, cumulative effects could potentially chronically disrupt sociocultural systems in the community [communities?], particularly in the case of bowhead whaling, around which the sociocultural system is based. Caribou hunting provides food and materials that support whaling. Seal hunting provides skins for Barrow's skin boat whaling in the spring and supplies meat for food. Fishing and bird hunting provide meat and fish for whalers, as well as for the festivals, *Nalukataq* and *Kivgiq,* associated with whaling. These festivals are important social activities that unify the communities, reunite families, and maintain the continuity of the present with past practice and tradition.
>
> Effects from industrial activities (e.g., noise, light, and chemical pollution), changes in human population and employment, and the accompanying changes in subsistence-harvest patterns, social bonds, and cultural values would be expected to disrupt community activities and traditional practices for harvesting, sharing, and processing subsistence resources, but they would not be expected to displace sociocultural institutions, social organization, or sociocultural systems. Funding cuts and reduced wage earnings would not likely reduce subsistence uses, but may require changes in seasonal round and longer periods of travel to get to subsistence harvest areas; however, these would more than likely resemble the pre-1950 pattern of residence and travel, and technology is available that could facilitate education services delivery via electronic means.
>
> Health issues caused by persistent and short-term pollution could shorten life spans of elders, who are the key repositories of traditional and cultural knowledge in the communities. Health issues from increased injuries as a result of the need to travel further over rough terrain to support families with subsistence foods could reduce community involvement with employment, tax the community health infrastructure, encourage outmigration, and lead to increases in substance abuse and depression in those no longer able to participate in subsistence activities. Cuts in funding for services would increase the severity of the problem of delivery of health services, as well as maintaining health and hygiene infrastructure (e.g., fresh water, sewers, and washeteria).
>
> Because of impacts from climate change on long-standing traditional hunting and gathering practices that promote health and cultural identity, and, considering the limited capacities and choices for adaptation and the ongoing cultural challenges of globalization to indigenous communities, North Slope peoples would experience cultural stresses, as well as impacts to

population, employment, and local infrastructure. The termination of oil activity could result in the outmigration of non-Iñupiat people from the North Slope, along with some Iñupiat who may depend on higher levels of medical support or other infrastructure and services than may be available in a fiscally-constrained, post-oil production circumstance. If subsistence livelihoods are disrupted, Iñupiat communities could face increased poverty, drug and alcohol abuse, and other social problems resulting from a loss of relationship to subsistence resources, the inability to support a productive family unit, and a dependence on non-subsistence foods (Langdon 1995, Peterson and Johnson 1995, USGCRP 2000, IPCC 2001). As stated by Parson et al. (2001), "It is possible that projected climate change will overwhelm the available responses. It is also realistic to expect that some general assistance could be found to mitigate the losses of nutrition, health, and income from diminished subsistence resources, but such assistance would likely have little effect in mitigating the associated social and cultural impacts."

The seismic-survey PEA (USDOI, MMS, 2006a) provides and updated cumulative effects discussion for the Beaufort Sea region. The seismic PEA is available on the MMS web site at: http://www.mms.gov/alaska/ref/pea_be.htm.

The NSB communities were concerned by a recent legislative initiative to reallocate revenues from Federal lease sales in the NPR-A. The proposal in the State legislature tightened the rules for awarding these monies to locally impacted communities and taking a bigger cut for the Permanent Fund (Sutton, 2006). Protests from local communities, the NSB, and regional legislators eventually defeated the effort, but the action does point out the difference in views among some legislators and local communities for development-oriented impacts to communities in the region. Locally, the NSB continues to adopt rezoning ordinances to accommodate nearshore development projects, including the Nikaitchuq and Oooguruk projects, both seaward of the Colville River Delta (Cashman, 2006a). As part of the rezoning measure, the operator was tasked with entering into a conflict avoidance agreement with the AEWC and formulating a Good Neighbor Policy, as well as coordinating barging and vessel traffic with whaling activities. The operator, as well, established a Nuiqsut Mitigation Fund with Nuiqsut's Kuukpik Corporation, the City of Nuiqsut, and the Native Village of Nuiqsut (Cashman, 2006b). Conoco Phillips has also recently established a subsistence mitigation fund protocol with Nuiqsut.

Locally, the NSB and the Northwest Arctic Borough have convened two joint Arctic Economic Development Summits to address the region's economic future, increase the availability of local jobs, and develop strategies to enhance the future well-being and success of Inupiat children through better education (Community Engagement Steering Committee, 2005).

IV.E.2.a(4) Cumulative Effects on Sociocultural Systems in the Context of Climate Change. Because of rapid and long-term impacts from climate change on long-standing traditional hunting and gathering practices that promote health and cultural identity, and considering the limited capacities and choices for adaptation and the ongoing cultural challenges of globalization to indigenous communities, we conclude that communities in the Arctic would experience significant cultural stresses, as well as major impacts on population, employment, and local infrastructure. If subsistence livelihoods are disrupted, communities in the Arctic could face increased poverty, drug and alcohol abuse, and other social problems (Langdon, 1995; Peterson and Johnson, 1995; National Assessment Synthesis Team, 2000; IPCC, 2001; Callaway et al., 1999; ARCUS, 1997). As stated by Parson et al. (2001):

> It is possible that projected climate change will overwhelm the available responses. It also is realistic to expect that some general assistance can be found to mitigate the losses of nutrition, health, and income from diminished subsistence resources, but such assistance would likely have little effect in mitigating the associated social and cultural impacts.

Summary. The incremental contribution of Sale 202 to overall cumulative effects is likely to be quite small. Sources that could affect subsistence resources include potential oil spills, noise and traffic disturbance, and disturbance from construction activities associated with ice roads, production facilities, pipelines, gravel mining, and supply efforts. The communities of Barrow, Nuiqsut, and Kaktovik potentially would be most affected, with Nuiqsut potentially being the most affected community, because it is within an expanding area of oil exploration and development both onshore (Alpine, Alpine Satellite, Northeast and Northwest NPR-A, Liberty); nearshore (Oooguruk and Nikaichug field developments); and offshore (Northstar, increased seismic-exploration activity, potential drilling operations off Kaktovik, and Canadian drilling off the Mackenzie River Delta).

In the event of a large spill from Sale 202, many harvest areas and some subsistence resources would become unavailable or undesirable for use for 1-2 years, a significant adverse effect. If a large spill assumed in the cumulative case occurred and contaminated essential whaling areas, major effects could occur when impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together. Any potential effects to subsistence resources and subsistence harvests are expected to be mitigated substantially but not eliminated.

Sale 202 represents a small proportion, 2-4%, of the total past, present, and reasonably foreseeable oil and gas development in the Beaufort Sea and the North Slope area. While the most likely number of oil spills ≥500 bbl from all past, present, and future activities onshore is estimated to be 0.65, the most likely number of offshore spills is estimated to be one. Sale 202 is estimated to contribute about 17% of the estimated mean number of cumulative offshore spills, with a most likely number of spills being zero.

In the event of a spill from Sale 202, many harvest areas and some subsistence resources would be unavailable for use. Some resource populations could suffer losses and, as a result of tainting, bowhead whales could be rendered unavailable for use. Whaling communities distant from and unaffected by potential spill effects are likely to share bowhead whale products with impacted villages. Harvesting, sharing, and processing of other subsistence resources should continue but would be hampered to the degree that these resources were contaminated. The contribution from Sale 202 to cumulative effects on the sociocultural systems of the communities of Barrow, Nuiqsut, and Kaktovik could come from disturbance from oil-spill-cleanup activities; small changes in population and employment; and disruption of subsistence-harvest patterns from oil spills and oil-spill cleanup, seismic noise, and climate change. Disturbance effects periodically could disrupt, but not displace, ongoing social systems; community activities; and traditional practices for harvesting, sharing, and processing subsistence resources; however, such traditional practices could be seriously curtailed in the short term, if there are concerns over the tainting of bowhead whales from an oil spill. In the event of a large spill, which is still considered to be a low-likelihood event, significant cumulative effects would be expected from Sale 202.

Any realistic analysis of cumulative effects on the North Slope needs to consider both onshore and offshore effects. Although onshore and offshore cumulative effects are difficult to separate, most cumulative effects are thought to result from onshore development. To date, no comprehensive onshore monitoring or baseline data gathering has ever been undertaken by responsible Federal and State agencies and industry; the most obvious cumulative effects have occurred and continue to occur onshore, as oil-field development expands westward from the initial Prudhoe Bay/Deadhorse area of development. Proposed and ongoing studies that will contribute to a more comprehensive understanding of cumulative effects to the Native population of the North Slope are discussed in the Environmental Justice cumulative effects section.

Conclusion. Conclusions and updated levels of effect on subsistence-harvest patterns and sociocultural systems, including the contribution of Sale 202 leases, would be the same as described in the multiple-sale EIS, i.e., there would be no new significant cumulative impacts other than those that already have been addressed in the Beaufort Sea multiple-sale EIS.

We conclude that potential overall cumulative impacts on subsistence and sociocultural systems from noise, disturbance, large oil-spills, and global climate change would be significant, warrant continued close attention, and the development, monitoring, and enforcement of effective mitigation practices. Additionally, the potential effects of the lease sale are assessed within the context of climate change. If any new major effect due to climate change were to occur, MMS would require changes to exploration or development/production designs and activities.

IV.E.2.b. Marine and Coastal Birds. The multiple-sale EIS addressed cumulative effects on threatened spectacled eiders, generally concluding that: "Potential cumulative effects on the...spectacled eider…would be of primary concern and warrants continued close attention and effective mitigation practices" (USDOI, MMS, 2003:Sec. V.A.6). More specifically, the EIS concluded that: "The spectacled eider population…may be slow to recover from small losses and declines in fitness or productivity" associated with various disturbance factors, but: "No significant overall population effect is expected to result from small losses … (and in) the event a large oil spill occurs in the marine environment … any substantial loss (for example, 25+ individuals) would represent a significant effect … ." It also states: "Recovery from substantial mortality is not expected to occur while the population exhibits a declining trend…."

A similar analysis was completed for the Steller's eider, stating: "Although little Steller's eider mortality is expected from an oil spill, knowledge regarding their numbers and distribution in this region is insufficient to allow realistic calculation of risk or effects from cumulative adverse factors."

Conclusions regarding cumulative effects on other bird species were that: "Disturbance may cause some small loss of productivity and lowered fitness or survival of birds occupying areas with high levels of industry activity, but these effects are not expected to be significant…." The EIS also stated: "Overall cumulative effects of oil-industry activities on marine and coastal birds potentially could be…significant in the case of long-tailed duck and king and common eiders, primarily as a result of mortality in the unlikely event a large oil spill occurs."

Section IV.B.2.b and Appendix D review relevant information pertaining to species distribution, abundance, and other important information since publication of the multiple-sale EIS. Section IV.C.1.b details recent information regarding the susceptibility of marine and coastal birds to mitigation or anticipated effects following Lease Sale 202, including bird-strike studies and changes in the OSRA. Overall, these updates include evidence for ongoing modifications to bird habitats resulting from changes in the abundance, distribution, and duration of arctic ice. These changes also may be affecting other species in ways not yet detected, and are anticipated to continue. Any negative effects from climate change would be in addition to nonsignificant changes associated with the proposed lease sale. It also is conceivable that some marine or coastal birds could realize short- or long-term benefits from arctic climate change.

Subsequent to the multiple-sale EIS and Sale 195 EA, the BLM amended the Northeast NPR-A IAP/EIS (USDOI, BLM, 2005). The amended IAP/EIS addressed opening up of previously protected areas within the Northeast Planning Area for oil and gas leasing and exploration. According to BLM (USDOI, BLM, 2006), a series of lease stipulations and Required Operating Procedures would be implemented to minimize resource impacts, including marine and coastal birds, following oil and gas leasing. The FWS prepared a Biological Opinion that specified an incidental take of 104 spectacled eiders and 9 Steller's eiders over the life of the Northeast NPR-A project (USDOI, FWS, 2005). This level of anticipated killing was not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat. Similarly, BLM concluded their "...obligations to protect...wildlife and their habitat..." would be satisfied through "...strict restrictions on land use activities and...all practicable mitigation and monitoring...."

Cumulative effects, including disturbance from increases in the potential for vehicle, vessel, and/or aircraft traffic and collision from additional buildings and pipelines, are expected to result from new infrastructure developments described in Section IV.E.1. However, substantial simultaneous developments in high bird-density areas would be required to cause significant effects beyond those described in the cumulative analysis of the multiple-sale EIS. The expected low probability of a large oil-spill occurrence in the context of the updated information presented here suggests that the potential level of cumulative-effect significance would be the same as stated in the multiple-sale EIS.

Conclusion. The updated information suggests, as stated in the multiple-sale EIS, that: "The incremental contribution of Sale [202] to the cumulative effects likely would be quite small." Specific potential effects of cumulative factors may include the loss of small numbers of spectacled eiders and other sea ducks or aquatic bird species as cumulative projects are developed. Minor declines in fitness, survival, or production of young resulting from exposure of these species to disturbance factors, or mortality from collision with structures, warrants continued close attention and effective mitigation practices. Mortality from a large oil spill, an unlikely event, could be rélatively substantial and represent a significant effect for any of several marine or coastal bird species; recovery of these species from such mortality is not expected to occur if their population is exhibiting a declining trend. In the context of new information that has become available since publication of the multiple-sale EIS, these conclusions remain consistent; thus, the updated level of effect on marine and coastal bird populations is expected to be the same as stated in that document.

IV.E.2.c. Local Water Quality. The multiple-sale EIS concluded that the cumulative effects on water quality would be due primarily to three factors: discharges of drilling muds, cuttings and produced waters; construction of gravel islands and pipeline trenches; and oil spills. The assessment included also the effects of transportation. The following is the EIS conclusion with regard to cumulative effects on water quality (USDOI, MMS, 2003:Sec. IV.C.1):

> A spill could affect water quality for 10 or more days in a local area. The effects of discharges and offshore construction activities are expected to be short term, lasting as long as the individual activity, and (to) have the greatest impact in the immediate vicinity of the activity.
>
> Levels of activities estimated for Alternative I for Sale 186 are used to estimate the contribution to the cumulative effects. There are more than 40 projects in the past, present, and reasonably foreseeable future development/production projects, 17 of which would be offshore prospects. Most of the 17 projects would be located completely offshore; however, 6 of the projects are or might be developed from onshore facilities. The contribution from Alternative I for Sale 186 to the total number of offshore projects (11) is about 9%. Therefore, we assumed that Alternative I for Sale 186 would contribute about one-tenth of the cumulative effects described in the previous paragraph.

The cumulative scenario or assumptions for proposed Sale 202 have not changed with regard to discharges, construction, transportation, and oil spills (Sec. IV.E.1). The cumulative scenario has changed with regard to only projected seismic exploration. The projected seismic exploration would not affect water quality (USDOI, MMS, 2006a: Sec.III.D.1.f).

There are no other proposed projects that would have a substantial, adverse effect on Beaufort Sea water quality. As explained in Section IV.C.1.c, climate change—especially the retreat of the summer and autumn ice cover—will probably increase the water-column mixing in the Beaufort Sea, and thereby mix and disperse any pollutants. This might reduce the level of local water-quality effects. Therefore, the cumulative conclusions for proposed Sale 202 are similar to those above for Sale 186.

IV.E.2.d. Bowhead Whales. The multiple-sale EIS concluded that potential cumulative effects on the bowhead whale would be of primary concern and would warrant continued close attention and effective mitigation practices (USDOI, MMS, 2003). During June 2006, the NMFS updated the Arctic Region Biological Opinion (ARBO), including the assessment of cumulative effects on bowhead whales (Appendix E). As explained in EA Section IV.C.2.d, the updated ARBO concludes that:

> After reviewing the current status of the bowhead whale, the environmental baseline for the action area, the biological and physical impacts of oil leasing and exploration, and cumulative effects, and in consideration that the described actions are expected to impact only the Western Arctic stock of bowhead whales, it is NMFS's biological opinion that oil and gas leasing and exploration in the Chukchi and Beaufort Seas is not likely to jeopardize the continued existence of the *Balaena mysticetus* endangered bowhead whale. No critical habitat has been designated for the bowhead whale, therefore none will be affected.

Cumulative effects are assessed in detail in ARBO Section V, including the effects of oil and gas operations in the Beaufort and Chukchi Seas, in the Canadian Beaufort Sea, and in nearshore waters of the State of Alaska. Activities that are not oil and gas related are included also, as explained in the following five paragraphs from the ARBO.

Activities that are not oil and gas related include ship strikes. Between 1976 and 1992, only three ship-strike injuries were documented out of a total of 236 bowhead whales examined from the Alaskan subsistence harvest (George et al. 1994). The low number of observed ship-strike injuries suggests that bowheads either do not often encounter vessels or they avoid interactions with vessels, or that interactions usually result in death of the animals. However, as discussed in section III, there is recent evidence that interaction of bowhead whales with ships and fishing gear may be increasing.

Subsistence harvest by Alaska Natives is another non-OCS activity that affects the bowhead whale. Bowheads are taken in the northern Bering Sea and in the Chukchi Sea on their spring migration and in the Beaufort Sea on their fall migration. Barrow whalers harvest whales during both the spring and fall migrations. Requests to harvest bowheads also have been made by Canadian ad Russian Natives. The Canadian Government granted permission in 1991 to kill one bowhead, and a bowhead was harvested in Mackenzie Bay in the fall of 1991. Additional permits were granted in 1993 and 1994, but no bowheads were harvested in either year. There has been a renewed interest by villages along the Russian Chukchi Sea coast to hunt bowhead whales. At the 1997 IWC meeting, the Commission approved a combined quota allowing an average of 56 bowheads to be landed each year to meet the needs of Eskimos in Alaska and Chukotka Natives of the Russian Far East.

The cumulative effects of noise on bowheads from offshore oil and gas activities would be similar to that described and summarized for OCS leasing and exploration. The effects from an encounter with aircraft generally are brief, and the whales should resume their normal activities within minutes. Bowheads may exhibit temporary avoidance behavior to vessels at a distance of 1-4 km. Fleeing from a vessel generally stopped within minutes after the vessel passed, but scattering may persist for a longer period. Bowheads also exhibited tendencies for reduced surfacing and dive duration, fewer blows per surfacing, and longer intervals between successive blows. Bowheads appear to recover from these behavioral changes within 30-60 minutes following the end of seismic activity. However, recent monitoring studies indicate that bowhead whales during the fall migration avoid an area around a seismic vessel operating in nearshore waters by a radius of about 20 km. Avoidance did not persist beyond 12 hours after the end of the seismic operations. This work also stated that bowhead whales may begin to deflect around a seismic source at distances up to 35 km.

Bowheads have been sighted within 0.2-5 km from drill ships, although bowheads change their migration speed and swimming direction to avoid close approach to most noise-producing activities. Bowheads may avoid drilling noise at 20-30 km. There are no observations of bowhead reactions to icebreakers breaking ice, but it has been predicted that roughly half of the bowheads would respond at a distance of 4.6-20 km when the S:N is 30 dB. Overall, bowhead whales exposed to noise-producing activities most likely would experience temporary, nonlethal effects. Some avoidance behavior could persist up to 12 hours.

Some bowhead whales could be exposed to spilled oil, resulting in temporary, nonlethal effects, although some mortality might result if there were a prolonged exposure to freshly spilled oil. Overall, bowhead whales exposed to noise-producing activities and oil spills associated with the proposal and other future and existing projects with the Arctic region—combined with the other activities with the range of migrating bowhead whales—most likely would experience temporary, nonlethal effects. However, exposure to oil spills could result in lethal effects.

Vessel traffic and, perhaps, aircraft activity may be expected to occur in the future in both the Chukchi and Beaufort Seas. The effects of these actions would be the same as that present for traffic associated with oil and gas actions. The NMFS is aware of the speculation that warmer ocean temperatures associated with climate change may allow for increased commercial fishing in the Chukchi Sea. However, we have no further information which would substantiate or quantify such development.

Overall, we conclude similarly that the cumulative effects on bowhead whales would not be significant. However, we also conclude, as we did in the multiple-sale EIS (USDOI, MMS, 2003), that cumulative effects on bowhead whales are of primary concern and, thus, warrant continued close attention and effective mitigation practices.

IV.E.2.e. Polar Bear. Despite the fact that the amount of proposed seismic activity has approximately doubled since the multi-sale EIS was written, the main effects of concern to polar bears are climate change, overharvest, and oil and fuel spills.

The Sale 195 EA concludes that:

> ...partly because of climate changes, we still conclude that potential effects on polar bears...would be a primary concern. We identify ringed seals and other ice-dependent pinnipeds as additonal resources of primary concern. Therefore, we conclude that the potential cumulative effects on polar bears, seals, and other ice-dependent pinnipeds would be of primary concern and would warrant continued close attention and effective mitigation practices (USDOI, MMS, 2004:Appendix I, Sec. I.2.e(3)).

Considering ongoing assessments of climate change (Section IV.A.1; Appendix D, Sec. D.2), this assessment still is relevant. Polar bears also face increased industrial development and increased human activity in the Arctic, which likely would interact synergistically in a cumulative fashion. Quantitative data is lacking that specifically addresses the potential cumulative impacts of development on polar bears and the effects of disturbance related to human activities on polar bear-habitat use, as well as recruitment and survival (Perham, 2005). There also is a high degree of uncertainty regarding the spatial scope of potential industry activities on the Alaskan OCS. However, the proposed activities would increase the overall industry footprint and add to the amount of industry activity in the sale area.

IV.E.2.e(1) Seismic Activities and Other Industrial Noise. Impacts to polar bears from marine open-water seismic-survey activity have not been studied but likely would be minimal. When swimming, polar bears normally keep their heads above or at the water's surface, where underwater noise is weak or undetectable (Richardson et al., 1995). Direct impacts causing injury (Level A) from seismic surveys are possible if animals entered the 190-dB zone immediately surrounding the sound source. However, with appropriate measures in place (e.g., marine mammal observers and shutdown procedures), seismic-survey-generated injuries could be mitigated. There also is the possibility that bears could be struck by seismic vessels or exposed to small-scale fuel spills, though these risks are considered slight. Because the proposed seismic operations will not be concentrated in any one area for extended periods, and are largely limited to the ice-free period, any impacts to polar bears should be relatively short in duration and should have a negligible impact on polar bear populations.

For a recent comprehensive overview of the effects of seismic activities, see the seismic-survey PEA on the MMS web site at: http://www.mms.gov/alaska/ref/pea_be.htm.

IV.E.2.e(2) Human Harvest of Polar Bears. Because of the lack of information concerning the CBS population, FWS has designated its status as "uncertain" at this time, although it likely is declining. Current human removals from the SBS population are believed to be at or near maximum sustainable levels, although recent information suggests that the SBS population may be smaller than previously estimated, which would indicate that current human harvest levels are no longer appropriate. See Appendix D, Section D.2 and Section IV.C.1.d (2) for more information.

IV.E.2.e(3) Oil and Fuel Spills. In addition to potential oil spills from industry infrastructure, as outlined in Section IV.C.1.d(2), the potential also exists for oil/fuel spills to occur from associated vessels, fuel barges, and even aircraft. However, this risk is considered slight in ice-free waters, and any spills that result from the Proposed Action most likely would be of small volume, and they are not considered a major threat to marine mammals in the Proposed Action area. Impacts to polar bears most likely would include temporary displacement until cleanup activities are completed. The potential impacts of a larger spill are similar to those discussed in Section IV.C.1.d(2).

Oil spills from offshore production activities are of concern because, as additional offshore oil exploration and production, such as the Liberty, Oooguruk and Nikaitchuq projects, occurs, the potential for large spills in the marine environment increases.

IV.E.2.e(4) Climate Change. According to the FWS, the status of polar bears worldwide is declining as a result of climate changes, loss of ice habitat, and unregulated hunting pressures (USDOI, FWS, 2005). The recent release of the Arctic Climate Impact Assessment's report on *Impacts of a Warming Arctic* (ACIA, 2004), combined with a peer-reviewed analysis of the effects of climate change on polar bears by three of the world's foremost polar bear experts (Derocher, Lunn, and Stirling, 2004) indicate that polar bears are facing a cascading array of effects as a result of dramatic changes to their habitat. Observed changes to date include reduced sea-ice extent, particularly in summer (Sec. IV.A.1) and progressively earlier sea-ice breakup dates, especially in more southerly areas. Bears at the southern edge of the species' range already are showing the impacts of these changes. Breakup of the annual ice in Western Hudson Bay (WHB) in Canada is now occurring more than 2 weeks earlier than it did 30 years ago (Stirling, Lunn, and Iacozza, 1999; Stirling et al., 2004), which is causing declining reproductive rates, subadult survival, and body mass in polar bears there. There is a highly significant correlation between this earlier breakup of the sea ice and condition of bears when they come to shore (Derocher, Lunn, and Stirling, 2004), which in turn is correlated with their reproductive success. Stirling, Lunn, and Iacozza (1999) correlated decreased body condition and reproductive performance in WHB bears with the trend toward earlier sea ice breakup, which shortens their feeding season and increases the length of their fasting season. Stirling, Lunn, and Iacozza (1999) also reported a significant decline in the body condition of both male and female adult polar bears in WHB, as well as a statistically significant relationship between the date of sea-ice breakup and the condition of adult female polar bears and natality. The earlier the breakup, the poorer the condition of females coming onshore and the lower their natality level. This is directly related to the effects of sea-ice condition on ringed seals. For example, ringed seals often give birth to and care for their pups on stable shorefast ice; therefore, changes in the extent and stability of shorefast ice or the timing of breakup could reduce their productivity. Because of the close predator-prey relationship between polar bears and ringed seals, decreases in ringed seal abundance can be expected to cause declines in polar bear populations (Stirling and Oritsland, 1995). In fact, a new analysis of the WHB subpopulation confirms that it has declined by almost 20% in the last 30 years (IUCN/PBSG press release, 2005), and that this decline is linked to significant reductions in the apparent survival of ringed seal pups coincident with larger amounts of open water earlier in the summer. Similar impacts also may be occurring in other polar bear populations, but they either have not yet been documented or have not yet been published.

Climate change also may explain why coastal communities in WHB recently have experienced increased bear-human conflicts prior to freezeup each fall. With earlier sea ice breakup, polar bears are forced ashore earlier, in poorer nutritional condition, and remain without access to seals for a longer time. As they exhaust their fat reserves towards the end of the ice-free period, they are more likely to encroach on human settlements in search of alternative food sources and come into conflict with humans. Thus, the increase in polar bear-human interactions in WHB probably reflect an increase in nutritionally stressed bears searching for food (Amstrup et al., 2006). Similar effects may be expected to occur in Alaska if global climate change continues.

Polar bear use of coastal areas during the fall open-water period has increased in recent years in the Beaufort Sea (Sec. IV.C.1.d (2)). This change in distribution has been correlated with the distance to the pack ice at that time of year (i.e., the farther from shore the leading edge of the pack ice is, the more bears are observed onshore) (Schliebe et al., 2005).

Climate change also has affected the severity of autumn storm events as a result of reduced sea-ice cover. In 2001, rough weather prevented scouting about one-third of the time that whaling crews were on Cross Island (Galginaitis and Funk, 2004:24) and about half of the time during 2003 (Galginaitis and Funk, 2005:18). The unusually rough water that restricted the scouting for whales might have been related to changes in the summer ice cover during recent years, which created an unusually long fetch. As explained in Section IV.A.1.a, analysis of long-term data sets indicates that substantial reductions in both the extent and thickness of the arctic sea-ice cover have occurred during the past 20-40 years, with record minimum extent in 2002 and again in 2005, and extreme minima in 2003 and 2004 (Stroeve et al., 2005; NASA, 2005).

The increased temporal and spatial extent of late summer and early autumn open water in northern Alaska has led also to the dramatic erosion of coastal shorelines and bluff habitats, which often are preferred den sites for maternal polar bears (Durner et al., 2006). When the ice cover is reduced, particularly during late summer, the available open-water surface area increases and waves are able to grow in height. Typical wave heights are up to 1.5 m during summer and up to 2.5 m during fall. Expected maximum wave heights are 7-7.5 m in the Beaufort Sea (Brower et al., 1988); a late-summer storm in the Beaufort in September 2000 developed waves 6-7 m high at Point Barrow (Lynch et al., 2003). Such large waves undoubtedly would induce energetic stress, or worse, in any swimming bears unfortunate enough to be caught in them. Despite being strong swimmers, energetically stressed bears are susceptible to misfortune on long-distance swims. For example, Monnett and Gleason (2006) reported unprecedented polar bear mortalities following a severe storm event in the Beaufort Sea in fall 2004. They estimated that at least 27 bears may have died as a result of this one storm and attributed the phenomenon to longer open-water periods and reduced sea-ice cover.

Polar bear terrestrial denning likely will become more important in the near future. The SBS polar bear population is unique in that approximately 50% of its maternal dens occur annually on the pack ice (Amstrup and Garner, 1994), which requires a high level of sea-ice stability for successful denning. Reproductive failure is known to occur in polar bears that den on unstable ice (Lentfer, 1975; Amstrup and Garner, 1994). If global climate change continues to decrease sea ice in the Arctic and increases the amount of unstable ice, a greater proportion of polar bears may seek to den on land (Durner et al., 2006). Those that do not may experience increased reproductive failure, which would have population-level effects. Considering that 65% of confirmed terrestrial dens found in Alaska from 1981-2005 were on coastal or island bluffs, the loss of such habitats, through storm-surge erosion, likely would alter future denning distributions (Durner et al., 2006) which, in turn, could affect reproductive success.

Polar bears also are susceptible to mortality from den collapse resulting from warmer temperatures and unusual rain events during late winter (Clarkson and Irish, 1991). In Alaska and western Canada, winter temperatures have increased by as much as 3-4 °C (5.4-7.2 °F) over the last 50 years, and rain events have increased substantially across much of the Arctic (ACIA, 2004).

In contrast to other species that may be able to shift northwards as the climate warms, polar bears are constrained to productive sea-ice habitat over relatively shallow waters. There is limited scope for a northward shift in distribution, as deep-water habitats likely would provide an unsuitable prey base for these large carnivores (Derocher et al, 2004). There also is limited scope for polar bears to move to terrestrial habitats. Although polar bears are known occasionally to feed on vegetation, berries, kelp, caribou, muskoxen, ptarmigan, sea birds, crabs, and even ground squirrels, they remain the apical predators of the arctic marine ecosystem (Amstrup, 2003) specialized in preying on phocid seals in ice-covered waters (Derocher, Lunn, and Stirling, 2004). Polar bears are very susceptible to overheating and are very inefficient walkers and runners, expending about twice the average energy of other mammals when walking (Best, 1982). This inefficiency helps explain why polar bears are not known to regularly prey on muskoxen, caribou, and other land animals, as the energy required to catch such animals almost certainly would exceed the amount of energy a kill would provide. For these reasons, polar bears are unlikely to be able to compensate for reduced ring seal availability by switching to terrestrial food sources (Derocher, Lunn, and Stirling, 2004).

Projected impacts to polar bears from climate change would affect virtually every aspect of the species' existence. The timing of ice formation and breakup will determine how long and how efficiently polar bears can hunt seals. Reductions in sea ice will result in increased distances between the ice edge and land which, in turn, will lead to increasing numbers of bears coming ashore during the open-water period, or drowning in the attempt. Reductions in sea ice also will also increase the polar bears' energetic costs of traveling, as moving through fragmented sea ice and open water is more energy intensive than walking across consolidated sea ice. Reductions in sea ice may result in reduced availability of ringed seals, and would result in direct mortalities of bears from starvation. Continued climate change also likely would increase the occurrence of bear-human interactions on land. All of these factors are likely to result in impacts to polar bear populations and distribution similar to what has already been documented in more southerly areas, such as WHB.

Conclusion. The potential impacts of a large oil spill are similar to those discussed in Section IV.C.1.e(2). Due primarily to increased concentrations of bears on parts of the coast, the relative oil-spill risk to the population has increased since preparation of the multiple-sale EIS. Further, based on the observed and predicted impacts that global climate change can have on polar bears, their distribution and population trends still warrant continued close attention and effective mitigation practices. The existing MMS operating regulations, the standard mitigation measures, and the proposed new ITL in Section III.C.2, would moderate the spill risk to polar bears. Thus, there would be no new significant cumulative effect.

IV.E.2.f. Other Marine Mammals. The Sale 195 EA states:

> We identify ringed seals and other ice-dependent pinnipeds as additional resources of primary concern. Therefore, we conclude that the potential cumulative effects on...seals, and other ice-dependent pinnipeds would be of primary concern and would warrant continued close attention and effective mitigation practices (USDOI, MMS, 2004:Appendix I, Sec. I.2.e(3)).

It also states: "Based on the assessment in this appendix, we have identified ringed seals and other ice-dependent pinnipeds as additional resources of primary concern due to the speculative effects of Arctic climate change" (USDOI, MMS, 2004:Appendix I, Sec. I.2.g).

Considering ongoing assessments of climate change (Sec. IV.A.1), the above statements still are relevant. Therefore, this discussion of cumulative impacts will focus on the effects of industrial noise climate change.

IV.E.2.f(1) Seismic and other Industrial Noise. There is a high degree of uncertainty regarding the spatial scope of potential industry activities on the Alaskan OCS. However, the proposed activities would increase the amount of seismic activity in the Beaufort Sea, increase the overall industry footprint, and add to the amount of industry activity in the sale area.

For a recent comprehensive overview of the effects of seismic activities on marine mammals, please see the draft seismic-survey PEA (USDOI, MMS, 2006a) on the MMS web site at: http://www.mms.gov/alaska/ref/pea_be.htm.

Seismic surveys in the Beaufort Sea are expected to have similar effects to those described in that document. No significant effects to nonendangered marine mammal populations are expected to result from planned seismic activities.

IV.E.2.f(2) Climate Change. As explained in Section IV.A.1.a, analysis of long-term data sets indicate that substantial reductions in both the extent and thickness of the arctic sea-ice cover have occurred during the past 20-40 years, with record minimum extent in 2002 and again in 2005, and extreme minima in 2003 and 2004 (Stroeve et al., 2005; NASA, 2005). In Alaska and western Canada, winter temperatures have increased by as much as 3-4 °C (5.4-7.2 °F) over the last 50 years, and rain events have increased substantially across much of the Arctic (ACIA, 2004).

Many authors have reported climate change effects on marine mammals. For marine mammals adapted to life with sea ice, the effects of reductions in sea ice are likely to be reflected initially by shifts in range and abundance (Tynan and DeMaster, 1997), particularly for seals, gray whales, and walruses. This is due not only to the changing sea-ice habitat but also to concurrent shifts in their prey distributions, such as fish, bivalves, and amphipods. Ice-associated pinnipeds, which rely on suitable ice substrate for resting, pupping, and molting, may be especially vulnerable to such changes. Indirect effects of climate change include regional or seasonal shifts in prey availability, which can affect nutritional status, reproductive success, and geographic range, and alterations in the timing or patterns of migrations, which may produce changes in species distribution and stock structure. Changes in the extent and concentration of sea ice may alter the seasonal distributions, geographic ranges, patterns of migration, nutritional status, reproductive success, and ultimately the abundance and stock structure of some species, including beluga and gray whales. Alteration in the extent and productivity of ice-edge systems may also affect the density and distribution of important ice-associated prey of marine mammals, such as arctic cod and sympagic ("with ice") amphipods" (Tynan and DeMaster, 1997).

Because of the Arctic Ocean's relatively low species diversity, it may be particularly vulnerable to trophic-level alterations caused by global warming (Derocher, Lunn, and Stirling, 2004). For example, Mecklenburg et al. (2005) and others show that changes in the arctic ice cover are affecting arctic fish (Loeng et al., 2005). In Hudson Bay for instance, Gaston, Woo, and Hipfner (2003) concluded that the decline in arctic cod and increase in capelin and sand lance were associated with a general warming of the waters and a significant decline in the amount of ice cover. In fact, their evidence suggests that the fish community in northern Hudson Bay shifted from arctic to subarctic from 1997 onwards, which was reflected in dramatically altered diets of thick-billed murres (*Uria lomvia*) in the region. Likewise, fish assemblages and populations in Alaska have undergone observable shifts in diversity and abundance during the last 20-30 years. Changes in distributions of important prey species, such as arctic cod, could have cascading effects throughout the ecosystem.

The arctic cod is a pivotal species in the arctic food web, as evidenced by its importance as a prey item to belugas, narwhals, ringed seals, and bearded seals (Davis, Finley, and Richardson, 1980). In arctic regions, no other prey items compare with arctic cod in abundance and energetic value. Arctic cod are believed to be adapted to feeding under ice, and ice-edge habitat is critical to cod recruitment (Tynan and DeMaster, 1997). Hydroacoustic surveys of fish have recorded the highest densities immediately below landfast sea ice (Crawford and Jorgenson, 1990). Because the life history of arctic cod is closely linked to sea ice, regional changes in the extent of sea ice may lead to a redistribution of this key prey species and, consequently, to redistributions and altered migrational patterns of the marine mammals that feed on it, such as belugas, ringed seals, and spotted seals. For example, belugas are known to forage at ice edges and ice cracks (Bradstreet, 1982; Crawford and Jorgenson, 1990), presumably to feed on arctic cod; beluga feeding aggregations primarily occur in nearshore areas, where dense schools of arctic cod concentrate in late summer. As a result, the IWC considers all stocks of beluga whale to be particularly vulnerable to global climate change.

Reduction in the extent of the ice edge and its associated biota may have deleterious consequences for marine mammals that have evolved with these unique systems (Tynan and DeMaster, 1997). For example, there is a linkage between ice algal production and benthic communities. Ungrazed ice algae that settle to the bottom provide a flux of carbon to the benthic community, and many marine mammals depend on this (Tynan and DeMaster, 1997). This sedimentation of carbon on shallow arctic shelves is critical to the benthic foraging success of walruses, bearded seals, and gray whales, and regional changes in this carbon flux could affect the distribution and reproductive success of these animals. In addition, the juxtaposition of the ice edge with shallow-shelf habitat suitable for benthic feeding is critical to walruses and bearded seals.

Species such as walruses and bearded seals feed on benthic prey and, therefore, are found on ice cover over shallow continental shelf areas (Derocher, Lunn, and Stirling, 2004). Arctic warming may move the summer position of the ice edge over deep water unsuitable for these shallow-water-adapted species; the effects of such changes on their populations could be substantial (Tynan and DeMaster, 1997). As sea ice declines, these species are forced farther offshore to find suitable habitat for feeding, making these activities more difficult, if not impossible, which ultimately may lead to a net reduction in their abundance (ACIA, 2004; Derocher, Lunn, and Stirling, 2004). Recent trends have resulted in seasonal sea-ice retreating off the continental shelf and over deep Arctic Ocean waters. This trend poses adaptive challenges for the walrus population (Tynan and DeMaster, 1997). For example, in the summer of 2004, nine motherless walrus calves were observed stranded on icefloes in deep waters off of northwest Alaska. These calves may have been abandoned by their mothers due to lack of food, and the authors speculate that many more motherless calves than the nine observed were present in their study area. Walrus calves depend on maternal care for 2 years or more before they are able to forage for themselves, and females with calves are not normally observed in deep Arctic basin waters due to the lack of food and depth limits to their diving. Thus, such events could have implications for the Pacific walrus population if they become more common (Cooper et al., 2006).

Phocid seals also may be particularly vulnerable to habitat loss from changes in the extent or concentration of arctic ice, because they depend on pack-ice habitat for pupping, foraging, molting, and resting (Tynan and DeMaster, 1997; ACIA, 2004; Derocher, Lunn, and Stirling, 2004). The ring seal, a species intricately entwined with the sea ice, likely would be among the first marine mammals to show the negative effects of climatic warming (Ferguson, Stirling, and McLoughlin, 2005). This species depends on the stability of ice for the successful rearing of its young (Burns, Shapiro, and Fay, 1981), and global warming likely would reduce its abundance and distribution. In the eastern Beaufort Sea, Harwood, Smith, and Melling (2000) found that early breakup of the ringed seals' landfast-ice breeding habitat had significant negative impacts on growth, condition, and survival of nursing pups. Although earlier spring breakup and an increased open-water season initially might benefit growth and reproduction of seals and, hence, recruitment, a continued trend toward earlier breakup eventually could be detrimental to ringed seals (Ferguson, Stirling, and McLoughlin, 2005). For example, young seal pups that are forced into open water at an early age may be exposed to increased risks of predation and thermal challenges (Smith and Harwood, 2001). Swimming exacts a high energy cost from pups (Smith, Hammill, and Taugbol, 1991), and they require access to ice for resting after they have molted and weaned (Smith, 1987).

Unseasonable warming and unusual rainfall events due to climate change have both been implicated in lower ringed seal reproduction and pup survival (Smith and Stirling, 1975; Hammill and Smith, 1991; Stirling and Smith, 2004). In WHB, spring breakup has occurred earlier each year over the past 30 years (Ferguson, Stirling, and McLoughlin, 2005) and decreased snow depth, particularly below 32 cm, has corresponded with a significant decrease in ringed seal recruitment there. Pups in subnivean birth or haulout lairs with thin snow roofs are more vulnerable to predators than those in lairs with thick roofs (Smith and Stirling, 1975; Hammill and Smith, 1991; Furgal, Innis, and Kovacs, 1996), as well as to death by exposure and hypothermia due to den collapse (Smith, Hammill, and Taugbol, 1991). For example, during a mild period with some rain in Canada in 1979, polar bear-hunting success was three times greater than previously recorded in the high Arctic, largely because many pups' lairs melted open, exposing them to predation (Hammill and Smith, 1991; Stirling and Smith, 2004). Researchers suspected that most of the pups in the affected area eventually were killed by polar bears, arctic foxes, and possibly gulls. Earlier spring breakup of sea ice together with snow trends suggest continued low pup survival in WHB (Ferguson, Stirling, and McLoughlin, 2005). If early-season rains become regular and widespread, the mortality of ringed seal pups will increase and populations may be significantly reduced, which likely also would produce negative effects on the reproduction and survival of polar bears (Stirling, 2002; Stirling and Smith, 2004; IUCN/PBSG press release, 2005).

In contrast, gray whales may benefit from global climate change. For example, sightings data of gray whale calves suggest that higher calf counts in the spring are associated with years of delayed onset of freezeup in the Chukchi Sea. During years of earlier freezeup, pregnant females must leave their feeding grounds sooner, having less time to nourish the developing fetus and store the fat necessary to support lactation during their stay in Mexican waters and long migration back to Alaska. Therefore, a warmer Arctic may be beneficial to gray whales (Tynan and DeMaster, 1997).

Conclusion. Due to the ongoing effects of climate change in the Arctic, continued close attention and effective mitigation practices with respect to nonendangered marine mammals populations and distributions are warranted, particularly with respect to ringed seals, which likely would be among the first marine mammals to show the negative effects of climatic warming.

IV.E.2.g Fishes and Essential Fish Habitat. The following section assesses the cumulative effects of the lease sale on fish in the context of climate change.

The Effect of Climate Change on Fish Resources. The climate of the Arctic is changing and affecting fish distributions. Evidence of such change is discussed in the Arctic Climate Impact Assessment (ACIA, 2005). Trends in instrumental records over the past 50 years indicate a reasonably coherent picture of recent environmental change in northern high latitudes (ACIA, 2005). It is probable that the past decade was warmer than any other in the period of the instrumental record. The observed warming in the Arctic might be without precedent since the early Holocene.

Climate change can affect fish production (e.g., individuals and/or populations) through a variety of means (Loeng et al., 2005). Direct effects of temperature on the metabolism, growth, and distribution of fishes occur. Food-web effects also occur through changes in lower trophic-level production or in the abundance of predators, but such effects are difficult to predict. Fish-recruitment patterns are strongly influenced by oceanographic processes such as local wind patterns and mixing and by prey availability during early lifestages. Recruitment success sometimes is affected by changes in the time of spawning, fecundity rates, survival rate of larvae, and food availability.

IV.E.2.h Additional Resources. This section updates the cumulative effects on air quality, archaeology, terrestrial mammals, and lower trophic-level organisms. There is no new information that would change the level of cumulative effects on air quality, terrestrial mammals or lower tropic-level organisms.

With regard to archaeological resources, the greatest cumulative effect in the Beaufort Sea region is from natural processes such as ice gouging, bottom scour, and thermokarst erosion. Because the destructive effects of natural processes are cumulative, they have affected and will continue to affect archaeological resources in this area. These natural processes would cause artifacts to be dispersed and the site context to be disturbed or even completely destroyed, resulting in the loss of archaeological information. Overall, a significant loss of data from submerged and coastal prehistoric sites probably has occurred, and will continue to occur, from the effects of natural geologic processes in the Beaufort Sea region. It is assumed that some of the data lost have been significant and/or unique, resulting in a major level of impact.

Accidental oil spills would affect onshore archaeological sites the most, but past cleanups have shown that spilled oil had little direct effect on archaeological resources (Bittner, 1993). Following the *Exxon Valdez* spill, the greatest effects came from vandalism, because more people knew about the locations of the resources and were present at the sites. Various mitigation measures used to protect archaeological sites while cleaning up oil spills are avoidance (preferred), site consultation and inspection, onsite monitoring, site mapping, scientific collection of artifacts, and programs to make people aware of cultural resources (Haggarty et al., 1991).

Although archaeological resources are not renewable, they are not affected directly or cumulatively by oil spills, the buildup of toxic substances, noise, or air pollution. Effects are minimized due to modern technologies and practices that reduce the impact to the environment and, therefore, to archaeological resources (no thawing of permafrost, restricted personnel access, wintertime operations, small-footprint drilling, and transportation technologies). Furthermore, mitigation measures, such as offshore high-resolution seismic surveys with archaeological analysis in zones of potential resources, and onshore archaeological surveys where offshore pipelines make landfall, would avoid damage or destruction of potential archaeological resources. Although a number of sites in the *Exxon Valdez* spill area were vandalized during the 1989 cleanup season, the large number of Exxon and Government agency archaeologists visible in the field may have lessened the amount of site vandalism that may have occurred (Mobley et al., 1990).

A study by Dekin (1993) found that small amounts of petroleum hydrocarbons may occur in most archaeological sites within the study area. This suggests a low-level petroleum contamination that previously had not been suspected. Because the researchers found no evidence of extensive soil contamination from a single definable source (the oil spilled from the *Exxon Valdez*), they "now add the continuing contamination of soils from small and large petroleum spills in areas where present and past land use coincide" (Dekin, 1993). Vandalism was found to have a significant effect on archaeological site integrity but could not be tied directly to the oil spill (Dekin, 1993).

Ocean bottom-cable seismic surveys potentially could impact both prehistoric and historic archaeological resources in waters inshore of the 20-m isobath or in deeper water, if cables are laid from shallow to deep water. Such offshore seismic-exploration activities projected for the 2006 open-water season could disturb these resources and their in situ context. Assuming compliance with existing Federal, State, and local archaeological regulations and policies and the application of MMS's G&G Permit Stipulation 6 (regarding the discovery of archaeological resources) and CFR 251.6 (a) (5) regarding G&G Explorations of the Outer Continental Shelf to not "disturb archaeological resources," most impacts to archaeological resources in shallow offshore waters of the Beaufort Sea Planning Area would be avoided. Therefore, no impacts or only minor impacts to archaeological resources are anticipated; cumulatively, proposed projects are not likely to disturb the seafloor. Under the cumulative scenario, the impact to both prehistoric and historic archaeological sites should be negligible. The incremental contribution of the Proposed Action to the cumulative impacts on archaeological resources should be minor.

Conclusion. In addition to Alternative I for Sale 202, other activities associated with this cumulative analysis that may affect archaeological resources in the Beaufort Sea include lease sales and activity onshore on Federal and State lands, State oil and gas fields, oil and gas transportation, noncrude carriers, and any Federal activities. Cumulatively, these proposed projects likely would disturb the seafloor more often, but remote-sensing surveys made before approval of any Federal or State lease actions should keep these effects low. Federal laws would preclude effects to most archaeological resources from these planned activities.

Contribution of the Preferred Alternative for Sale 202 to Cumulative Effects. The contribution of the Preferred Alternative for Sale 202 to the cumulative case is expected to be minimal for archaeological resources, because any surface-disturbing activities that could damage archaeological sites would be mitigated by current State and Federal procedures, which require identification and mitigation of archaeological resources in the proposed project areas. Overall effects of the Preferred Alternative would be additive to effects anticipated for other future projects and, in the case of oil spills, are uncertain. However, data from the *Exxon Valdez* oil spill indicate that <3% of the resources within a spill area would be significantly affected.

IV.E.2.i. Environmental Justice. Alaskan Inupiat Natives, a recognized minority, are the predominant residents of the NSB, the area potentially most affected by Sale 202 exploration and development. Effects on Inupiat Natives could occur because of their reliance on subsistence foods, and cumulative effects could affect subsistence resources and harvest practices. Potential effects from noise, disturbance, and oil spills on subsistence resources and practices and sociocultural patterns, as described in Section IV.E.2.a and IV.E.2.b, would focus on the Inupiat communities of Barrow, Atqasuk, Nuiqsut, and Kaktovik.

For Environmental Justice, the multiple-sale EIS concludes that:

> Potential effects would focus on the Inupiat communities of Barrow, Nuiqsut, and Kaktovik, within the NSB; however, effects are not expected from routine activities and operations. If a large spill assumed in the cumulative case occurred and contaminated essential whaling areas, major effects could occur when impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together. Such impacts would be considered disproportionately high adverse effects on Alaskan Natives, because oil-spill contamination of subsistence foods is the main concern regarding potential effects on Native health. Any potential effects to subsistence resources and subsistence harvests are expected to be mitigated substantially, though not eliminated. (USDOI, MMS, 2003:Sec. V.C.16)

After publication of the multiple-sale EIS, the effects of a proposed lease sale in the Northwest NPR-A final IAP/EIS were assessed (USDOI, BLM and MMS, 2003). That assessment summarizes the effects of an offshore spill on environmental justice:

> In the unlikely event that a large spill were to occur and if it contaminated essential whaling areas, major effects could result from the combined factors of shoreline contamination, tainting concerns, cleanup disturbance, and disruption of subsistence practices. Such impacts would be considered disproportionately high adverse effects on Alaska Natives. Oil-spill contamination of subsistence foods is the main concern regarding potential effects on Native health.
>
> Any potential effects on subsistence resources and subsistence harvests would be expected to be mitigated substantially, though not eliminated. (USDOI, BLM and MMS, 2003:Sec. IV.F.8.p)

After publication of the multiple-sale EIS and the Sale 195 EA, the effects of additional development around the Alpine Field as described in the Alpine Satellite Development Plan Final EIS (USDOI, BLM, 2004) and a proposed lease sale in the Northeast NPR-A as described in the Northeast NPR-A Final Amended IAP/EIS (USDOI, BLM, 2005) were assessed. Section 4G.7.4.2 of the Alpine Satellite Development Plan assesses the effects of increased oil field development in the area on environmental justice. The conclusion to the cumulative analysis states:

> Alaska Inupiat Natives, a recognized minority, are the predominant residents of the NSB, the area potentially most affected by ASD development and other past, present, and reasonably foreseeable projects on the North Slope. Environmental justice effects on Inupiat Natives could occur because of their reliance on subsistence foods, and cumulative effects may affect subsistence resources and harvest practices.
>
> Potential effects would focus on the Inupiat communities of Nuiqsut, Barrow, Atqasuk, and Anaktuvuk Pass. Development as contemplated in the cumulative case could cause long-term displacement and/or functional loss of habitat to CAH, TCH, and WAH caribou over the life of CPAI's proposed development. This could result in a significant impact on access to, and perhaps the availability of, this important subsistence resource. Such impacts would be considered disproportionately high adverse effects on Alaskan Natives. Access to subsistence-hunting areas and subsistence resources, and the use of subsistence resources could change if oil development were to reduce the availability of resources or alter their distribution patterns.
>
> In the unlikely event that a large spill were to occur, and if it were to contaminate essential whaling areas, major effects could result from the combined factors of shoreline contamination, tainting concerns, cleanup disturbance, and disruption of subsistence practices. Such impacts would be considered disproportionately high adverse effects on Alaskan Natives. Oil-spill contamination of subsistence foods is the main concern regarding potential effects on Native health.
>
> Any potential effects on subsistence resources and subsistence harvests would be expected to be mitigated, though not eliminated.

Section 4.7.7.14 of the Northeast NPR-A Final Amended IAP/EIS assesses the effects of increased oil development in the area on environmental justice. The conclusion reads:

> Alaska Iñupiat Natives, a recognized minority, are the predominant residents of the NSB, the area that would likely be affected by exploration and development in the Planning Area and other past, present, and reasonably foreseeable projects on the North Slope. Environmental justice effects on Iñupiat Natives could occur because of their reliance on subsistence foods, and cumulative effects would increase the effects on subsistence resources and harvest practices.
>
> Potential effects would focus on the Iñupiat communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut within the NSB. Based on potential cumulative, long-term displacement and/or functional loss of CAH, TLH, and WAH caribou habitat over the life of the Northeast National Petroleum Reserve-Alaska oil and gas lease sales, and from other oil and gas developments on the North Slope, this important subsistence resource could become less readily available or undesirable for use, or experience long-term population and productivity effects. Such impacts would disproportionately affect Alaska Natives. Access to subsistence-hunting areas and subsistence resources, and the use of subsistence resources, could change if oil development were to reduce the availability of resources or alter their distribution patterns.
>
> Because the potential impacts of climate change on marine and terrestrial ecosystems in the Arctic would cause impacts on subsistence resources, traditional culture, and community infrastructure, subsistence-based indigenous communities in the Arctic would be expected to experience disproportionate, environmental and health effects.

> In the unlikely event that a large spill were to occur and contaminate essential whaling areas, major effects to subsistence resources could result from the combined factors of shoreline contamination, tainting concerns, clean-up disturbance, and disruption of subsistence practices. Such impacts would have a disproportionately high affect on Alaska Natives. Contamination of subsistence foods by oil spills would potentially affect Native health.
>
> It is expected that the cumulative effects on subsistence resources and subsistence harvests in the Planning Area would...be mitigated substantially, though not eliminated, by proposed ROPs [Required Operating Procedures] and lease stipulations.

The seismic-survey PEA (USDOI, MMS, 2006a) provides an updated cumulative effects discussion for the Beaufort Sea region. The seismic PEA is available on the MMS web site at: http://www.mms.gov/alaska/ref/pea_be.htm.

For a detailed discussion of ongoing and proposed studies that will contribute to a more comprehensive understanding of cumulative impacts to the Native population of the North Slope, see the Environmental Justice cumulative effects sections in the Beaufort Sea Multiple Sale final EIS (USDOI, MMS, 2003), the Northwest NPR-A final IAP/EIS (USDOI, BLM and MMS, 2003), the Beaufort Sea Sale 195 EA (USDOI, MMS, 2004), the Alpine Satellite Development Plan final EIS (USDOI, BLM, 2004), and the Northeast NPR-A final Amended IAP/EIS (USDOI, BLM, 2005).

More recent ongoing and proposed research and sovereignty initiatives regarding cumulative impacts to the indigenous populations in the Arctic and Native populations on the North Slope include:

- the Second International Conference on Arctic Research Planning (ICARP-2) that met in April 2005 to develop a plan to study the resilience and vulnerability of rapid change to local communities in the Arctic;
- a U.S. Census Bureau report *We the People: American Indians and Alaska Natives in the United States* that provides a portrait of the demographic, social, and economic characteristics collected from Census 2000 of indigenous American populations and discusses specific tribal groupings, reservations, and Alaska Native village statistical areas;
- *Food Security in Arctic Alaska: A Preliminary Assessment* (Caulfield, 2000) that advocates for a better understanding of subsistence food security, more up-to-date research to determine country foods types, pricing, transportation systems, and a better understanding of relevant laws, policies, and controlling institutions;
- *Human and Chemical Ecology of Arctic Pathways by Marine Pollutants* study (O'Hara et al., 2002) that will document reliance by indigenous arctic marine communities in Canada, Alaska, and Russia on arctic resources at risk from chemical pollutants and incorporate traditional knowledge systems for harvesting;
- the *Arctic Human Development Report* developed by the Arctic Council in 2005 to provide an overview of human development in the Arctic, identify critical data gaps, establish priorities for sustainable development, and shed light on the dimensions of human well-being in the region;
- *Vital Arctic Graphics Report* (UNEP, 2006) that identifies critical Arctic ecosystems to protect important indigenous regions and food sources to ensure sustainable development in the region; and
- the subsistence foods study *The Contribution of Subsistence Foods to the Total Diet of Alaska Natives in 13 Rural Communities* funded by the Agency for Toxic Substances and Disease Registry conducted by Ballew et al. Researchers confirmed, as many other studies have before, that subsistence foods make up a large part of the total Alaska Native diet. They quantified this intake and set the stage for the long-term goal of the study which is to evaluate the health benefits and risks of consuming subsistence foods to allow people to make more informed food choices. They were unable to quantify the economic balance of subsistence and purchased foods. They reiterated that the data to assess exposure to contaminants in subsistence foods were inadequate, because many traditional foods have yet to be tested, and that testing of the foods that people consume most should be the highest research priority (Ballew et al., 2006).

Since 2003, MMS has funded the Nuiqsut-based study *Analysis of Variation in Abundance of Arctic Cisco in the Colville River*, which sponsored a local workshop in Nuiqsut for Traditional and Western science experts on arctic cisco to answer questions about arctic cisco abundance. The proceedings of this workshop were published in the MMS Study Report MMS 2004-033. Separate Traditional Knowledge and Western Science reports will be final products of this study.

Indigenous initiatives to address Arctic issues include the formation of an alliance of grass-roots Native activists called Resisting Environmental Devastation on Indigenous Lands (REDOIL) to confront oil and gas development issues in Alaska. This alliance condemns extractive industries and the Alaska Native Claims Settlement Act (ANCSA) and has come together to address aboriginal, economic, and Environmental Justice issues concerning the role of corporations, the State of Alaska, and the Federal Government in oil and gas development (Dobbyn, 2003). In April 2006, the Indigenous Peoples and Nations Coalition sent a petition to the United Nations challenging U.S. title to Alaska and Hawaiian Native lands, referring the situation to the proper United Nations agencies, "so that the rights of the Indigenous Peoples can be vindicated, including the right to self-government and to enjoyment of their natural resources" (AITC, 2006).

The formation of the North Slope Science Initiative Science Technical Group in February 2006 bodes well for addressing cumulative impacts on Alaska's North Slope. This 15-member group, composed of Federal, State, local, and industry leadership, is tasked with developing a consistent scientific approach to North Slope research and is the most likely group to develop and implement research, monitoring, and mitigation regimes that will address community impacts from North Slopewide oil exploration and development (*Petroleum News*, 2006).

Cumulative Effects on Environmental Justice in the Context of Climate Change. Because potential climate change impacts on marine and terrestrial ecosystems in the Arctic would cause significant impacts on subsistence resources, traditional culture, and community infrastructure, subsistence-based indigenous communities in the Arctic and on Alaska's North Slope would be expected to experience disproportionate, high adverse environmental and health effects. See the discussion on global climate change in the subsistence-harvest patterns cumulative effects section.

Summary. The incremental contribution of Sale 202 to overall cumulative effects is likely to be quite small. Sources that could affect subsistence resources include potential increased seismic-survey activity, oil spills, noise and traffic disturbance, and disturbance from construction activities associated with ice roads, production facilities, pipelines, gravel mining, and supply efforts. The communities of Barrow, Atqasuk, Nuiqsut, and Kaktovik potentially would be most affected, with Nuiqsut potentially being the most affected community because it is within an expanding area of oil exploration and development onshore (Alpine, Alpine Satellite, Northeast and Northwest NPR-A); nearshore (Oooguruk and Nikaichug field developments); and offshore (Northstar, the proposed Liberty project, increased seismic-exploration activity, potential drilling operations off Kaktovik, and Canadian drilling off the McKenzie River Delta). In the event of a large spill from Sale 202, many harvest areas and some subsistence resources would be unavailable for use. Some resource populations could suffer losses and, as a result of tainting, bowhead whales could be rendered unavailable for use.

Major additive significant effects could occur when impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together. One or more important subsistence resources would become unavailable or undesirable for use for 1-2 years, a significant adverse effect. Increases in population growth and employment could cause long-term disruptions to (1) the kinship networks that organize the Inupiat communities' subsistence production and consumption, (2) extended families, and (3) informally derived systems of respect and authority (mainly respect of elders and other leaders in the community). Cumulative effects on social organization could include decreasing importance of the family, cooperation, sharing and subsistence as a livelihood, and increased individualism, wage labor and entrepreneurship. Long-term effects on subsistence-harvest patterns also could be expected.

At the same time, revenues from NSB taxation on oil development have produced positive cumulative impacts that include increased funding for infrastructure, higher incomes (that can be used to purchase better equipment for subsistence), better health care, and improved educational facilities. Nevertheless, we may see increases in social problems, such as rising rates of alcoholism and drug abuse, domestic violence, wife and child abuse, rape, homicide, and suicide. Because Nuiqsut is relatively close to oil-development activities on the North Slope, cumulative effects chronically could disrupt sociocultural systems in the community—a significant effect; however, overall effects from these sources are not expected to displace ongoing sociocultural systems, community activities, and traditional subsistence practices. Such chronic disruption could affect subsistence-task groups and displace sharing networks, but it would not tend to displace subsistence as a cultural value. The same potential impacts could occur in the communities of Barrow, Atqasuk, and Kaktovik, as Beaufort Sea areawide leasing, exploration, and development proceed on- and offshore.

Even as an optimistic scenario, projects for Sale 202 represents a small proportion, 2-4%, of the total past, present, and reasonably foreseeable oil and gas development in the Beaufort Sea and the North Slope area. While the most likely number of oil spills ≥500 bbl from all past, present, and future activities onshore is estimated to be 0.65, the most likely number of offshore spills is estimated to be one. Sale 202 is estimated to contribute about 17% of the estimated mean number of cumulative offshore spills, with a most likely number of spills of zero.

In the event of a spill from Sale 202, many harvest areas and some subsistence resources would be unavailable for use. Some resource populations could suffer losses and, as a result of tainting, bowhead whales could be rendered unavailable for use. Whaling communities distant from and unaffected by potential spill effects are likely to share bowhead whale products with impacted villages. Harvesting, sharing, and processing of other subsistence resources should continue but would be hampered to the degree that these resources were contaminated. The contribution from Sale 202 to cumulative effects on the communities of Barrow, Atqasuk, Nuiqsut, and Kaktovik could come from disturbance from oil-spill-cleanup activities; small changes in population and employment; disruption of subsistence-harvest patterns from oil spills and oil-spill cleanup; and increased seismic survey activities. Disturbance effects periodically could disrupt, but not displace, ongoing social systems; community activities; and traditional practices for harvesting, sharing, and processing subsistence resources. On the other hand, such traditional practices could be seriously curtailed in the short term, if there are concerns over the tainting of bowhead whales from an oil spill. Only in the event of a large spill, which is a low likelihood event, would disproportionate, high adverse effects be expected on Alaska Natives from Sale 202.

Conclusion. Potential significant impacts to subsistence resources and harvests and consequent significant impacts to sociocultural systems would indicate significant cumulative environmental justice impacts—disproportionate, high adverse environmental and health effects on low-income, minority populations in the region. We still conclude that potential environmental justice effects would focus on the Inupiat communities of Barrow, Atqasuk, Nuiqsut, and Kaktovik within the NSB; such cumulative impacts would be considered disproportionately high adverse effects on Alaska Natives. Any potential effects are expected to be mitigated substantially, although not eliminated.

Potential impacts on human health from contaminants in subsistence foods and long-term climate change impacts on marine and terrestrial ecosystems in the Arctic—affecting subsistence resources, traditional culture, and community infrastructure of subsistence-based indigenous communities on the North Slope—would be an expected and additive contribution to cumulative environmental justice impacts.

IV.E.2.j. Overall Summary of Cumulative Effects. The level of cumulative effects has changed mainly for polar bears. Due primarily to increased concentrations of bears on parts of the coast, the relative and cumulative oil-spill risk to the population has increased since preparation of the multiple-sale EIS. The existing MMS operating regulations, the standard mitigation measures, and the proposed new ITL's in Section III.C.2, would moderate the cumulative risk to polar bears. The level of cumulative effects on other marine mammals, subsistence-harvest patterns, marine and coastal birds, local water quality, fish and Essential Fish Habitat, archaeology, and other resources would be the same as assessed in the multiple-sale

EIS. Thus, there would be no new significant cumulative effect for the proposed lease sale that already had not been analyzed in the multiple-sale EIS.

IV.F. Overall Summary of Section IV.

The assessment in the multiple-sale EIS concluded that proposed Sales 186, 195 and 202 would results in significant effects on subsistence-harvest patterns, marine and coastal birds, and local water quality. The potential for significant effect on water quality was due partly to the difficulty of responding to possible, but highly unlikely, large oil spills in broken ice, in spite of the required spill-contingency plans. The assessment of cumulative effects noted concerns about several resources.

The effects of proposed Sale 195, which also would offer leasing incentives at prices below current levels, were updated in an EA that concluded there would be no new significant effect that already had not been assessed in the multiple-sale EIS, partly because projections of future operations could be handled with the standard mitigation. The assessment of cumulative effects, which covered the effects of the sale in the context of climate change, noted some additional concerns, especially with the retreating summer ice cover and ice-dependent fauna. For example, the assessment examined the effects of the sale in the context of additional polar bears around onshore support facilities.

The environmental information and level of effects of proposed Sale 202 were updated with this EA. It concludes in Section IV.B that parts of the Beaufort Sea environment have changed substantially since preparation of the multiple-sale EIS. There have been substantial reductions in the Arcticwide ice cover, particularly during the summer and autumn. The resources that are depended on summer and autumn ice cover, such as polar bears, also have changed. The Sale 195 EA predicted that more polar bear might be forced to stay onshore during summer, leading to increased interaction between polar bear and oil industry personnel (USDOI, MMS, 2004:Appendix I, Sec. I.2.g). Recent observations confirm that more polar bear are staying onshore during the autumn, and that more are in the water where they are vulnerable to severe storm waves. Further, storm waves during autumn 2001 and 2003 prevented subsistence whalers from scouting for whales during much of the time that they were on Cross Island. In contrast, no substantial changes have been observed in either anadromous fish or marine and coastal birds. Further, the MMS monitors the bowhead whale migration yearly via aerial surveys; the most recent survey report concludes that bowhead sightings were within the normal historical range from the coast. Similarly, the Beaufort stock of ringed seals, which are dependent on the ice cover during spring (as opposed to summer and autumn), appear to be within their normal historical range, although reliable stock estimates are not available.

This EA concludes in Section IV.C.2 that the likelihood of one or more large oil spills occurring and contacting a land segment is still very low (e.g., <2% within 60 days). Due primarily to increased concentrations of polar bears on parts of the coast, the relative oil-spill risk to the population has increased since preparation of the multiple-sale EIS. The existing MMS operating regulations, the standard mitigation measures, and the following proposed new ITL's, described fully in EA Section III.C.2, would moderate the spill risk to polar bears:

> Proposed New Information to Lessees for protection of polar bears, entitled Planning for Protection of Polar Bears. It states in part that lessees are advised to consult with the Fish and Wildlife Service (FWS) and local Native communities while planning their activities and before submission of their Oil-Spill Contingency Plans.
>
> Revisions to Standard Information to Lessee Clauses
> Standard ITL No. 4, entitled Bird and Marine Mammal Protection. The revision in part adds polar bears to the list of species that have been proposed for listing under the Endangered Species Act.
>
> Standard ITL No. 11, entitled Sensitive Areas to Be Considered in the Oil-Spill Contingency Plans (OSCP's). The revision explains in part that coastal aggregations of polar bears during the open

water/broken ice period are particularly vulnerable to the effects of an oil spill, which lessees must account for in their OSCP's.

The levels of effect on other resources--including subsistence, marine and coastal birds, local water quality, bowheads, fish and Essential Fish Habitat, and other organisms--were similar to those levels in the multiple-sale EIS (Section IV.C.1.b and USDOI, MMS, 2003). Specifically, there still would be potentially significant effects on subsistence-harvest patterns and sociocultural systems in the unlikely event of a large oil spill. While an oil spill under certain conditions still would result in a potentially significant effect to spectacled and Steller's eiders, the coincidence of all the factors that would have to occur simultaneously to result in such an impact to spectacled eiders is improbable. A spill of 1,500 bbl or 4,600 bbl in the proposed lease area still would lead to hydrocarbon concentrations in the surface water in excess of the 1.5 parts per million (ppm) acute toxic criteria during the first day in a local area. Our reanalysis of potential effects for bowhead whales supports the conclusion that no significant impacts to this endangered species are expected due to activities associated with proposed Lease Sale 202, including the effects of an assumed oil spill. This EA concludes that no new impact to pinnipeds, belugas, or gray whales was identified for the proposed sale that was not already assessed in the multiple-sale EIS. The updated conclusion about the effects of proposed Sale 202 on fishes and EFH is that the effects of an oil spill would be considered higher than in Sales 186 and 195 but still moderate because in most cases, fishes and EFH would recover within one generation. Therefore, no new significant impact was identified for the Proposed Action that was not already assessed in the multiple-sale EIS.

Section IV.D about alternatives concludes that the effects of most of the alternatives are very similar to the effects of the Proposed Action; the effects of only subsistence-harvest patterns are changed slightly by most of the alternatives. However, the Eastern Deferral would help to moderate the level of effects on bowhead whales, polar bear, and subsistence whaling. An alternative to the Nuiqsut Subsistence Whaling Deferral would be the MMS exclusion of leasing incentives from the Nuiqsut subsistence area.

Section IV.E about cumulative effects concludes that the level of spill risk to polar bears would be greater than assessed in the multiple-sale EIS, as explained in Section IV.C. The existing MMS operating regulations, the standard mitigation measures, and the proposed new ITL's in Section III.C.2, would moderate the risk to polar bears. The level of cumulative effects on other marine mammals, subsistence-harvest patterns, marine and coastal birds, local water quality, fish and Essential Fish Habitat, archaeology, and other resources would be the same as assessed in the multiple-sale EIS. Thus, there would be no new cumulative significant effect that is not already analyzed in the multiple-sale EIS.

V. OUTREACH AND GOVERNMENT-TO-GOVERNMENT CONSULTATION

The draft Area Identification explains that the EA will analyze the comments received in response to the Request for Information (RFI). The RFI included instructions for interested parties to submit written comments by mail, email, or hand delivery.

Comments were received from ConocoPhillps Alaska, Inc. indicating their interest in opportunities to discover and develop significant oil and gas accumulations. They support efforts by the MMS to conduct sales on a regular basis within the Alaskan outer continental shelf (OCS). One public comment was received from Jean Public from New Jersey in opposition to Lease Sale 202. Comments were also received from the Chairman of the Alaska Eskimo Whaling Commission (AEWC) and Earthjustice. These comments are summarized briefly below and more detailed summaries are available from Minerals Management Service (MMS).

(1) Because of the large number of bids received in Sale 195, the AEWC requested that the MMS give greater protection to the subsistence whaling areas around Kaktovik and Barrow, and to design a deferral area around Cross Island to protect whaling activities in Nuiqsut.

The AEWC also requests that MMS revise its significant thresholds to prohibit activity in a single hunting season and undertake a new, rigorous cumulative impact analysis in its environmental review for Lease Sale 202 to account for the increase of industrial activity.

(2) Earthjustice comments were submitted on behalf of the Alaska Coalition, Alaska Wilderness League, Arctic Connections Gwich'in Steering Committee, Natural Resources Defense Council, Sierra Club, and the Wilderness Society. Earthjustice believes MMS should not hold Lease Sale 202 because of the serious risk to ecologically important areas and the nearby communities that depend on coastal resources. Earthjustice is concerned about the risks posed to sensitive marine life and coastal environment from the proposed oil and gas activities on the OCS. Earthjustice believes the multiple-sale environmental impact statement (EIS) is inadequate and a new EIS be prepared if MMS decides to proceed with Lease Sale 202.

Because of our commitments to ongoing consultative processes among the MMS, North Slope Borough, AEWC, and the Inupiat Community of the Arctic Slope, MMS will continue working with North Slope interests to resolve outstanding issues. The MMS has considered the information provided in comments to our RFI as we prepared this environmental assessment (EA). The EA will determine whether further National Environmental Policy Act analysis is warranted.

Also, the assessment in this EA benefited from comments that were submitted to MMS about the concurrent assessments for proposed Chukchi Sea Sale 193 and the 5-Year Program. This EA summarizes some of the written comments in Section III.A; however, the EA does not present an exhaustive list of all the individual comments received. Also, it neither presents responses to the comments or conclusions nor summarizes the decisions related to the content of the comments. The comments about proposed Sale 202 were received through a variety of channels, including:

Government-to-Government meetings were held with the federally recognized Native Alaskan Tribes, including the Native Village of Barrow (February 2, 2006); and the Inupiat Community of the Arctic Slope (February 2, 2006).

The MMS held open public meetings in Barrow (February 1, 2006); and Anchorage, Alaska (February 9, 2006); and a toll-free phone session (February 10, 2006).

Contacts with the State of Alaska and local governments.

Outreach and information meetings with nongovernment organizations, including the AEWC, Alaska Beluga Whale Committee, and Alaska Walrus Commission.

In-house activities including Chukchi Sea Science Update during October 2005 (USDOI, MMS, 2005b:Appendix E), in which recognized experts made a variety of presentations to MMS staff regarding the physical, biological, and social resources of the Beaufort and Chukchi area.

Approximately two dozen organizations or individuals, including Alaskan Natives, environmental organizations; private industry, and local, State, tribal, and Federal government agencies; and organizations provided written or other input. In addition to written comments received in response to the Notice of Intent to Prepare an EIS, we also examined comments that MMS received during the 5-Year Program process for relevance to the Sale 193 EIS. We documented comments made during the public meetings. Some commenter's submitted input through multiple channels. The comments originated predominantly from within Alaska.

More than 120 persons participated in the public scoping meetings. The meetings were advertised in local media; through notices posted in the villages; announcements made via local communication channels, such as community citizen band radios; and word of mouth.

During public meetings and Government-to-Government meetings, MMS personnel discussed past lease sales, proposed Sales 202 and 193, and other OCS activities including the 5-year draft proposed program process and schedule, the Programmatic Environmental Assessment of potential seismic survey activity in the summer of 2006 in the Beaufort Sea and Chukchi seas, and the potential continuation of that activity in 2007. Inupiat translation was provided where needed. These presentations highlighted our desire to received input on the resources, issues, alternatives, and mitigation measures to be included in the environmental analysis. We emphasized that the EIS is an information document that discloses the potential effects of the Proposed Action and alternatives, including potential mitigation measures to the decisionmakers, and that no decision regarding the proposed action had been made.

After review of this assessment, MMS might decide that there would be no new significant effect that already had not been assessed in the multiple-sale EIS, that the preparation of an EIS would not be necessary, and that preparation of a Finding of No New Significant Impacts (FONNSI) would be appropriate. The agency then would announce the availability of the EA and FONNSI in the *Federal Register* and would distribute the assessment. After the announcement, the agency would solicit public comments on the assessment for 30 days before preparing a Record of Decision that includes responses to review comments.

VI BIBLIOGRAPHY

ACIA. 2004. Impacts of a Warming Arctic: Arctic Climate Impact Assessment. Cambridge, UK: Cambridge University Press.

ACIA. 2005. Arctic Climate Impact Assessment. Cambridge, UK: Cambridge University Press.

Acoustic Ecology Institute. 2005. Seismic Surveys at Sea: The Contributions of Airguns to Ocean Noise. Santa Fe, NM: Acoustic Energy Institute, 9 pp.

AITC. 2006. Alaska Inter-Tribal Council Press Release on Indigenous Peoples' and Nations' Coalition. http://www.aitc.org/site_documents/Geneva%20Press%20Release.pdf

Alaska Consultants, Inc., C.S. Courtnage, and S.R. Braund and Assocs. 1984. Barrow Arch Socioeconomic and Sociocultural Description. Technical Report 101. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 641 pp.

Alaska Native Health Board, Inc. 1999. Alaska Pollution Issues. Anchorage, AK: ANB.

Alaska Native Health Board, Inc. 2002. Alaska Pollution Issues Update. Anchorage, AK: ANB.

AMAP (Arctic Monitoring and Assessment Program). 1997. AMAP Assessment Report Arctic Pollution Issues. Oslo, Norway: AMAP, pp. 373-453.

Amstrup, S.C. 1993. Human Disturbance of Denning Polar Bears in Alaska. *Arctic* 463:245-250.

Amstrup, S.C. 1995. Movements, Distribution, and Population Dynamics of Polar Bears in the Beaufort Sea. Ph.D Dissertation. Fairbanks, AK: University of Alaska, 299 pp.

Amstrup, S.C. 2000. Polar Bear. Chapter 7. *In: The Natural History of an Arctic Oil Field: Development and Biota,* J.C. Truett and S.R. Johnson, eds. San Diego, CA: Academic Press, pp. 133-157.

Amstrup, S.C. 2002. Polar Bears. *In*: Proceedings of the 13th Working Meeting of the IUCN/SSC Polar Bear Specialist Group, N.J. Lunn, S.L. Schliebe, and E.W. Born, eds. Gland, Switzerland: IUCN—the World Conservation Union, 153 pp.

Amstrup, S. C. 2003. Polar Bear *Ursus maritimus*. *In*: *Wild Mammals of North America: Biology, Management, and Conservation,* G.A. Feldhamer, B.C. Thompson, and J.A. Chapman, eds. Baltimore, MD: Johns Hopkins University Press, pp. 587-610.

Amstrup, S.C. and D.P. DeMaster. 1988. Polar Bear. *In:* Selected Marine Mammals of Alaska: Species Accounts with Research and Management Recommendations, J.W. Lentfer, ed. Washington, DC: Marine Mammal Commission, pp. 39-56.

Amstrup, S.C. and C. Garner. 1994. Polar Bear Maternity Denning in the Beaufort Sea. Journal *Wildlife Mangement* 581:1-10.

Amstrup, S.C., K.C. Myers, and F.K. Oehme. 1989. Ethylene Glycol (Antifreeze) Poisoning in a Free-Ranging Polar Bear. *Veterinary and Human Toxicology* 31:317-319.

Amstrup, S.C., G.M. Durner, and T.L. McDonald. 2000. Estimating Potential Effects of Hypothetical Oil Spills from the Liberty Oil Production Island on Polar Bears. Anchorage, AK: U.S. Geological Survey, Biological Resource Div., 42 pp.

Amstrup, S.C., G.M. Durner, I. Stirling, T.L. McDonald. 2005. Allocating Harvest among polar Bear Stocks in the Beaufort Sea. *Arctic* 58:247-259.

Amstrup, S.C., G.M. Durner, G. York, E. Regehr, K.S. Simac, D. Douglas, T.S. Smith, S.T. Partridge, T. O'Hara, T. Bentzen, and C. Kirk. 2006. USGS Polar Bear Research in the Beaufort Sea, 2005. PBTC Meeting, Feb. 2006, St. Johns, Newfoundland.

Anchorage Daily News. 1997. UAF Scientist Reports Loss of Permafrost. Anchorage, AK: *Anchorage Daily News.*

Andersen, M., E. Lie, A.E. Derocher, S.E. Belikov, A. Bernhoft, A.N, Boltunov, G.W. Garner, J.U. Skaare, and O. Wiig. 2001. Geographic Variation of PCB Congeners in Polar Bears (*Ursus maritumus*) from Svalbard East to the Chukchi Sea. *Polar Biology* 244:231-238.

Angliss, R.P. and A.L. Lodge. 2003. Final 2003 Alaska Marine Mammal Stock Assessment. Juneau, AK: USDOC, NOAA, NMFS.

Angliss, R.P. and A.L. Lodge. 2004. Alaska Marine Mammal Stock Assessments, 2003. NOAA Technical Memo NMFS-AFSC-144. Juneau, AK: USDOC, NOAA, NMFS, Alaska Fisheries Science Center.

Angliss, R.P. and R. Outlaw, eds. 2005. Draft Alaska Marine Mammal Stock Assessments 2005. Report SC-CAMLR-XXIV. Seattle, WA: National Marine Mammal Lab., Alaska Fisheries Science Center.

Angliss, R.P., D.P. DeMaster, and A.L. Lopez. 2001. Alaska Marine Mammal Stock Assessments, 2001. Seattle, WA: USDOC, NOAA, NMFS, and AFSC, 203 pp.

ARCUS (Arctic Research Consortium of the United States). 1997. People and the Arctic: The Human Dimensions of the Arctic System, Prospectus for Research. Fairbanks, AK: University of Alaska Fairbanks, ARCUS, pp. 1-2.

Augerot, X. 2005. *Atlas of Pacific Salmon.* Berkeley, CA: University of California Press.

Babaluk, J.A., J.D. Reist, J.D. Johnson, and L. Johnson. 2000. First Records of Sockeye Salmon (*Oncorhynchus nerka*) and Pink Salmon (*O. gorbuscha*) from Banks Island and Other Records of Pacific Salmon in Northwest Territories, Canada. *Arctic* 532:161-164.

Bendock, T.N. 1979. Beaufort Sea Estuarine Fishery Study. Environmental Assessment of the Alaskan Continental Shelf, Final Reports of Principal Investigators Vol. 4 Biological Studies. Boulder, CO and Anchorage, AK: USDOC, NOAA, OCSEAP and USDOI, BLM, pp. 670-729.

Bendock, T.N. and J.M. Burr. 1984. Freshwater Fish Distributions in the Central Arctic Coastal Plain (Ikpikpuk River to Colville River). Fairbanks, AK: State of Alaska, Dept. of Fish and Game, Sport Fish Div.

Bengtson, J.L., L.M. Hiruki-Raring, M.A. Simpkins, and P.L. Boveng. 2005. Ringed and Bearded Seal Densities in the Eastern Chukchi Sea, 1999-2000. *Polar Biology* 28:833-845.

Berge, J., G. Johnson, F. Nilsen, B. Gulliksen, and D. Slagstad. 2005. Ocean Temperature Oscillations Enable Reappearance of Blue Mussels *Mytilus edulis* in Svalbard after a 1000 Year Absence. *Mar. Ecol. Prog. Ser.* 303:167-175.

Best, R.C. 1982. Thermoregulation in Nesting and Active Polar Bears. *Journal of Comparative Physiology* 146:63-73.

Bielawski, E. 1997. Aboriginal Participation in Global Change Research in Northwest Territories of Canada. *In*: *Global Change and Arctic Terrestrial Ecosystems*, W.C. Oechel, T. Callaghan, T. Gilmanov, J.I. Holten, B. Maxwell, U. Molau, and B. Sveinbjörnsson, eds. New York: Springer-Verlag.

Bigg, M.A. 1981. Harbour Seal (*Phoca vitulina Linnaeus*), 1758, and (*Phoca largha Pallas*), 1811. *In: Handbook of Marine Mammals*, S.H. Ridgway and R.J. Harrison, eds. Vol. 2 Seals. New York: Academic Press, 359 pp.

Biggs, E.D. and T.T. Baker. 1993. Summary of Known Effects of the *Exxon Valdez* Oil Spill on Herring in Prince William Sound, and Recommendations for Future Inquiries. *In: Exxon Valdez* Oil Spill Symposium, Abstract Book, B. Spies, L.J. Evans, B. Wright, M. Leonard, and C. Holba, eds. and comps. Anchorage, Ak., Feb. 2-5, 1992. Anchorage, AK: *Exxon Valdez* Oil Spill Trustee Council; University of Alaska Sea Grant College Program; and American Fisheries Society, Alaska Chapter, pp. 264-267.

Bittner, J.E. 1993. Cultural Resources and the *Exxon Valdez* Oil Spill. *In: Exxon Valdez* Oil Spill Symposium, Program and Abstracts, B.Spies, L.J. Evans, B. Wright, M. Leonard, and C. Holba, eds. and comps. Anchorage, Ak., Feb. 2-5, 1992. Anchorage, AK: *Exxon Valdez* Oil Spill Trustee Council; University of Alaska Sea Grant College Program; and American Fisheries Society, Alaska Chapter, pp. 13-15.

Blackwell, S.B. and C.R. Greene, Jr. 2004. Sounds from Northstar in the Open-Water Season: Characteristics and Contribution of Vessels. *In:* Monitoring of Industrial Sounds, Seals, and Bowhead Whales near BP's Northstar Oil Development, Alaskan Beaufort Sea, 1999-2003., W.J. Richardson and M.T. Williams, eds. LGL Report TA4002-4. Anchorage, AK: BPXA, Dept. of Health, Safety, & Environment.

Bond, W.A. 1987. A Background Paper on the Anadromous Coregonic Fishes of the Lower Mackenzie River and Southern Beaufort Sea. *In:* Report of the Canada-United States-Alaska Arctic Fisheries Workshop, Banff, Alb., Canada, Dec. 1-4, 1986. Ottawa, Ont., Canada: Regulatory and Native Affairs, Dept of Fisheries and Oceans, Central and Arctic Region.

Boyd, T., M. Steele, C. Muench, and J.T. Gunn. 2002. Partial Recovery of the Arctic Ocean Halocline. *Geophysical Research Letters* 2914:1657.

BP Exploration (Alaska), Inc. 1998. Liberty Development Project, Environmental Report. Anchorage, AK: BPXA.

Bradstreet, M.S.W. 1982. Occurrence, Habitat Use and Behavior of Seabirds, Marine Mammals and Arctic Cod at the Pond Inlet Ice Edge. *Arctic* 34:28-40.

Braham, H.W. 1984. Distribution and Migration of Gray Whales in Alaska. *In*: *The Gray Whale Eschrichtius robustus.*, M.L. Jones, S.L. Swartz, and S. Leatherwood, eds. Orlando, FL: Academic Press, 600 pp.

Braham, H.W., J.J. Burns, G.A. Fedoseev, and B. Krogman. 1984. Habitat Partitioning by Ice-Associated Pinnipeds: Distribution and Density of Seals and Walruses in the Bering Sea, April 1976. *In:* Soviet-American Cooperative Research on Marine Mammals. Vol. I - Pinnipeds, F.M. Fay and G.A. Fedoseev, eds. NOAA Technical Report NMFS 12. Seattle, WA: USDOC, NOAA, NMFS, pp. 25-47.

Brannon, E.L. and A.W. Maki. 1996. The *Exxon Valdez* Oil Spill: Analysis of Impacts on the Prince William Sound Pink Salmon. *Reviews in Fisheries Science* 4:289-337.

Brannon, E.J., L.L. Moulton, L.G. Gilbertson, A.W. Maki, and J.R. Skalski. 1993. An Assessment of Oil Spill Effects on Pink Salmon Populations following the *Exxon Valdez* Oil Spill-Part 1: Early Life History. *In: Exxon Valdez* Oil Spill: Fate and Effects in Alaskan Waters, Third Symposium on Environmental Toxicology and Risk Assessment: Aquatic, Plant, and Terrestrial, Atlanta, Ga., Apr. 25-28, 1993. Philadelphia, PA: American Society for Testing and Materials, pp. 548-584.

Brigham, L. and B. Ellis, eds. 2004. Arctic Marine Transport Workshop, Scott Polar Research Institute, Cambridge University, Sept. 29-30, 2004. Anchorage, AK: Circumpolar Infrastructure Task Force, Secretariat at the Institute of the North; United States Arctic Research Commission; International Arctic Science Commision.

Brower C.D., A. Carpenter, M.L. Branigan, W. Calvert, T. Evans, A.S. Fischbach, J.A. Nagy, S. Schliebe, and I. Stirling. 2002. The Polar Bear Management Agreement for the Southern Beaufort Sea: An Evaluation of the First Ten Years of a Unique Conservation Agreement. *Arctic* 554:362-372.

Brower, G. 2005. Testimony of Gordon Brower, Barrow, Alaska, in comments on MMS' 2007-2012 Proposed 5-Year OCS Oil and Gas Leasing Program.

Brower, T.P. 1980. Qiniqtuagaksrat Utuqqanaat Inuuniagninisiqun: The Traditional Land Use Inventory for the Mid-Beaufort Sea. Vol. I. Barrow, AK: NSB, Commission on History and Culture.

Brower, W.A., Jr., R.G. Baldwin, Jr. C.N. Williams, J.L. Wise, and L.D. Leslie., 1988. Climatic Atlas of the Outer Continental Shelf Waters and Coastal Regions of Alaska, Vol. I, Gulf of Alaska. OCS Study, MMS 87-0011. Asheville, NC and Anchorage, AK: USDOD, NOCD; USDOI, MMS, Alaska OCS Region; and USDOC, NOAA, NOS, 530 pp.

Brown, D.W., D.G. Burrows, C.A. Sloan, R.W. Pearce, S.M. Pierce, J.L. Boulton, K.L. Tilbury, K.L. Dana, S.-L. Chan, and U. Varanasi. 1996. Survey of Alaskan Subsistence Invertebrate Seafoods Collected in 1989-1991 to Determine Exposure to Oil Spilled from the *Exxon Valdez*. *American Fisheries Society Symposium* 18:844-855.

Brown, J., P. Boehm, L. Cook, J. Trefry, and G. Durell. 2005. The MMS ANIMIDA Program; Hydrocarbon Chemistry of Sediments in the Nearshore Beaufort Sea. *In*: Tenth Information Transfer Meeting and Barrow Information Update Meeting, Anchorage, Ak., Mar. 24-16, 2005. OCS Study, MMS 2005-36. Anchorage, AK: USDOI, MMS, Alaska OCS Region, pp. 35-37.

Bue, B.G., S. Sharr, and J.E. Seeb. 1998. Evidence of Damage to Pink Salmon Populations Inhabiting Prince William Sound, Alaska, Two Generations After the *Exxon Valdez* Oil Spill. *Trans. Am. Fish. Soc.* 1271:35-43.

Buist, I. and S.L. Ross Environmental Research, Ltd. 1999. In Situ Burning of Oil Spills Workshop Proceedings, W.D. Walton and N.H. Jason, eds. New Orleans, La., Nov. 2-4, 1998. Special Publication No. 935. Gaithersburg, MD: National Institute of Standards and Technology.

Bump, J.K. and J.R. Lovvorn. 2004. Effects of Lead Structure in Bering Sea Pack Ice on the Flight Costs of Wintering Spectacled Eiders. *J. of Marine Systems* 50:113-139.

Bunnell, F.L. and D.E.N. Tait. 1981. Population Dynamics of Bears - Implications. *In*: *Dynamics of Large Mammal Populations,* C.W. Fowler and T.D. Smith, eds. New York: Wiley and Sons, pp. 75-98.

Burgess, W.C. and C.R. Greene, Jr. 1999. Physical Acoustic Measurements. *In*: Marine Mammal and Acoustical Monitoring of Western Geophysical's Open-Water Seismic Program in the Alaskan Beaufort Sea, 1998., W.J. Richardson, ed. LGL Report TA2230-3. Houston, TX; Anchorage, AK; and Silver Spring, MD: Western Geophysical and USDOC, NMFS, 390 pp.

Burns, J.J. 1981. Ribbon Seal-*Phoca fasciata*. *In*: *Handbook of Marine Mammals,* S.H. Ridgway and R.J. Harrison, eds. Vol. 2 Seals. New York: Academic Press, pp. 89-109.

Burns, J.J. and B.P. Kelly. 1982. Studies of Ringed Seals in the Alaskan Beaufort Sea during Winter: Impacts of Seismic Exploration. Annual Report. Juneau, AK: USDOC, NOAA, OCSEAP.

Burns, J.J., L.H. Shapiro, and F.H. Fay. 1981. Ice as Marine Mammal Habitat in the Bering Sea. *In:* The Eastern Bering Sea Shelf: Oceanography and Resources, D.W. Hood and J.A. Calder, eds. Vol. II. Juneau, AK: USDOC, NOAA, OMPA, and USDOI, BLM, pp. 781-797.

Callaway, D. 1995. Resource Use in Rural Alaskan Communities. *In*: *Human Ecology and Climate Change. People and Resources in the Far North,* D.L. Peterson and D.R. Johnson, eds. Washington, DC: Taylor & Francis.

Callaway, D., J. Earner, E. Edwardsen, C. Jack, S. Marcy, A. Olrun, M. Patkotak, D. Rexford, and A Whiting. 1999. Effects of Climate Change on Subsistence Communities in Alaska. *In*: Assessing the Consequences of Climate Change for Alaska and the Bering Sea Region, G. Weller and P.A. Anderson, eds. Fairbanks, Ak., Oct. 29-30, 1998. Washington, DC: U.S. Global Change Research Program, National Science Foundation, U.S. Dept. of the Interior, and International Arctic Science Committee, pp. 59-74.

Cannon, T.C. and L. Hachmeister, eds. 1987. Endicott Environmental Monitoring Program. Integration and Assessment Chapter. Draft report. Anchorage, AK: U.S. Army Corps of Engineers, Alaska District.

Carls, M.G., G.D. Marty, and J. E. Hose. 2002. Synthesis of the Toxicological Impacts of the *Exxon Valdez* Oil Spill on Pacific Herring (*Clupea pallasi*) in Prince William Sound, Alaska, U.S.A. *Can. J. Fish. Aquat. Sci.* 59:153-172.

Carls, M.G., R.A. Heintz, G.D. Marty, and S.D. Rice. 2005. Cytochrome P4501A Induction in Oil-Exposed Pink Salmon *Oncorhynchus gorbuscha* Embryos Predicts Reduced Survival Potential. *Marine Ecology Progress Series* 301:253-265.

Carmack, E.C., R.W. MacDonald, R.G. Perkin, F.A. McLaughlin, and R.J. Pearson. 1995. Evidence for Warming of Atlantic Waters in the Southern Canadian Basin of the Arctic Ocean: Results from the Larsen-93 Expedition. *Geophysical Research Letters* 22:1061-1064.

Carroll, G.M., J.C. George, L.F. Lowry, and K.O. Coyle. 1987. Bowhead Whale (*Balaena mysticetus*) Feeding near Point Barrow, Alaska during the 1985 Spring Migration. *Arctic* 40:105-110.

Cashman, K. 2006a. Borough OK's Rezone: Pioneers Proposed Ooguruk Oil Project Rezoned for Resource Development. *Petroleum News*, Jan. 15, 2006.

Cashman, K. 2006b. Borough Seeks Native Allotment Mandate. *Petroleum News*, Jan. 22, 2006.

Caulfield, R.A. 2000. Food Security in Arctic Alaska: A Preliminary Assessment. http://www.chaireconditionautochtone.fss.ulaval.ca/extranet/doc/100.pdf. Quebec, QC, Canada: Chaire de recherche du Canada sur la condition autochtone comparee, Centre interuniversitaire d'etudes et de rechereches autochtones, Universite Laval.

Center for Biological Diversity. 2004. Petition to List the Yellow-Billed Loon, *Gavia adamsii*, as an Endangered or Species under the Endangered Species Act, March 30, 2004. Sitka, AK: CBD, 64 pp.

Cimato, J. 1980. Hydrocarbons and Drilling Fluids in the Marine Environment. *In:* Proposed Five-Year OCS Oil and Gas Lease Sale Schedule, March 1980-February 1985, Final Environmental Impact Statement, Appendix 8. Washington, DC: USDOI, BLM.

Clark, C.W., W.T. Ellison, and K. Beeman. 1986. A Preliminary Account of the Acoustic Study Conducted During the 1985 Spring Bowhead Whale, *Balaena mysticetus*, Migration off Point Barrow, Alaska. Report of the International Whaling Commission No. 36. Cambridge, UK: IWC, pp. 311-317.

Clarke, J., S. Moore, and D. Ljungblad. 1989. Observations on the Gray Whale (*Eschrichtius robustus*) Utilization and Patterns in the Northeast Chukchi Sea, July-October 1982-1987. *Canadian Journal of Zoology* 67:2646-2653.

Clarke, J.T., S.E. Moore, and M.M. Johnson. 1993. Observations on Beluga Fall Migration in the Alaskan Beaufort Sea, 198287, and Northeastern Chukchi Sea, 198291. Report of the International Whaling Commission 43. Cambridge, UK: IWC, pp. 387-396.

Clarkson, P.L. and D. Irish. 1991. Den Collapse Kills Female Polar Bear and Two Newborn Cubs. *Arctic* 44:83-84.

Comiso, J.C. 2002a. Correlation and Trend Studies of the Sea-Ice Cover and Surface Temperatures in the Arctic. *Ann. Glaciol.* 34:420-428.

Comiso, J.C. 2002b. A Rapidly Declining Perennial Sea Ice Cover in the Arctic. *Geophysical Research Letters.* 2920:1956.

Comiso, J.C. 2003. Warming Trends in the Arctic from Clear Sky Satellite Observations. *Journal of Climate* 1621:3498-3510.

Comiso, J.C. 2005. Overview - Satellite Observed Variability of the Arctic Ice Cover. *In*: MMS Chukchi Sea Science Update, Anchorage, Ak., Oct. 31, 2005. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Comiso, J.C. 2006. Arctic Warming Signals from Satellite Observations. *Weather* 613:70-76.

Community Engagement Steering Committee. 2005. Attitude & Behavior: Survey Results, All North Slope Schools. PowerPoint presentation. Barrow, AK: North Slope Borough CESC.

Cooper, L.W., C.J. Ashjian, S.L. Smith, L.A. Codispoti, J.M. Grebmeir, R.G. Campbell, and E.B. Sherr. 2006. Rapid Seasonal Sea-Ice Retreat in the Arctic Could be Affecting Pacific Walrus (*Odobenu rosmarus divergens*) Recruitment. *Aquatic Mammals* 32:98-102.

Costello, M., M. Elliott, and R. Thiel. 2002. *In*: *Fishes in Estuaries,* M. Elliott and K. Hemingway, eds. Oxford, UK: Blackwell Science.

Council on Environmental Quality. 1997. Draft Guidance Regarding Consideration of Global Climate Change in Environmental Documents Prepared Pursuant to the National Environmental Policy Act. Washington, DC: Executive Office of the President, CEQ.

Craig, P.C. 1984. Fish Use of Coastal Waters of the Alaskan Beaufort Sea: A Review. *Transactions of the American Fisheries Society* 113:265-282.

Craig, P.C. and L. Halderson. 1981. Beaufort Sea Barrier Island-Lagoon Ecological Processes Studies: Final Report, Simpson Lagoon, Part 4, Fish. Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators, Vol. 7 Biological Studies (Feb. 1981). Boulder, CO and Anchorage, AK: USDOC, NOAA, OCSEAP and USDOI, BLM, pp. 384-678.

Craig, P.C. and L. Halderson. 1986. Pacific Salmon in the North American Arctic. *Arctic* 391:2-7.

Craig, P.C., W.B. Griffiths, L. Halderson, and H. McElderry. 1982. Ecological Studies of Arctic Cod (*Boreogadus saida*) in Beaufort Sea Coastal Waters, Alaska. *Can. J. Fish. Aquat. Sci.* 39:395-406.

Crawford, R.E. and J.K. Jorgenson. 1990. Density Distribution of Fish in the Presence of Whales at the Admiralty Inlet Landfast ice Edge. *Arctic* 43:215-222.

Crawford, R.E. and J.K. Jorgenson. 1993. Schooling Behavior of Arctic Cod, *Boreogadus saida*, in Relation to Drifting Pack Ice. *Environmental Biology of Fishes* 36:345-357.

Cummings, W.C., D.V. Holliday, W.T. Ellison, and B.J. Graham. 1983. Technical Feasibility of Passive Acoustic Location of Bowhead Whales in Population Studies off Point Barrow, Alaska. Report T-83-06-002. Barrow, AK: North Slope Borough.

Dau, C.P. and W.W. Larned. 2004. Aerial Population Survey of Common Eiders and Other Waterbirds in Nearshore Waters and Along Barrier Islands of the Arctic Coastal Plain of Alaska, 24-27 June 2004. Anchorage, AK: USDOI, FWS.

Dau, C.P. and W.W. Larned. 2005. Aerial Population Survey of Common Eiders and Other Waterbirds in Nearshore Waters and Along Barrier Islands of the Arctic Coastal Plain of Alaska, 24-27 June 2005. Anchorage, AK: USDOI, FWS, Migratory Bird Management.

Davis, R.A., K.J. Finley, and W.J. Richardson. 1980. The Present Status and Future Management of Arctic Marine Mammals in Canada. Science Advisory Board of NWT Vol. 3. Yellowknife, NWT, Canada: Government of the Northwest Territories, Dept. of Information, 93 pp.

Day, R.H., J.R. Rose, A.K. Prichard, R.J. Blaha, and B.A. Cooper. 2004. Environmental Effects on the Fall Migration of Eiders at Barrow, Alaska. *Marine Ornithology* 32:13-24.

Dekin, A.A., Jr. 1993. *Exxon Valdez* Oil Spill Archaeological Damage Assessment, Management Summary, Final Report. Juneau, AK: U.S. Dept. of Agriculture, Forest Service.

Derocher, A.E. and I. Stirling. 1991. Oil Contamination of Polar Bears. *Polar Record* 27160:56-57.

Derocher A.E., O. Wiig, and G. Bangjord. 2000. Predation of Svalbard Reindeer by Polar Bears. *Polar Biology* 23:675-678.

Derocher, A.E., N.J. Lunn, and I. Stirling. 2004. Polar Bears in a Warming Climate. *Integrative and Comparative Biology* 44:163-176.

Dobbyn, P. 2003. Native Group Wants to Stop New Searches for Gas, Oil. Anchorage, AK: *Anchorage Daily News*, Feb. 13, 2003.

Dunton, K.H., E. Reimnitz, and S. Schonberg. 1982. An Arctic Kelp Community in the Alaskan Beaufort Sea. *Arctic* 354:465-484.

Durner, G.M. and S.C. Amstrup. 2000. Estimating the Impacts of Oil Spills on Polar Bears. *Arctic Research* 14:33-37.

Durner, G.M., S.C. Amstrup, R. Neilson, and T. McDonald. 2004. The Use of Sea Ice Habitast by Female Polar Bears in the Beaufort Sea. OCS Study, MMS 2004-014. Anchorage, AK: U. S. Geological Survey, Alaska Science Center.

Earnst, S.L. 2004. Status Assessment and Conservation Plan for the Yellow-Billed Loon (*Gavia adamsii*). Scientific Investigations Report 2004-5258. U.S. Geological Survey, 42 pp.

Earnst, S.L., R.A. Stehn, R.M. Platte, W.W. Larned, and E.J. Mallek. 2005. Population Size and Trend of Yellow-Billed Loons in Northern Alaska. *The Condor* 107:289-304.

Eberhardt, L.L. and D.B. Siniff. 1977. Population Dynamics and Marine Mammal Management Policies. *Journal of Fisheries Research Board of Canada* 34:183-190.

Egeland, G.M., L.A. Feyk, and J.P. Middaugh. 1998. The Use of Traditional Foods in a Healthy Diet in Alaska: Risks in Perspective. *State of Alaska Epidemiology Bulletin* 21.

Eicken, H., L.H. Shapiro, A.G. Gaylord, A. Mahoney, and P.W. Cotter. 2006. Mapping and Characterization of Recurring Spring Leads and Landfast Ice in the Beaufort and Chukchi Seas. OCS Study MMS 2005-068. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 141 pp. plus appendices.

Ely, C.R., C.P. Dau, and C.A. Babcock. 1994. Decline in a Population of Spectacled Eiders Nesting on the Yukon-Kuskokwim Delta, Alaska. *Northwestern Naturalist* 75:81-87.

Fair, J. 2002. Status and Significance of Yellow-Billed Loon Populations in Alaska. Anchorage, AK: The Wilderness Society and Trustees for Alaska.

Fall, J.A. and C.J. Utermohle. 1999. Subsistence Harvests and Uses in Eight Communities Ten Years After the *Exxon Valdez* Oil Spill. Technical Paper No. 252. Juneau, AK: State of Alaska, Dept. of Fish and Game, Div. of Subsistence.

Fall, J.A., L.J. Field, T.S. Nighswander, N. Peacock, and U. Varansi, eds. 1999. Overview of Lessons Learned from the *Exxon Valdez* Oil Spill: A 10-Year Retrospective. *In:* Evaluating and Communicating Subsistence Seafood Safety in a Cross-Cultural Context. Pensacola, FL: SETAC Press, 338 pp.

Fay, F.H. 1982. Ecology and Biology of the Pacific Walrus, *Odobenus rosmarus divergens* Illiger. *North American Fauna* 74:279.

Fay, F.H. and J.J. Burns. 1988. Maximal Feeding Depths of Walruses. *Arctic* 413:239-240.

Fechhelm, R.G and W.B. Griffiths. 2001. Status of Pacific Salmon in the Beaufort Sea, 2001. Anchorage, AK: LGL Alaska Research Assocs., Inc., 13 pp.

Federal Register. 1993. Final Rule to List Spectacled Eider as Threatened. *Federal Register* 5888:27,474-27,480.

Federal Register. 1997. Threatened Status for the Alaska Breeding Population of the Steller's Eider. *Federal Register* 62(112):31,748-31,757.

Federal Register. 2002. Final Determination on a Petition to Designate Critical Habitat for the Bering Sea Stock of Bowhead Whales. 67(169):55,767-55,771.

Federal Register. 2004. Review of Species that Are Candidates or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petitions: Annual Description of Progress on Listing Actions. *Federal Register* 69:24,876-24,904.

Federal Register. 2006 . Taking of Marine Mammals Incidental to Specified Activities; On-ice Seismic Operations in the Beaufort Sea. *Federal Register* 71(38): 9782-9786.

Federal Register. 2006. Draft Conservation Agreement for the Yellow-Billed Loon. *Federal Register* 71(49):13,155-13,157.

Federal Register. 2006. Marine Mammals; Incidental Take During Specified Activities. *Federal Register* 71(55):14,446-14,467.

Ferguson, S.H., I. Stirling, and P. McLoughlin. 2005. Climate Change and Ringed Seal (*Phoca hispida*) Recruitment in Western Hudson Bay. *Marine Mammal Science* 21:121-135.

Finley, K.J. 1982. The Estuarine Habitat of the Beluga or White Whale, *Delphinapterus leucas*. *Cetus* 4:4-5.

Fischer, J.B. and W.W. Larned. 2004. Summer Distribution of Marine Birds in the Western Beaufort Sea. *Arctic* 572:143-159.

Flint, P. and M. Herzog. 1999. Breeding of Steller's Eiders *Polysticta stelleri,* on the Yukon-Kuskokwim Delta, Alaska. *Canadian Field-Naturalist* 113:306-308.

Flint, P.L., J.A. Reed, J.C. Franson, T.E. Hollmen, J.B. Grand, M.D. Howell, R.B. Lanctot, D.L. Lacroix, and C.P. Dau. 2003. Monitoring Beaufort Sea Waterfowl and Marine Birds. OCS Study, MMS 2003-037. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Francis, J.A., E. Hunter, J.R. Key, and X. Wang. 2005. Clues to Variability in Arctic Minimum Sea Ice Extent. *Journal of Geophysical Research* 32:L21501.

Friends of Cooper Island. 2005. Seattle, WA: www.cooperisland.org/index.htm

Frost, K.J. and L.F. Lowry. 1981. Ringed Baikal and Caspian Seals. Chapter 2. *In*: *Handbook of Marine Mammals,* S.H. Ridgeway and R.J. Harrison, eds. Vol. II, Seals. New York: Academic Press.

Frost, K.J. and L.F. Lowry. 1983. Demersal Fishes and Invertebrates Trawled in the Northeastern Chukchi and Western Beaufort Seas, 1976-1977. NOAA Technical Report NMFS SSRF-764. Seattle, WA: USDOC, NOAA, NMFS, 22 pp.

Frost, K.J., L.F. Lowry, J.R. Gilbert, and J.J. Burns. 1988. Ringed Seal Monitoring: Relationships of Distribution and Abundance to Habitat Attributes and Industrial Activities. OCS Study, MMS 89-0026. Anchorage, AK: USDOC, NOAA, and USDOI, MMS, pp. 345-445.

Frost, K.J., L.F. Lowry, G. Pendleton, and H.R. Nute. 2002. Monitoring Distribution and Abundance of Ringed Seals in Northern Alaska. OCS Study, MMS 2002-043. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 66 pp.

Frost, K.J., L.F. Lowry, G. Pendleton, and H.R. Nute. 2004. Factors Affecting the Observed Densities of Ringed Seals, *Phoca hispida*, in the Alaskan Beaufort Sea, 1996-99. *Arctic* 57:115-128.

Fuller, A.S. and J.C. George. 1997. Evaluation of Subsistence Harvest Data from the North Slope Borough 1993 Census for Eight North Slope Villages: for the Calendar Year 1992. Barrow, AK: North Slope Borough, Dept. of Wildlife Management.

Galginaitis, M. and D.W. Funk. 2004. Annual Assessment of Subsistence Bowhead Whaling near Cross Island, 2001 and 2002: ANIMIDA Task 4 Final Report. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Galginaitis, M. and D.W. Funk. 2005. Annual Assessment of Subsistence Bowhead Whaling near Cross Island. ANIMIDA Task 4 Annual Report. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Galginaitis, M. and D.W. Funk. 2006a. Annual Assessment of Subsistence Bowhead Whaling near Cross Island, 2004: AMIMIDA Task 7, Annual Report. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Galginaitis, M. and D.W. Funk. 2006b. Annual Assessment of Subsistence Bowhead Whaling near Cross Island, 2005: ANIMIDA Task 7 Preliminary Report. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Gaston, A.J., K. Woo, and M. Hipfner. 2003. Trends in Forage Fish Populations in Northern Hudson Bay Since 1981, as Determined from the Diet of Nesting Thick-Billed Murres *Uria lomvia*. *Arctic* 56:227-233.

George, J.C., C. Clark, G.M. Carroll, and W.T. Ellison. 1989. Observations on the Ice-Breaking and Ice Navigation Behavior of Migrating Bowhead Whales (*Balaena mysticetus*) near Point Barrow, Alaska, Spring 1985. *Arctic* 42(1):24-30.

George, J.C., L.M. Philo, K. Hazard, D. Withrow, G.M. Carroll, and R. Suydam. 1994. Frequency of Killer Whales (*Orcinus orca*) Attacks and Ship Collisions Based on Scarring on Bowhead Whales (*Balaena mysticetus*) of the Bering-Chukchi-Beaufort Seas Stock. *Arctic* 473:247-255.

George, J.C., R.S. Suydam, L.M. Philo, T.F. Albert, J.E. Zeh, and G.M. Carroll. 1995. Report of the Spring 1993 Census of Bowhead Whales, *Balaena msticetus,* off Point Barrow, Alaska, with Observations on the 1993 Subsistence Hunt of Bowhead Whales by Alaska Eskimos. Reports of the International Whaling Commission 45. Cambridge, UK: IWC, pp. 371-384.

George, J.C., J. Bada, J.E. Zeh, L. Scott, S.E. Brown, T. O'Hara, and R.S. Suydam. 1999. Age and Growth Estimates of Bowhead Whales (*Balaena mysticetus*) via Aspartic Acid Racemization. *Canadian Journal of Zoology* 77(4):571-580.

George, J.C., H. Hunington, K. Brewster, H. Eicken, D.W. Norton, and R. Glenn. 2003. Observations on Shorefast Ice Dynamics in Arctic Alaska and the Responses of the Inupiat Hunting Community. *Arctic* 57(4):363-374.

George, J.C., R. Zeh, R.P. Suydam, and C. Clark. 2004. Abundance and Population Trend (1978-2001) of Western Arctic Bowhead Whales Surveyed near Barrow, Alaska. *Marine Mammal Science* 20(4):755-773.

Gerber, L.R. and D.P. DeMaster. 1999. A Quantitative Approach to Endangered Species Act Classification of Long-Lived Vertebrates: Application to the North Pacific Humpback Whale. *Conservation Biology* 17(3):1-12.

Gilbert, J., G. Fedoseev, D. Seagars, E. Razlivalov, and A. Lachugin. 1992. Aerial Census of Pacific Walrus, 1990. Anchorage, AK: USDOI, FWS, Marine Mammal Management, 33 pp.

Gloersen, P. and W.J. Campbell. 1991. Recent Variations in Arctic and Antarctic Sea-Ice Covers. *Nature* 352:33-36.

Goold, J.C. and P.J. Fish. 1998. Broadband Spectra of Seismic Survey Airgun Emissions, with Reference to Dolphin Auditory Thresholds. *Journal of the Acoust. Soc. of Amer.* 103:2177-2184.

Grebmeier, J.M., J.E. Overland, S.E. Moore, E.V. Farley, E.C. Carmack, L.W. Cooper, K.E. Frey, J.H. Helle, F.A. McLaughlin, and S.L. McNutt. 2006. A Major Ecosystem Shift in the Northern Bering Sea. *Science* 311:1461-1464.

Greene, C.R. 1981. Underwater Acoustic Transmission Loss and Ambient Noise in Arctic Regions. *In:* The Question of Sound from Icebreaker Operations, Proceedings of a Workshop, N.M. Peterson, ed. Toronto, Ont., Canada, Feb. 23-24, 1981. Calgary, Alb., Canada: Arctic Pilot Project, Petro-Canada, pp. 234-258.

Greene, C.R., Jr. and W.J. Richardson. 1988. Characteristics of Marine Seismic Survey Sounds in the Beaufort Sea. *J. Acoust. Soc. Am.* 83(6):2246-2254.

Greene, C.R., Jr. and M.W. McLennan. 2001. Acoustic Monitoring of Bowhead Whale Migration, Autumn 2000. *In:* Monitoring of Industrial Sounds, Seals, and Whale Calls During Construction of BP's Northstar Oil Development, Alaskan Beaufort Sea, Summer and Autumn 2000: 90-Day Report, LGL and Greeneridge, eds. LGL Report TA 2431-1. King City, Ont., Canada: LGL Ecological Research Associates, Inc., 37pp.

Griffiths, W.B. 1999. Zooplankton. *In:* Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information. Retrospective and 1998 Results, W.J. Richardson and D.H. Thomson, eds. LGL Report TA- 2196-2. King City, Ont., Canada: LGL Ecological Research Associates, Inc., 57 pp.

Griffiths, W.B., D.H. Thomson, and M.S.W. Bradstreet. 2002. Zooplankton and Water Masses at Bowhead Whale Feeding Locations in the Eastern Beaufort Sea. *In:* Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information, W.J. Richardson and D.H. Thomson, eds. LGL Report TA2196-7. King City, Ont., Canada: LGL Limited, environmental research associates, pp. 1-44.

Groat, C.C. 2001. Statement of Charles C. Groat, Director, U.S. Geological Survey, Department of the Interior, Before the Committee on Appropriations, United States Senate on Climate Change and its Impact on the Arctic Region and Alaska, May 29, 2001.

Grotefendt, K., K. Logermann, D. Quadfasel, and S. Ronski. 1998. Is the Arctic Ocean Warming? *Journal of Geophysical Research* 103C(12):27,679-27,687.

Gunn, J.R. and R.D. Muench. 2001. Observed Changes in Arctic Ocean Temperature Structure over the Past Half Decade. *Geophysical Research Letters* 28(6):1035-1038.

Haggarty, J.C., C.B. Wooley, J.M. Erlandson, and A. Crowell. 1991. The 1990 *Exxon Valdez* Cultural Resource Program: Site Protection and Maritime Cultural Ecology in Prince William Sound and the Gulf of Alaska. Anchorage, AK: Exxon Company, USA.

Hall, J.D., M.L. Gallagher, K.D. Brewer, P.R. Regos, and P.E. Isert. 1994. ARCO Alaska, Inc. 1993 Kuvlum Exploration Area Site Specific Monitoring Program. Final Report. Anchorage, AK: ARCO Alaska, Inc.

Hamilton, C.I., S.J. Starr, and L.L. Trasky. 1979. Recommendations for Minimizing the Impacts of Hydrocarbon Development on the Fish, Wildlife, and Aquatic Plant Resources of Lower Cook Inlet. Vols. I and II. Anchorage, AK: State of Alaska, Dept. of Fish and Game, Marine and Coastal Habitat Management, 420 pp.

Hammill, M.O. and T.G. Smith. 1991. The Role of Predation in the Ecology of the Ringed Seal in Barrow Strait, Northwest Territories, Canada. *Marine Mammal Science* 7:123-135.

Hammill, M.O., C. Lydersen, M. Ryg, and T.G. Smith. 1991. Lactation in the Ringed Seal (*Phoca hispida*). *Canadian Journal of Fisheries and Aquatic Science.* 48:2471-2476.

Hampson, G.R. and H.L. Sanders. 1969. Local Oil Spill. *Oceanus* 15:8-11.

Harcharek, R.C. 1992. North Slope Borough 1992 Economic Profile, Vol. VI. Barrow, AK: NSB, Dept. of Planning and Community Services.

Harington, C.R. 1968. Denning Habits of the Polar Bear (*Ursus maritimus*) Phipps. WS Report, Series 5. Ottawa, Ont., Canada: Canadian Wildlife Service, 33 pp.

Harwood, L.A. and I. Stirling. 1992. Distribution of Ringed Seals in the Southeastern Beaufort Sea during Late Summer. *Can. J. Zool.* 70(5):891-900.

Harwood, L.A., T.G. Smith, and H. Melling. 2000. Variation in Reproduction and Body Condition of the Ringed Seal (*Phoca hispida*) in Western Prince Albert Sound, NT, Canada, as Assessed through a Harvest-Based Sampling Program. *Arctic* 53:422-431.

Harwood, L.A., F. McLaughlin, R.M. Allen, J. Illasiak, Jr., and J. Alikamik. 2005. First-Ever Marine Mammal and Bird Observation in the Deep Canada Basin and Beaufort/Chukchi Seas: Expeditions during 2002. *Polar Biology* 28(3):250-253.

Haynes, T. and S. Pedersen. 1989. Development and Subsistence: Life After Oil. *Alaska Fish and Game* 21(6):24-27.

Hazard, K. 1988. Beluga Whale, *Delphinapterus leucas. In:* Selected Marine Mammals of Alaska: Species Accounts with Research and Management Recommendations, J.W. Lentfer, ed. Washington, DC: Marine Mammal Commission, 275 pp.

Heintz, R.A., J.W. Short, and S.D. Rice. 1999. Sensitivity of Fish Embryos to Weathered Crude Oil: Part II. .Incubating Downstream from Weathered *Exxon Valdez* Crude Oil Caused Increased Mortality of Pink Salmon (*Oncorhynchus gorbuscha*) Embryos. *Environ. Tox. Chem.* 18:494-503.

Heintz, R.A., S.D. Rice, A.C. Wertheimer, R.F. Bradshaw, F.P. Thrower, J.E. Joyce, and J.W. Short. 2000. Delayed Effects on Growth and Marine Survival of Pink Salmon *Oncorhynchus gorbuscha* After Exposure to Crude Oil during Embryonic Development. *Mar. Ecol. Prog. Ser.* 208:205-216.

Hoekstra, K.A., L.A. Dehn, J.C. George, K.R. Solomon, D.C.G. Muir, and T.M. O'Hara. 2002. Trophic Ecology of Bowhead Whales (*Balaena mysticetus*) Compared with that of Other Arctic Marine Biota as Interpreted from Carbon-, Nitrogen-, and Sulphur-Isotope Signatures. *Canadian Journal of Zoology* 80(2):223-231.

Hoffman, A.G., K. Hepler, and P. Hansen. 1993. Assessment of Damage to Demersal Rockfish in Prince William Sound Following the *Exxon Valdez* Oil Spill. *In: Exxon Valdez* Oil Spill Symposium, Abstract Book, B. Spies, L.J. Evans, B. Wright, M. Leonard, and C. Holba, eds. and comps. Anchorage, Ak., Feb. 2-5, 1992. Anchorage, AK: *Exxon Valdez* Oil Spill Trustee Council; University of Alaska, Sea Grant College Program; and American Fisheries Society, Alaska Chapter, pp. 241-242.

International Whaling Commission. 1997. Chairman;s Report of the 48th Annual Meeting. Report of the International Whaling Commission 47. Cambridge, UK: IWC, pp. 17-55.

International Whaling Commission. 2001. Annex F. 2001 Report of the Subcommittee on Bowhead, Right, and Gray Whales. Cambridge, UK: IWC.

International Whaling Commission. 2003. Annex F. Report of the Sub-Commitee on Bowhead, Right and Gray Whales. Cambridge, UK: IWC.

International Whaling Commission. 2004a. Report of the Scientific Committee. Report IWC/57/REPI. Cambridge, UK: IWC.

International Whaling Commission. 2004b. Report of the Sub-Committee on Bowhead, Right and Gray Whales. Cambridge, UK: IWC, 27 pp.

International Whaling Commission. 2005a. Report of the Scientific Committee. Cambridge, UK: IWC.

International Whaling Commission. 2005b. Annex F. Report of the Sub-Committee on Bowhead, Right and Gray Whales. Report 13:23. Cambridge, UK: IWC, 12 pp.

IPCC. 2001. Summary for Policymakers. *In*: Climate Change 2001: Synthesis Report, Wembly, UK, Sept. 24-29, 2001. Geneva: IPCC.

Jangaard, P.M. 1974. The Capelin (*Thallotus villosus*): Biology, Distribution, Exploitation, Utilization, and Composition. *Bulletin of the Fisheries Research Board of Canada* 186:70.

Jarvela, L.E. and L.K. Thorsteinson. 1999. The Epipelagic fish Community of Beaufort Sea Coastal Waters, Alaska. *Arctic* 52(1):80-94.

Jay, C. and S. Hills. 2005. Movements of Walruses Radio-Tagged in Bristol Bay, Alaska. *Arctic* 58:192-202.

Jefferson, T.A., S. Leatherwood, and M.A. Webber. 1993. FAO Species Identification Guide. Marime Mammals of the World. Rome: UNEP/FAO.

Johannessen, G.M., M. Miles, and E. Bjorgo. 1995. The Arctic's Shrinking Ice. *Nature* 376:1260-127.

Johannessen, K.I. 1976. Effects of Seawater Extract of Ekofisk Oil on Hatching Success of Barents Sea Capelin. *International Council for the Exploration of the Sea Publication CM* E:29.

Johnson, S.R. 1979. Fall Observations of Westward Migrating White Whales (*Delphinapterus leucas*) along the Central Alaskan Beaufort Sea Coast. *Arctic* 32(3):275-276.

Johnson, S.R. and D.R. Herter. 1989. The Birds of the Beaufort Sea. Anchorage, AK: BPXA.

Jones, M. L. and S.L. Swartz., 1984. Demography and Phenology of Gray Whales and Evaluation of Whale-Watching Activities in Laguna San Ignacio, Baja California Sur, Mexico. *In: The Gray Whale,* M.L. Jones, S. L. Swartz and S. Leatherwood, eds. New York: Academic Press, pp. 309-372.

Kalxdorff, S.B. 1997. Collection of Local Knowledge Regarding Polar Bear Habitat Use in Alaska. FWS Technical Report MMM 97-2. Anchorage, AK: USDOI, FWS and MMS, 55 pp.

Karcher, M. J., R. Gerdes, F. Kauker, and C. Köberle. 2003. Arctic Warming: Evolution and Spreading of the 1990s Warm Event in the Nordic Seas and the Arctic Ocean. *Journal of Geophysical Research* 108(C2):3034.

Kato, H. 1982. Food Habits of Largha Seal Pups in the Pack Ice Area. Scientific Report No. 34. Tokyo, Japan: Whales Research Institute, pp. 123-136.

Kelly, B.P. 1988. Ringed Seal. *In:* Selected Marine Mammals of Alaska: Species Accounts with Research and Management Recommendations, J.W. Lentfer, ed. Washington, DC: Marine Mammal Commission, pp. 57-77.

Kelly, B.P. 2005. Correction Factor for Ringed Seal Surveys in Alaska, 32 pp.

Kertell, K. 1991. Disappearance of the Steller's Eider from the Yukon-Kuskokwim Delta, Alaska. *Arctic* 443:177-187.

Khan, R.A. and J. Thulin. 1991. Influence of Pollution on Parasites of Aquatic Animals. *Adv. Parasitol.* 30:201-238.

Kikuchi, T., K. Hatakeyama, and J.H. Morrison. 2004. Distribution of Convective Lower Halocline Water in the Eastern Arctic Ocean. *Journal of Geophysical Research* 109:C12030.

King, J.E. 1983. *Seals of the World,* 2nd ed. London: British Museum of Natural History, 240 pp.

Kinney, P.J., D.K. Button, and D.M. Schell. 1969. Kinetics of Dissipation and Biodegradation of Crude Oil in Alaska's Cook Inlet. *In:* Proceedings of the 1969 Joint Conferences on Prevention and Control of Oil Spills, New York and Washington, DC: American Petroleum Institute, pp. 333-340.

Koons, D.N., R.F. Rockwell, and J.B. Grand. 2006. Population Momentum: Implications for Wildlife Management. *J. Wildlife Management* 70(1):19-26.

Koski, W.R. 2000. Bowheads: Summary. *In:* Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information. Results of Studies Conducted in Year 3, W.J. Richardson and D.H. Thomson, eds. LGL Report TA 2196-5. King City, Ont., Canada: LGL Limited, environmental research associates, pp. 1-4.

Koski, W.R., G.W. Miller, and W.J. Gazey. 2000. Residence Times of Bowhead Whales in the Beaufort Sea and Amundsen Gulf During Summer and Autumn. *In:* Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information. Results of Studies Conducted in Year 3, W.J. Richardson and D.H. Thomson, eds. LGL Report TA- 2196-5. King City, Ont., Canada: LGL Limited, environmental research associates, pp. 1-12.

Koski, W.R., R.A. Davis, G.W. Miller, and D.E. Withrow., 1993. Reproduction. *In: The Bowhead Whale,* J.J. Burns, J.J. Montague, and C.J. Cowles, eds. Special Publication of The Society for Marine Mammalogy, 2. Lawrence, KS: The Society for Marine Mammalogy, pp. 239-274.

Koski, W.R., T.A. Thomas, G.W. Miller, R.E. Elliot, R.A. Davis, and W.J. Richardson. 2002. Rates of Movement and Residence Times of Bowhead Whales in the Beaufort Sea and Amundsen Gulf During Summer and Autumn. *In*: Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information, W.J. Richardson and D.H. Thomson, eds. OCS Study, MMS 2002-012. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 41 pp.

Kristof, N.D. 2003. It's Getting Awfully Warm Up Here in Alaska. *International Herald Tribune.* htt://www.iht.com/articles.

Kwok, R. 2004. Annual Cycles of Multiyear Sea Ice Coverage of the Arctic Ocean: 1999–2003. *Journal of Gephysical Research* 109:C11004.

Kwok, R., W. Maslowski, and S.W. Laxon. 2005. On Large Outflows of Arctic Sea Ice Into the Barents Sea. *Geophysical Research Letters* 32:L22503.

Langdon, S. 1995. An Overview of North Slope Society: Past and Future. *In:* Proceedings of the 1995 Synthesis Meeting, Anchorage, Ak., Oct. 23-25, 1995. OCS Study, MMS 95-0065. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Langdon, S. and R. Worl. 1981. Distribution and Exchange of Subsistence Resources in Alaska. Anchorage, AK: USDOI, FWS.

Larned, W.W. and T. Tiplady. 1997. Late Winter Population and Distribution of Spectacled Eiders *(Somateria fischeri)* in the Bering Sea 1995-97. Anchorage, AK: USDOI, FWS, Migratory Bird Management, 6 pp. plus appendices.

Larned, W.W., R. Stehn, and R. Platte. 2005. Eider Breeding Population Survey Arctic Coastal Plain, Alaska 2005. Anchorage, AK: USDOI, FWS, Migratory Bird Management,

Larsen, T. 1985. Polar Bear Denning and Cub Production in Svalbard, Norway. *J. Wildlife Management* 49(2):320-326.

Lee, S.H. and D.M. Schell. 2002. Regional and Seasonal Feeding by Bowhead Whales as Indicated by Stable Isotope Ratios. *In:* Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information, W.J. Richardson and D.H. Thomson, eds. LGL Report TA2196-7. King City, Ont., Canada: LGL Limited, environmental research associates, pp. 1-28.

Lee, S.H., D.M. Schell, T.L. McDonald, and W.J. Richardson. 2005. Regional and Seasonal Feeding by Bowhead Whales *Balaena mysticetus* as Indicated by Stable Isotope Rations. *Mar. Ecol. Prog. Ser. (2005)* 285:271-287.

Lentfer, J. 1975. Polar Bear Denning on Drifting Sea Ice. *Journal of Mammalogy* 56(3):716-718.

Lentfer, J.W. and R.J. Hensel. 1980. Alaskan Polar Bear Denning. *In:* Bears - Their Biology and Management: A Selection of Papers and Discussion from the Fourth Conference on Bear Research, C.J. Martinka and K.J. McArthur, eds. Kalispell, Mont.,Feb. 1977. Tonto Basin, AZ: Bear Biology Association.

LGL Ltd. 2005. Environmental Assessment of a Marine Geophysical Survey by the Coast Guard Cutter *Healy* across the Atlantic Ocean. LGL Report 4122-1. King City, Ont., Canada: LGL Ltd.

Lindsay, R.W. and J. Zhang. 2005. The Thinning of Arctic Sea Ice 1998-2003: Have We Passed a Tipping Point. *Journal of Climate* 18:4879-4894.

Ljungblad, D.K., S.E. Moore, and D.R. Van Schoik. 1984. Aerial Surveys of Endangered Whales in the Northern Bering, Eastern Chukchi and Alaskan Beaufort Seas, 1983: With a Five Year Review, 1979-1983. NOSC Technical Report 955. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 357 pp.

Ljungblad, D.K., S.E. Moore, J.T. Clarke, and J.C. Bennett. 1986. Aerial Surveys of Endangered Whales in the Northern Bering, Eastern Chukchi, and Alaskan Beaufort Seas, 1985: With a Seven Year Review, 1979-85. OCS Study, MMS 86-0002. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 142 pp.

Ljungblad, D.K., S.E. Moore, J.T. Clarke, and J.C. Bennett. 1987. Distribution, Abundance, Behavior, and Bioacoustics of Endangered Whales in the Western Beaufort and Northeastern Chukchi Seas, 1979-86. OCS Study, MMS 87-0039. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 187 pp.

Loeng, H. 2005. Marine Systems. *In*: Arctic Climate Impact Assessment: Scientific Report, ACIA. Cambridge University Press, pp. 454-538.

Lowry, L.F. 1984. The Spotted Seal (*Phoca jargha). In*: Marine Mammals, Species Accounts, J. Burns, ed. Wildlife Technical Bulletin No. 7. Fairbanks, AK: State of Alaska, Dept. of Fish and Game.

Lowry, L.F. and K.J. Frost. 1984. Foods and Feeding of Bowhead Whales in Western and Northern Alaska. Scientific Reports of the Whales Research Institute 35 1-16. Tokyo, Japan: Whales Research Institute.

Lowry, L.F. and G. Sheffield. 2002. Stomach Contents of Bowhead Whales Harvested in the Alaskan Beaufort Sea. *In:* Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information, LGL and Greeneridge, eds. 28 pp. LGL Report TA 2196-6. King City, Ont., Canada: LGL Ecological Research Associates, Inc.

Lowry, L.F., G. Sheffield, and J.C. George. 2004. Bowhead Whale Feeding in the Alaskan Beaufort Sea, Based on Stomach Contents Analyses. *J. Cetacean Res. Manage.* 63:223.

Lydersen, C. and M.O. Hammill. 1993. Diving in Ringed Seal (*Phoca hispida*) Pups during the Nursing Period. *Canadian Journal Zoology* 71:991-996.

Lynch, A.H., E.N. Cassano, J.J. Cassano, and L.R. Lestak. 2003. Case Studies of High Wind Events in Barrow, Alaska: Climatological Context and Development Processes. *Monthly Weather Review* 131(4):719–732.

MacKenzie, K., H.H. Williams, B. Williams, A.H. McVicar, and R. Siddall. 1995. Parasites as Indicators of Water Quality and the Potential Use of Helminth Transmission in Marine Pollution Studies. *Adv. Parasitol.* 35:85-144.

Maki, A.W., E.J. Brannon, L.G. Gillbertson, L.L. Moulton, and J.R. Skalski. 1995. An Assessment of Oil Spill Effects on Pink Salmon Population Following the *Exxon Valdez* Oil Spill-Part 2: Adults and Escapement. *In*: *Exxon Valdez* Oil Spill Fate and Effects in Alaskan Waters, P.G. Wells, J.N. Butler, and J.S. Hughes, eds. Philadelphia, PA: American Society for Testing and Materials, pp. 585-625.

Malins, D.C. 1977. Biotransformation of Petroleum Hydrocarbons in Marine Organisms Indigenous to the Arctic and Subarctic. *In:* Fate and Effects of Petroleum Hydrocarbons, in Marine Ecosystems and Organisms, Proceedings of a Symposium, D.A. Wolfe, ed. Seattle, Wash., Nov. 10-12, 1976. Sponsored by USDOC, NOAA, and USEPA. New York: Pergamon Press.

Mallek, E J. and C.P. Dau. 2005. Aerial Survey of Emperor Geese and Other Waterbirds in Southwestern Alaska, Fall 2005. Anchorage, AK: USDOI, FWS, Migratory Bird Management.

Mallek, E.J., R. Platte, and R. Stehn. 2005. Aerial Breeding Pair Surveys of the Arctic Coastal Plain of Alaska - 2004. Unpublished report. Fairbanks, AK: USDOI, FWS.

Martin, D. 1992. Response of Migrating Adult Pink Salmon to a Simulated Oil Spill. *In:* MMS, Alaska OCS Region, Fourth Information Transfer Meeting, Anchorage, Ak., Jan. 28-30, 1992. Anchorage, AK: USDOI, MMS, Alaska OCS Region, pp. 131-138.

Maslanki, J.A., M.C. Serreze, and R.G. Barry. 1996. Recent Decreases in Arctic Summer Ice cover and Linkages to Atmospheric Circulation Anomalies. *Geophysical Research Letters* 23(13):1677-1680.

Mate, B.R., G.K. Krutzikowsky, and M.H. Winsor. 2000. Satellite-Monitored Movements of Radio-Tagged Bowhead Whales in the Beaufort and Chukchi Seas During the Late-Summer Feeding Season and Fall Migration. *Canadian Journal of Zoology* 78:1168-1181.

McCaffrey, B.J., R.E. Gill, D.R. Ruthrauff, and C.M. Handel. 2006. Bar-Tailed Godwits Staging in Western Alaska: Evidence of Steep Population Decline. Abstract. *In*: Shorebird Science in the Western Hemisphere, Boulder, Colo., Feb. 27-Mar. 2, 2006. Boulder, Co: University of Colorado.

McLaughlin, F.A., E.C. Carmack, R.W. MacDonald, and J.K.B. Bishop. 1996. Physical and Geotechnical Properties Across the Atlantic/Pacific Water Mass Boundary in the Southern Canadian Basin. *Journal of Geophysical Research* 101:1183-1197.

McLaughlin, F.A., E.C. Carmack, R.W. Macdonald, H. Melling, J.H. Swift, P.A. Wheeler, B.F. Sherr, and E.B. Sherr. 2004. The Joint Roles of Pacific and Atlantic-Origin Waters in the Canada Basin 1997-1998. *Deep Sea Research* 51:107-128.

McLeod, C.D. et al. 2005. Climate Change and the Cetacean Community of North-West Scotland. *Biological Conservation* 124:271-482.

Mecklenburg, C.W., D.L. Stein, B.A. Sheiko, N.V. Chernova, and T.A. Mecklenburg. RUSALCA 2004: Fishes of the Northern Bering Sea and Chukchi Sea: Summary. Kotor, Serbia and Montenegro.

Melling, H., D. Riedel, and Z. Gedalof. 2005. Trends in the Draft and Extent of Seasonal Pack Ice, Canadian Beaufort Sea. *Geophysical Research Letters* 32:L24501.

Mel'nikov, V.V. 2000. Humpback Whales *Megaptera novaeangliae* off Chukchi Peninsula. *Oceonology* 40(6):844-849.

Mel'nikov, V.V., M.A. Zelensky, and L.I. Ainana. 1997. Observations on Distribution and Migration of Bowhead Whales (*Balaena mysticetus*) in the Bering and Chukchi Seas. Scientific Report of the International Whaling Commission 50. Cambridge, UK: IWC.

Mel'nikov, V.V., D.I. Litovka, I.A. Zagrebin, G.M. Zelensky, and L.I. Ainana. 2004. Shore-Based Counts of Bowhead Whales along the Chukotka Peninsula in May and June 1999-2001. *Arctic* 57(3):290-298.

Miller, G.W., R.E. Elliott, and W.J. Richardson. 1996. Marine Mammal Distribution, Numbers and Movements. *In:* Northstar Marine Mammal Monitoring Program, 1995: Baseline Surveys and Retrospective Analyses of Marine Mammal and Ambient Noise Data from the Central Alaskan Beaufort Sea. LGL Report TA 2101-2. King City, Ont., Canada: LGL Ecological Research Associates, Inc., pp 3-72.

Miller, G.W., R.E. Elliott, and W.J. Richardson. 1998. Whales. *In*: Marine Mammal and Acoustical Monitoring of BP Exploration (Alaska)'s Open-Water Seismic Program in the Alaskan Beaufort Sea, 1997, LGL and Greeneridge, eds. LGL Report TA 2150-3. King City, Ont., Canada: LGL Ecological Research Associates, Inc., 124 pp.

Miller, G.W., R.E. Elliott, W.R. Koski, and W.J. Richardson. 1997. Whales. *In:* Northstar Marine Mammal Monitoring Program, 1996: Marine Mammal and Acoustical Monitoring of a Seismic Program in the Alaskan Beaufort Sea, LGL and Greeneridge, eds. LGL Report TA 2121-2. King City, Ont., Canada: LGL Ecological Research Associates, Inc., 115 pp.

Miller, G.W., R.E. Elliott, W.R. Koski, V.D. Moulton, and W.J. Richardson. 1999. Whales. *In:* Marine Mammal and Acoustical Monitoring of Western Geophysical's Open-Water Seismic Program in the Alaskan Beaufort Sea, 1998, LGL and Greeneridge, eds. LGL Report TA 2230-3. King City, Ont., Canada: LGL Ecological Research Associates, Inc., 109 pp.

Miller, G.W., R.A. Davis, V.D. Moulton, A. Serrano, and M. Holst. 2002. Integration of Monitoring Results, 2001. *In*: Marine Mammal and Acoustical Monitoring of Anderson Exploration Limited's Open-Water Seismic Program in the Southeastern Beaufort Sea, 2001. LGL Report TA 2618-1. King City, Ont., Canada: LGL Ecological Research Associates, Inc., 207 pp.

Miller, S., S. Schliebe, and K. Proffitt. 2006. Demographics and Behavior of Polar Bears Feeding on Bowhead Whale Carcasses at Barter and Cross Islands, Alaska. OCS Study MMS 2006-14. Anchorage, AK: USDOI, FWS, p. 29.

Milne, A.R. and J.H. Ganton. 1964. Ambient Noise Under Arctic-Sea Ice. *J. Acoust. Soc. Am.* 36(5):855-863.

Mobley, C.M., J.C. Haggarty, C.J. Utermohle, M. Eldridge, R.E. Reanier, A. Crowell, B.A. Ream, D.R. Yeaner, J.M. Erlandson, P.E. Buck, W.B. Workman, and K.W. Workman. 1990. The 1989 *Exxon Valdez* Cultural Resource Program. Anchorage, AK: Exxon Shipping Company and Exxon Company, USA, 300 pp.

Moles, A. and B.L. Norcross. 1998. Effects of Oil-Laden Sediments on Growth and Health of Juvenile Flatfishes. *Can. J. Fish. Aquat. Sci.* 55:605-610.

Moles, A. and T.L. Wade. 2001. Parasitism and Phagocytic Function among Sand Lance *Ammodytes hexapterus* Pallas Exposed to Crude Oil-Laden Sediments. *Bull. Environ. Contam. Toxicol.* 66:528-535.

Moles, A., S.D. Rice, and B.L. Norcross. 1994. Non-Avoidance of Hydrocarbon Laden Sediments by Juvenile Flatfishes. *Netherlands J. Sea Research* 32(3/4):361-367.

Monnett, C. and S.D. Treacy. 2005. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 2002-2004. OCS Study, MMS 2005-037. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Monnett, C. and J.S. Gleason. 2006. Observations of Mortality with Extended Open-Water Swimming by Polar Bears in the Alaskan Beaufort Sea. *Polar Biology.*

Moore, S.E. 1992. Summer Records of Bowhead Whales in the Northeastern Chukchi Sea. *Arctic* 45(4):398-400.

Moore, S.E. 2000. Variability of Cetacean Distribution and Habitat Selection in the Alaskan Arctic, Autumn 1982-91. *Arctic* 53(4):448-460.

Moore, S.E. and J.T. Clarke. 1990. Distribution, Abundance and Behavior of Endangered Whales in the Alaskan Chukchi and Western Beaufort Seas, 1989. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Moore, S.E. and R.R. Reeves., 1993. Distribution and Movement. *In: The Bowhead Whale Book*, J.J. Burns, J.J. Montague, and C.J. Cowles, eds. Special Publication of The Society for Marine

Mammalogy, 2. Lawrence, KS: The Society for Marine Mammalogy, pp. 313-386.

Moore S.E. and D.P. DeMaster. 1997. Cetacean Habitats in the Alaskan Arctic. *Journal of Northwest Atlantic Fishery Science* 22:55-69.

Moore, S.E. and D.P. DeMaster. 2000. North Pacific Right Whale and Bowhead Whale Habitat Study: R/V *Alpha Helix* and CCG *Laurier* Cruises, July 1999, A.L. Lopez and D.P. DeMaster, eds. Silver Spring, MD: NMFS, Office of Protected Resources.

Moore, S.E., J.T. Clarke, and D.K. Ljungblad. 1986. A Comparison of Gray Whale (*Eschrichtius robustus*) and Bowhead Whale (*Balaena mysticetus*) Distribution, Abundance, Habitat Preference and Behavior in the Northeastern Chukchi Sea, 1982-1984. Report of the International Whaling Commission 36. Cambridge UK: IWC, pp. 273-279.

Moore, S.E., D.P. DeMaster, and P.K. Dayton. 2000. Cetacean Habitat Selection in the Alaskan Arctic during Summer and Autumn. *Arctic* 53(4):432-447.

Moore S.E., J.M. Grebmeier, and J.R. Davies. 2003. Gray Whale Distribution Relative to Forage Haitat in the Northern Bering Sea: Curren Conditions and Retrospective Summary. *Canadian Journal Zoology* 81:734-742.

Moore, S.E., J.C. George, K.O. Coyle, and T.J. Weingartner. 1995. Bowhead Whales Along the Chukotka Coast in Autumn. *Arctic* 48(2):155-160.

Moore, S.E., K.M. Stafford, D.K. Mellinger, and J.A. Hildebrand. 2006. Listening for Large Whales in the Offshore Waters of Alaska. *BioScience* 56:49-55.

Morrison, J., M. Steel, and R. Andersen. 1998. Hydrography of the Upper Arctic Ocean Measured from the Nuclear Submarine *USS Pargo*. *Deep-Sea Research* I 451:15-38.

Morrow, J.E. 1980. *The Freshwater Fishes of Alaska*. Anchorage, AK: Alaska Northwest Publishing Co., 248 pp.

Moulton, L.L., M.H. Fawcett, and T.A. Carpenter. 1985. Fish. *In:* Lisburne Development Environmental Studies: 1984. Final Report. Anchorage, AK: ARCO Alaska, Inc.

Muir D.C.G., E.W. Born, K. Koczansky, and G.A. Stern. 2000. Temporal and Spatial Trends of Persistent Organochlorines in Greenland Walrus (*Odobenus rosmarus rosmarus*). *The Science of the Total Environment* 245:73-86.

Munkittrick, K.R. and D.G. Dixon. 1989. A Holistic Approach to Ecosystem Health Assessment using Fish Population Characteristics. *Hydrobiologia* 188/189:123-135.

Murphy, M.L., R.A. Heintz, J.W. Short, M.L. Larsen, and S.D. Rice. 1999. Recovery of Pink Salmon Spawning Areas after the *Exxon Valdez* Oil Spill. *Transactions of the American Fisheries Society* 128:909-919.

Nageak, B.P. 1998. Letter dated Mar. 12, 1998, from B.P. Nageak, Mayor, North Slope Borough, to B. Babbitt, Secretary of the Interior; subject: comments on the NPR-A IAP/EIS.

Naidu, A.S., J.J. Kelley, D. Misra, and M.I. Venkatesan. 2005. Trace Metals and Hydrocarbons in Sediments of the Beaufort Lagoon, Northeast Arctic Alaska, Exposed to Long-term Natural Oil Seepage, Recent Anthropogenic Activities and Pristine Conditions. OCS Study, MMS 2005-041. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 57 pp.

NASA. 2005. Arctic Sea Ice Continues to Decline, Arctic Temperatures Continue to Rise In 2005. http//nass.gov/centers/goddard/news/topstory/2005/arcticice_decline.html

National Assessment Synthesis Team. 2000. Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change. Washington, DC: U.S. Global Change Research Program, 6 pp.

National Research Council. 2003. Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope. www.nap.edu/openbook/0309087376/html/1.html. Washington, DC: The National Academies Press, 465 pp.

Nelson, K. 2003a. Arctic Platform in Place. *Petroleum News Alaska* 814:13.

Nelson, K. 2003b. Building Resource Roads. *Petroleum News Alaska* 817:1.

Nerini, M.K. 1984. A Review of Gray Whale Feeding Ecology. *In: The Gray Whale,* M.L. Jones, S. Leatherwood, and S.L. Swartz, eds. New York: Academic Press, Inc., pp. 423-450.

NewScientist.com. 2002. Climate Change. Poor Nations Demand Climate Compensation. http://www.newscientist.com/hottopics/climate.

NMFS. 1999. Endangeresd Species Act Section 7 Consultation (Biological Opinion) for the Proposed Construction and Operation of the Northstar Oil and Gas Project in the Alaskan Beaufort Sea. Anchorage, AK: NMFS, 75 pp.

NMFS. 2001. Endangered Species Act Section 7 Consultation (Biological Opinion) for the Arctic Region for Federal Oil and Gas Leasing and Exploration in the Alaskan Beaufort Sea. Anchorage, AK: USDOC, NMFS.

NMFS. 2005. Final Environmental Impact Statement for Essential Fish Habitat Identification and Conservation in Alaska. Juneau, AK: National Marine Fisheries Service.

Norcross, B.L., J.E. Hose, M. Frandsen, and E.D. Brown. 1996. Distribution, Abundance, Morphological Condition, and Cytogenetic Abnormalities of Larval Herring in Prince William Sound, Alaska, following the *Exxon Valdez* Oil Spill. *Can. J. Fish. Aquat. Sci.* 53:2376-2387.

Norstrom R.J., M..Simon, D.G.C. Muir, and R.E. Schweinsburg. 1988. Organochlorine Contaminants in Arctic Marine Food Chains: Identification, Geographical Distribution and Temporal Trends in Polar Bears. *Environmental Science and Technology* 22:1063-1071.

North Slope Borough. 1995. North Slope Borough 1993/1994 Economic Profile and Census Report, Vol. VII. Barrow, AK: NSB, Dept. of Planning and Community Services.

North Slope Borough. 1999. Economic Profile and Census Report. Barrow, AK: North Slope Borough.

North Slope Borough, Dept. of Planning and Community Services. 1989. North Slope Borough Census, Preliminary Report on Population and Economy. Draft report. Barrow, AK: NSB, Dept of Planning and Community Services, Warren Matumeak, Director.

North Slope Borough, Science Advisory Committee. 1987. A Review of the Report: Importance of the Eastern Beaufort Sea to Feeding Bowhead Whales, 1985-86. NSB-SAC-OR-109. Barrow, AK: North Slope Borough, 53 pp.

O'Corry-Crowe, G. M., R.S. Suydam, A. Rosenberg, K.J.Frost, and A.E. Dizon. 1997. Phylogeography, Population Structure and Dispersal Patterns of the Beluga Whale *Delphinapterus leucas* in the Western Nearctic Revealed by Mitochondrial DNA. *Molecular Ecology* 6:955-970.

O'Hara, T.M., L. Duffy, E. Follman, K. Kassam, D. Muir, D. Norton, L. Dehn, and P. Hoeskstra. 2002. Human and Chemical Ecology of Arctic Pathways by Marine Pollutants. http://www/cifar.uaf.edu/ari00/o'hara_pathways.html.

Oritsland, N.A., F.R. Engelhardt, R.A. Juck, R.J. Hurst, and P.D. Watts. 1981. Effect of Crude Oil on Polar Bears. Northern Affairs Program, Eastern Arctic Marine Environmental Studies Program Environmental Study No. 24. Ottawa, Ont., Canada: Indian and Northern Affairs Canada, 268 pp.

Ott, R., C. Peterson, and S. Rice. 2001. *Exxon Valdez* Oil Spill (EVOS) Legacy: Shifting Paradigms in Oil Ecotoxicology. http://www.alaskaforum.org.

Overland, J.E. 2006. Arctic Change: Multiple Observations Recent Understanding. *Weather* 61(3):78-83.

Overland, J.E. and M. Wang. 2005. The Arctic Climate Paradox: The Recent Decrease of the Arctic Oscillation. *Geophysical Research Letters* 32:L06701.

Parkinson, C.L., D.J. Cavalieri, P. Gloersen, H.J. Zwally, and J.C. J.C. Cosimo. 1999. Arctic Sea Ice Extents, Areas, and Trends, 1978-1996. *Journal of Geophysical Research* 104C(9):20,837-20,856.

Parson, E.A., L. Carter, P. Anderson, B. Wang, and G. Weller. 2001. Potential Consequences of Climate Variability and Change for Alaska. *In*: The Potential Consequences of Climate Variability and Change: Foundation Report. Cambridge, UK: Cambridge University Press, pp. 283-313.

Patin, S. 1999. *Environmental Impact of the Offshore Oil and Gas Industry.* East Northport, NY: EcoMonitor Publ., 425 pp.

Pearson, W.H., J.R. Skalski, and C.I. Malme. 1992. Effects of Sounds from a Geophysical Survey Device on Behavior of Captive Rockfish (*Sebastes* spp.). *Caan. J.Fish. Aquatic Sci.* 49:1343-1356.

Pearson, W.H., E. Mokness, and J.R. Skalski. 1993. A Field and Laboratory Assessment of Oil Spill Effects on Survival and Reproduction of Pacific Herring following the *Exxon Valdez* Oil Spill. *In:* American Society for Testing and Materials, Third Symposium on Environmental Toxicology and Risk Assessment: Aquatic, Plant and Terrestrial, Atlanta, Ga., Apr. 26-28, 1993. Philadelphia, PA: American Society for Testing and Materials, Unpublished Preprint.

Pedersen, S. and A.Linn, Jr. 2005. Kaktovik 2000-2002 Subsistence Fishery Harvest Assessment. Final Report for FIS Study 01-101. Anchorage, AK: USDOI, FWS, Fisheries Resource Management Program.

Pedersen, S., R.J. Wolfe, C. Scott, and R.A. Caulfield. In prep. Subsistence Economies and Oil Development: Case Studies from Nuiqsut and Kaktovik, Alaska. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Perham, C.J. 2005. Proceedings of the Beaufort Sea Polar Bear Monitoring Workshop.l. Anchorage, AK: USDOI, FWS.

Petersen, M.R. and P.L. Flint. 2002. Population Structure of Pacific Common Eiders Breeding in Alaska. *Condor* 104:780-787.

Petersen, M.R. and D.C. Douglas. 2004. Winter Ecology of Spectacled Eiders: Environmental Characteristics and Population Change. *The Condor* 106:79-94.

Petersen, M.R., W.W. Larned, and D.C. Douglas. 1999. At-Sea Distribution of Spectacled Eiders: A 120-Year-Old Mystery Resolved. *Auk* 1164:1009-1020.

Peterson, C.H., S.D. Rice, J.W. Short, D. Esler, J.L. Bodkin, B.E. Ballachey, and D.B. Irons. 2003. Long-Term Ecosystem Responses to the *Exxon Valdez* Oil Spill. *Science* 302:2082-2086.

Peterson, D.L. and D.R. Johnson, eds. 1995. *Human Ecology and Climate Change: People and Resources in the Far North.* Washington, DC: Taylor & Francis, p. 12.

Petroleum News. 2006. Members of Science Technical Group Named. *Petroleum News*, Feb. 19, 2006.

Phillips, L. 2005. Migration Ecology and Distribution of King Eiders. M.S. Thesis. Fairbanks, AK: University of Alaska, Fairbanks.

Philo, M., J.C. George, R. Suydam, T.F. Albert, and D. Ramey. 1993. Report of Field Activities of the Spring 1992 Census of Bowhead Whales, *Balaena mysticetus*, off Point Barrow, Alaska with Observations on the Subsistence Hunt of Bowhead Whales 1991 and 1992. Report of the International Whaling Commission 44. Cambridge, UK: IWC, pp. 335-342.

Platte, R.M. and R.A. Stehn. 2005. Abundance and Trend of Waterbirds on Alaska's Yukon-Kuskokwim Delta Coast Based on 1988-2005 Aerial Surveys. Unpublished report. Anchorage, AK: USDOI, FWS, Migratory Bird Management, 39 pp.

Polyakov, V., G.V. Alekseev, L.A. Timokhov, U.S. Bhatt, L. Colony, H.L. Simmons, D. Walsh, J.E. Walsh, and V.F. Zakharov. 2004. Variability of the Intermediate Atlantic Water of the Arctic Ocean over the Last 100 Years. *Journal of Climate* 17(23):4485-4497.

Polyakov, I.V., A. Beszczynska, E.C. Carmack, I.A. Dmitenko, E. Fahrbach, I.E. Frolov, R. Gerdes, E. Hansen, J. Holfort, V.V. Ivanov, M.A. Johnson, M. Karcher, F. Kauker, M. Morison, K.S. Orvik, U. Schauer, H.L. Simmons, O. Skageth, V.T. Sokolov, M. Steele, L.A. Timokhov, D. Walsh, and J.E. Walsh. 2005. One More Step Toward a Warmer Arctic. *Geophysical Research Letters* 32:L17605.

Powell, A.N., A.R. Taylor, and R.B. Lanctot. 2004. Pre-Migratory Movements and Physiology of Shorebirds Staging on Alaska's North Slope. *In*: Annual Report No. 11, Fiscal Year 2004. OCS Study, MMS 2005-055. Anchorage, AK: USDOI, MMS, Alaska OCS Region, pp. 138-149.

Powell, A.N., L. Phillips, E.A. Rexstad, and E.J. Taylor. 2005. Importance of the Alaskan Beaufort Sea to King Eiders (*Somateria spectabilis*. OCS Study, MMS 2005-057. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Proshutinsky, A.Y. and M.A. Johnson. 1997. Two Circulation Regimes of the Wind-Driven Arctic Ocean. *Journal of Geophysical Research* 102C(6):12493-12514.

Proshutinsky, A.Y., M.A. Johnson, J.A. Maslanki, and T.O. Proshutinsky. 2000. Beaufort and Chukchi Sea Seasonal Variability for Two Arctic Climate States. OCS Study, MMS 2000-070. Annual Report No. 7. Fairbanks and Anchorage, AK: University of Alaska Fairbanks, Coastal Marine Institute and USDOI, MMS, Alaska OCS Region.

Quakenbush, L.T. 1988. Spotted Seal. *In: Selected Marine Mammals of Alaska*, J.W. Lentfer, ed. Washington, DC: Marine Mammal Commission, pp. 107-124.

Quakenbush, L.T., R.H. Day, B.A. Anderson, F.A. Pitelka, and B.J. McCaffery. 2002. Historical and Present Breeding Season Distribution of Steller's Eiders in Alaska. *Western Birds* 33:99-120.

Quakenbush, L.T., R. Suydam, T. Obritschkewitsch, and M. Deering. 2004. Breeding Biology of Steller's Eiders (*Polysticta stelleri*) near Barrow, Alaska, 1991-99. *Arctic* 57(2):166-182.

Quinn, T.P. 2005. The Behavior and Ecology of Pacific Salmon and Trout. Bethesda, MD: American Fisheries Society.

Rahn, K.A. 1982. On the Causes, Characteristics and Potential Environmental Effects of Aerosol in the Arctic Atmosphere. *In: The Arctic Ocean: The Hydrographic Environment and the Fate of Pollutants,* L. Ray, ed. New York: John Wiley and Sons, pp. 163-195.

Ramsay, M.A. and I. Stirling. 1988. Reproductive Biology and Ecology of Female Polar Bears (*Ursus maritimus*). *Journal of Zoology* (London) 214:601-634.

Reese, C.S., J.A. Calvin, J.C. George, and R.J. Tarpley. 2001. Estimation of Fetal Growth and Gestation in Bowhead Whales. *Journal of the American Statistical Association* 96(455):915-923.

Reeves R.R., B.S. Stewart, and S. Leatherwood. 1992. *The Sierra Club Handbook of Seals and Sirenians.* Hong Kong: Dai Nippon Printing Co. Ltd.

Rice, D.W. and A.A. Wolman. 1971. *In*: The Life History and Ecology of the Gray Whale (*Eschrichtius robustus*). Special Publication No. 3. Seattle, WA: The American Society of Mammalogists, 142 pp.

Rice, S.D., S. Korn, and J.F. Karinen. 1981. Lethal and Sublethal Effects on Selected Alaskan Marine Species After Acute and Long-Term Exposure to Oil and Oil Components. Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the year ending March 1981, Vol. IV: Effects of Contaminants. Boulder, CO and Anchorage, AK: USDOC, NOAA and USDOI, BLM, pp. 61-78.

Rice, S.D., J.W. Short, C.C. Brodersen, T.A. Mecklenberg, D.A. Moles, C.J. Misch, D.L. Cheatham, and J.F. Karinen. 1976. Acute Toxicity and Uptake Depuration Studies with Cook Inlet Crude Oil, Prudhoe Bay Crude Oil, No. 2 Fuel Oil, and Several Subarctic Marine Organisms. NWAFC Processed Report. Auke Bay, AK: USDOC, NOAA, NMFS, NWAFC, Auke Bay Fisheries Laboratory, 98 pp.

Rice, S.D., J.W. Short, R.A. Heintz, M.G. Carls, and A. Moles., 2000. Life History Consequences of Oil Pollution in Fish Natal Habitat. *In*: *Energy 2000: The Beginning of a New Millennium,* P. Catania, ed. Lancaster, UK: Technomic Publishing Co., pp. 1210-1215.

Richardson, W.J., ed. 1987. Importance of the Eastern Alaskan Beaufort Sea to Feeding Bowhead Whales 1985-86. OCS Study, MMS 87-0037. Reston, VA: USDOI, MMS, 547 pp.

Richardson, W.J., ed. 2000. Marine Mammal and Acoustical Monitoring of Western Geophysical's Open-Water Seismic Program in the Alaskan Beaufort Sea, 1999. LGL Report TA-2313-4. King City, Ont., Canada: LGL Ltd., Environmental Research Associates, 155 pp.

Richardson, W.J. and D.H. Thomson. 2002. Email dated Apr. 25, 2002, to S. Treacy, USDOI, MMS, Alaska OCS Region; subject: bowhead whale feeding study.

Richardson, W.J. and M.T. Williams, eds. 2003. Monitoring of Industrial Sounds, Seals, and Bowhead Whales near BP's Northstar Oil Development, Alaskan Beaufort Sea, 1999-2002. Anchorage, AK: BPXA and USDOC, NMFS.

Richardson, W.J. and M.T. Williams, eds. 2004. Monitoring of Industrial Sounds, Seals, and Bowhead Whales near BP's Northstar Oil Development, Alaskan Beaufort Sea, 1999-2003. Annual and Comprehensive Report. LGL Report TA 4001. Anchorage, AK: BPXA.

Richardson, W.J., C.R. Greene, C.I. Malme, D.H. Thomson, S.E. Moore, and B. Wursig. 1991. Effects of Noise on Marine Mammals. OCS Study, MMS 90-0093. Herndon, VA: USDOI, MMS, Atlantic OCS Region, 462 pp.

Richardson, W.J., Jr. C.R. Greene, C.I. Malme, and D.H. Thomson., 1995. Man-Made Noise. *In: Marine Mammals and Noise.* San Diego, CA: Academic Press, Inc., pp. 1-576.

Ritchie, R.J., P. Lovely, and M.J. Knoche. 2002. Aerial Surveys for Nesting and Brood-Rearing Brant and Snow Geese, Barrow to Fish Creek Delta, Alaska, 2001. Final Report. Fairbanks, AK: ABR, Inc.

Rosing-Asvid, A. 2006. The Influence of Climate Variability on Polar Bear (*Ursus maritimus*) and Ringed Seal (*Pusa hispida*) Population Dynamics. *Canadian Journal of Zoology* 84:357-364.

Rothrock, D.A., Y. Yu, and G.A. Maykut. 1999. Thinning of the Arctic Sea-Ice Cover. *Geophysical Research Letters* 2623:3469-3472.

Rugh, D.J.K., W. Shelden, and D.E. Withrow. 1997. Spotted Seals, *Phoca largha*, in Alaska. *Marine Fisheries Review* 59(1):1-18.

Rugh, D.J.K., M.M. Muto, S.E. Moore, and D.P. DeMaster. 1999. Status Review of the Eastern North Pacific Stock of Gray Whales. Seattle, WA: USDOC, NOAA, MNFS, Marine Mammal Lab, 96 pp.

Russell, R., ed. 2005. Interactions Between Migrating Birds and Offshore Oil and Gas Platforms in the Northern Gulf of Mexico. OCS Study, MMS 2005-009. New Orleans, LA: USDOI, MMS, Gulf of Mexico Region, 348 pp.

Schell, D.M. 1999a. Habitat Usage as Indicated by Stable Isotope Ratios. *In:* Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information, W.J. Richardson and D.H. Thomson, eds. LGL Report TA 2196-2 . Herndon, VA: USDOI, MMS, pp. 179-192.

Schell, D.M. 1999b. North Pacific and Bering Sea Carrying Capacity: A Hindcast and a Look at Changes Ahead. *In:* Alaska OCS Region Seventh Information Transfer Meeting Proceedings. OCS Study, MMS 99-0022. Anchorage, AK: USDOI, MMS, pp. 34.

Schell, D.M. and S.M. Saupe. 1993. Feeding and Growth as Indicated by Stable Isotopes. *In: The Bowhead Whale Book,* J.J. Burns, J.J Montague, and C.J. Cowles, eds. Special Publication of The Society for Marine Mammalogy, 2. Lawrence, KS: The Society for Marine Mammalogy, 491-509 pp.

Schell, D.M., S.M. Saupe, and N. Haubenstock. 1987. Bowhead Whale Feeding: Allocation of Regional Habitat Importance Based on Stable Isotope Abundances. *In:* Importance of the Eastern Alaskan Beaufort Sea to Feeding Bowhead Whales 1985-86, W.J. Richardson, ed. OCS Study, MMS 87-0037. Reston, VA: USDOI, MMS, pp. 369-415.

Schliebe, S., T.J. Evans, S. Miller, C.J. Perham, J.M. Wilder, and L.J. Lierheimer. 2005. Polar Bear Management in Alaska, 2000-2004. E:\Jim\Literature\Ursids\Polar Bears\USGS_FWS Reports. Anchorage, AK: USDOI, FWS, 25 pp.

Schmidt, D.R., R.O. McMillan, and B.J. Gallaway. 1983. Nearshore Fish Survey in the Western Beaufort Sea: Harrison Bay to Elson Lagoon. OCS Study, MMS 89-0071. Anchorage, AK: USDOC, NOAA, and USDOI, MMS, pp. 491-552.

Serreze, M.C., J.A. Maslanki, T.A. Scambos, F. Fetterer, J. Stroeve, K. Knowles, C. Fowler, S. Drobot, R.G. Barry, and T.M. Haran. 2003. A Record Minimum Arctic Sea Ice Extent and Area in 2002 . *Geophysical Research Letters* 303:10-1.

Shaughnessy, P.D. and F.H. Fay. 1977. A Review of the Taxonomy and Nomenclature of North Pacific Harbor Seals. *J. Zool.* (London) 182:385-419.

Shelden, K.E.W. and D.J. Rugh. 1995. The Bowhead Whale, *Balaena mysticetus*: Its Historic and Current Status. *Marine Fisheries Review* 57(3-4):20.

Shelden, K.E.W. and D.J. Rugh. 2002. The Bowhead Whale, *Balaena mysticetus*: Its Historic and Current Status. NOAA website: http://nmml.afsc.noaa.gov/CetaceanAssessment/bowhead/bmsos.htm, 21 pp.

Shimida, K., F. McLaughlin, E. Carmack, A. Proshutinsky, S. Nishino, and M. Itoh. 2004. Penetration of the 1990's Warm Temperature Anomaly of Atlantic Water in the Canada Basin. *Geophysical Research Letters* 31:L20301.

Shimada, K., T. Kamoshida, M. Itoh, S. Nishino, E. Carmack, F. McLaughlin, S. Zimmerman, and A. Proshutinsky. 2006. Pacific Ocean Inflow: Influence on Catastrophic Reduction of Sea Ice Cover in the Arctic Ocean. *Geophysical Research Letters* 33:L08605.

Short, J.W., S.D. Rice, R. Heintz, M.G. Carls, and A. Moles. 2003. Long-Term Effects of Crude Oil on Developing Fish: Lessons from the *Exxon Valdez* Oil Spill. *Energy Sources* 25(6):7750-1-9.

Simpkins, M.A., L.M. Hiruki-Raring, G. Sheffield, J.M. Grebmeier, and J.L. Bengtson. 2003. Habitat Selection by Ice-Associated Pinnipeds near St. Lawerence Island, Alaska in March 2001. *Polar Biology* 26:577-586.

Smith, A.E. and M.R.J. Hill. 1996. Polar Bear, *Ursus maritimus*, Depredation of Canada Goose, *Branta canadensis*, Nests. *Canadian Field-Naturalist* 110 :339-340.

Smith, T.G. 1985. Polar Bears, *Ursus maritimus*, as Predators of Belugas, *Delphinapterus leucas*. *Canadian Field-Naturalist* 99:71-75.

Smith, T.G. 1987. The Ringed Seal, *Phoca hispida*, of the Canadian Western Arctic. *Can. Bull. Fish Aquat. Sci.* 216:81.

Smith, T.G. and J. Stirling. 1975. The Breeding Habitat of the Ringed Seal (*Phoca hispida*): The Birth Lair and Associated Structures. *Canadian Journal of Zoology* 53:1297-1305.

Smith, T.G. and L.A. Harwood. 2001. Observations of Neonate Ringed seals, *Phoca hispida*, After Early Break-Up of the Sea Ice in Prince Albert Sound, Northwest Territories, Canada, Spring 1998. *Polar Biology* 24:215-219.

Smith, T.G., M.O. Hammill, and G. Taugbol. 1991. A Review of the Development Behavioural and Physiological Adaptations of the Ringed Seal, P*hoca hispida*, to Life in the Arctic Winter. *Arctic* 442:124-131.

St. Aubin, D.J., 1990a. Physiologic and Toxic Effects on Pinnipeds. Chapter 4. *In: Sea Mammals and Oil: Confronting the Risks,* J.R. Geraci and D.J. St Aubin, eds. San Diego, CA: Academic Press, Inc., and Harcourt Brace Jovanovich, 282 pp.

St. Aubin, D.J., 1990b. Physiologic and Toxic Effects on Polar Bears. Chapter 10. *In: Sea Mammals and Oil: Confronting the Risks,* J.R. G eraci and D.J. St Aubin, eds. San Diego, CA: Academic Press, Inc., and Harcourt Brace Jovanovich, 282 pp.

Stang, P.R. and J.C. George. 2003. Letter dated Aug. 27, 2003, from P.R. Stang, Regional Supervisor, Leasing and Environment, MMS Alaska OCS Region and J.C. George, Wildlife Biologist, North Slope Borough Dept. of Wildlife Management to NSB Mayor Ahmaogak; subject: response to Mayor's letter on coordination and cooperation with the North Slope Borough.

Stapleton, R. 2005. North Slope Borough Mayoral Election Heats Up. *Alaska Journal of Commerce* http://www/alaskajournal.com/cgi-bin/printme.pl

Starr, S.J., M.N. Kuwada, and L.L. Trasky. 1981. Recommendations for Minimizing the Impacts of Hydrocarbon Development on the Fish, Wildlife, and Aquatic Plant Resources of the Northern Bering Sea and Norton Sound. Anchorage, AK: State of Alaska, Dept. of Fish and Game, Habitat Div., 525 pp.

State of Alaska, Dept. of Community and Economic Development. 2005. Community Database Online. www.dced.state.ak.us/dca/commdb/CF_COMDB.htm: State of Alaska, DCED.

State of Alaska, Dept. of Natural Resources. 1997. Oil and Gas Lease Sale 86, Central Beaufort Sea: Final Finding of the Director. Anchorage, AK: State of Alaska, DNR.

Steele, M., J. Morison, W. Ermold, I. Rigor, M. Ortmeyer, and K. Shimada. 2004. Circulation of Summer Pacific Halocline Water in the Arctic Ocean. *Journal of Geophysical Research* 109:C02027.

Stehn, R. and R. Platte. 2000. Exposure of Birds to Assumed Oil Spills at the Liberty Project. Final report. Anchorage, AK: USDOI, FWS.

Stehn, R.A., C.P. Dau, B. Conant, and W.I. Butler, Jr. 1993. Decline of Spectacled Eiders Nesting in Western Alaska. *Arctic* 46:264-277.

Steinhauer, M.S. and P.D. Boehm. 1992. The Composition and Distribution of Saturated and Aromatic Hydrocarbons in Nearshore Sediments, River Sediments, and Coastal Peat of the Alaskan Beaufort Sea: Implications for Detecting Anthropogenic Hydrocarbon Inputs. *Marine Environmental Research* 33:223-253.

Stephenson, S.A. 2006. A Review of the Occurrence of Pacific Salmon (*Oncorhynchus* spp.) in the Canadian Western Arctic. *Arctic* 591:37-46.

Stern, G.A. and R.W. MacDonald. 2005. Biographic Provinces of Total and Methyl Mercury in Zooplankton and Fish from the Beaufort and Chukchi Seas: Results from the SHEBA Drift. *Environ. Sci. Technol.* 39:4707-4713.

Stirling, I. 1997. The Importance of Polynyas, Ice Edges, and Leads to Marine Mammals and Birds. *Journal of Marine Systems* 10:9-21.

Stirling, I. 2002. Polar Bear and Seals in the Eastern Beaufort Sea and Amundsen Gulf: A Synthesis of Population Trends and Ecological Relationships over Three Decades. *Arctic* 55(Suppl. 1):59-76.

Stirling, I. and E.H. McEwan. 1975. The Caloric Value of Whole Ringed Seals (*Phoca hispida*) in Relation to Polar Bear (*Ursus maritimus*) Ecology and Hunting Behavior. *Can. J. Fish. Aquat. Sci.* 538:1021-1027.

Stirling I. and N.A. Oritsland. 1995. Relationships Between Estimates of Ringed Seal (*Phoca hispida*) and Polar Bear (*Ursus maritimus*) Populations in the Canadian Arctic. *Canadian Journal of Fisheries and Aquatic Sciences* 52:2594-2612.

Stirling, I. and T. Smith. 2004. Implications of Warm Temperatures and Unusual Rain Event for Survival of Ringed Seals on the Coast of Southeastern Baffin Island. *Arctic* 571:59-67.

Stirling, I., D. Andriashek, and P. Latour. 1975. Distribution and Abundance of Polar Bears in the Eastern Beaufort Sea. Beaufort Sea Technical Report No. 2. Edmonton, Alb., Canada: Canadian Wildlife Service, 59 pp.

Stirling, I., N.J. Lunn, and J. Iacozza. 1999. Long-Term Trends in the Population Ecology of Polar Bears in Western Hudson Bay in Relation to Climate Change. *Arctic* 523:294-306.

Stirling, I., M.C.S. Kingsley, and W. Calvert. 1981. The Distribution and Abundance of Ringed and Bearded Seals in the Eastern Beaufort Sea, 1974-1979. Edmonton, Alb., Canada: Dome Petroleum Limited, ESSO Resources Canada Limited and the Department of Indian and Northern Affairs, 70 pp.

Stirling, I., N.J. Lunn, J. Iacozza, C. Elliot, and M. Obbard. 2004. Polar Bear Distribution and Abundance on the Southwestern Hudson Bay Coast during Open Water Season, in Relation to Population Trends and Annual Ice Patterns. *Arctic* 57:15-26.

Stroeve, J.C. and M. C. Serreze, F. Fetterer T. Arbetter W. Meier J. Maslanik and K. Knowles. 2005. Tracking the Arctic's Shrinking Ice Cover: Another Extreme September Minimum in 2004. Geophysical Research Letters 32:L04501.

Sutton, A. 2006. State Senate Votes to Reallocate NPR-A Grants. *Petroleum News*, Feb. 26, 2006.

Suydam R.S., L.F. Lowry, K.J. Frost, G.M. O'Corry-Crowe, and D. Pikok, Jr. 2001. Satellite Tracking of Eastern Chukchi Sea Beluga Whales into the Arctic Ocean. *Arctic* 543:237-243.

Swartz, S.L. and M.L. Jones. 1981. Demographic Studies and Habitat Assessment of Gray Whales, *Eschrichtius robustus*, in laguna San Ignacio, Baha California, Mexico. MMC Report MMC-78/03. Washington, DC: Marine Mammal Commission, 34 pp.

Swift, J.H., E.P. Jones, K. Aagaard, E.C. Carmack, M. Hingston, F.A. MacDonald, F.A. McLaughlin, and R.B. Perkin. 1998. Waters of the Makarov and Canadian Basin. *Deep Sea Research* 44:1502-1529.

Taylor, A., R.B. Lanctot, A.N. Powell, and T. Williams. 2006. Should I Stay or Should I Go Now: The Importance of Staging Sites to Shorebirds on Alaska's North Slope. Abstract. *In*: Shorebird Science in the Western Hemisphere, Boulder, Colo., Feb. 27-Mar. 2, 2006. Boulder, CO: University of Colorado.

Taylor, M.K., D.P. DeMaster, F.L. Bunnell, and R.E. Schweinsburg. 1987. Modeling the Sustainable Harvest of Female Polar Bears. *Journal of Wildlife Management* 51:811-820.

Teal, J.M. and R.W. Howarth. 1984. Oil Spill Studies: A Review of Ecological Effects. *Environmental Management* 81:27-44.

Thomson, D.H. and W.J. Richardson. 1987. Integration. *In:* Importance of the Eastern Alaskan Beaufort Sea to Feeding Bowhead Whales, 1985-86, W.J. Richardson, ed. OCS Study, MMS 87-0037. Reston, VA: USDOI, MMS, pp. 449-511.

Thomson, D.H., W.R. Koski, and W.J. Richardson. 2002. Integration and Conclusions. *In*: Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information, W.J. Richardson, and D.H. Thomson, eds. LGL Report TA2196-7. King City, Ont., Canada: LGL Limited, environmental research associates, pp. 1-35.

Tolstoy, M.J., B. Diebold, S.C. Webb, D.R. Bohnenstiehl, E. Chapp, R.C. Holmes, and M. Rawson. 2004. Broadband Calibration of the R/V *Ewing* Seismic Sources. *Geophysical Research Letters* 31:L14310.

Tomilin, A.G. 1957. Mammals of the USSR and Adjacent Countries., Israel Program for Scientific Translation, Translator. Cetacea (in Russian), Vol. 9. Moscow: Isdatel'stvo Akademii Nauk SSR, 717 pp.

Townsend, C.H. 1935. The Distribution of Certain Whales as Shown by Logbook Records of Certain Whaleships. *Zoologica* 11-50 plus 4 charts.

Treacy, S.D. 1988. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 1987. OCS Study, MMS 89-0030. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 141 pp.

Treacy, S.D. 1989. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 1988. OCS Study, MMS 89-0033. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 101 pp.

Treacy, S.D. 1990. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 1989. OCS Study, MMS 90-0047. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 104 pp.

Treacy, S.D. 1991. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 1990. OCS Study, MMS 91-0055. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 107 pp.

Treacy, S.D. 1992. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 1991. OCS Study, MMS 92-0017. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 92 pp.

Treacy, S.D. 1993. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 1992. OCS Study, MMS 93-0023. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 135 pp.

Treacy, S.D. 1994. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 1993. OCS Study, MMS 94-0032. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 78 pp.

Treacy, S.D. 1995. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 1994. OCS Study, MMS 95-0033. Anchorage, AK: USDOI, MMS, Alaska OCS Region, Environmental Studies, 116 pp.

Treacy S.D. 1996. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 1995. OCS Study, MMS 96-0006. Anchorage, AK: USDOI, MMS, Alaska OCS Region, Environmental Studies Program, 70 pp.

Treacy, S.D. 1997. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 1996. OCS Study, MMS 97-0016. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 115 pp.

Treacy, S.D. 1998. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 1997. OCS Study, MMS 98-0059. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 143 pp.

Treacy, S.D. 2000. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 1998-1999. OCS Study, MMS 2000-066. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 135 pp.

Treacy, S.D. 2001. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 2000. OCS Study, MMS 2001-014. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 111 pp.

Treacy, S.D. 2002. Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 2001. OCS Study, MMS 2002-061. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 117 pp.

Trefry, J.H., R.D. Rember, R.P. Trocline, and M. Savoie. 2005. Sources, Concentrations and Dispersion Pathways for Suspended Sediment in the Coastal Beaufort Sea - Executive Summary. OCS Study, MMS 2005-051. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Tynan C.T. and D.P. DeMaster. 1997. Observations and Predictions of Arctic Climate Change: Potential Effects on Marine Mammals. *Arctic* 504:308-322.

UNEP. 2006. Vital Arctic Graphics: People and Global Heritage on Our Last Wild Shores. http://www/vitalgraphics.net/arctic.cfm:

U.S. Army Corps of Engineers. 1999. Final Environmental Impact Statement. Beaufort Sea Oil and Gas Development/Northstar Project. Anchorage, AK: U.S. Army Corps of Engineers, 7 Vols.

U.S. Dept. of Energy. 1997. Sale of Naval Petroleum Reserve No. 1 (Elk Hills) Kern County, California. Draft Supplemental EIS for the Sale of NPR-1. DOE/SEIS/PEIR-0158S. Washington, DC: USDOE.

USDOC, Bureau of the Census. 1991. 1990 Census of Population, Vol. 1: Pacific Division. 1990 Census of Population and Housing, Summary Tape File 1A. Issued September 1991. CD90-1A-9-1. Washington, DC: USDOC, Bureau of the Census, Data User Div.

USDOC, Bureau of the Census. 2000. htpp://quickfacts.census.gov/qfd/index.html. Washington, DC: USDOC, Bureau of the Census.

USDOC, Bureau of the Census. 2001. htpp://quickfacts.census.gov/qfd/index.html. Washington, DC: USDOC, Bureau of the Census.

USDOC, Bureau of the Census. 2002. Area Boroughs, Cities and U.S. Census Places. Washington, DC: USDOC, Bureau of the Census.

USDOC, NOAA and North Slope Borough. .2005. Workshop of Bowhead Whale Stock Structure Studies in the Bering-Chukchi-Beaufort Seas: 2005-2006, Seattle, Wash., Feb. 23-24, 2005. Seattle, WA and Barrow, AK: USDOC, NOAA, AFSC/NMML and NSB.

USDOI, BLM. 2004. Alpine Satellite Development Plan Draft Environmental Impact Statement. BLM/AK/PL-04/007+3130+931. Anchorage, AK: USDOI, BLM, 2 Vols.

USDOI, BLM. 2005. Northeast NPR-A final Amended Integrated Activity Plan/EIS. Anchorage, AK: USDOI, BLM.

USDOI, BLM and MMS. 2003. Northwest National Petroleum Reserve-Alaska Final Integrated Activity Plan/Environmental Impact Statement. BLM/AK/PL-04/002+3130+930. Anchorage, AK: USDOI, BLM and MMS, 3 Vols.

USDOI, FWS. 1996. Spectacled Eider Recovery Plan. Anchorage, AK: USDOI, FWS, 157 pp.

USDOI, FWS. 1999. Population Status and Trends of Sea Ducks in Alaska. Final report. Fairbanks, AK: USDOI, FWS, Migratory Bird Management, 137 pp.

USDOI, FWS. 2002a. Steller's Eider Recovery Plan. Fairbanks, AK: USDOI, FWS, 25 pp.

USDOI, FWS. 2002b. Birds of Conservation Concern 2002. Arlington, VA: USDOI, FWS.

USDOI, FWS. 2003. Chukchi Sea Polar Bears: A Population Concern. Anchorage, AK: USDOI, FWS, 25 pp.

USDOI, FWS. 2004. Letter dated Aug. 23, 2004, from S. Lewis, Field Supervisor, Fish and Wildlife Field Office to S. Childs, Project Leader, USDOI, BLM; subject: draft Amended Integrated Activity Plan/Environmental Impact Statement for the Northeast Planning Area of the National Petroleum Reserve-Alaska.

USDOI, FWS. 2005. Beringian Seabird Colony Catalog: Computer Database. Anchorage, AK: USDOI, FWS, Migratory Bird Management.

USDOI, FWS. 2005. Final Biological Opinion to Bureau of Land Management for the Proposed Amendment to the Integrated Activity Plan/Environmental Impact Statement for the Northeast National Petroleum Reserve-Alaska, dated January 12, 2005. Fairbanks, AK: USDOI, FWS.

USDOI, FWS. 2006. Letter received Jan. 5, 2006 from USDOI, FWS; subject: species list for Chukchi and Beaufort Seas.

USDOI, FWS. 2006b. Draft Study Plan for Estimating the Size of the Pacific Walrus Population. Marine Mammals Management, USDOI, FWS, Alaska Science Center; U. S. Geological Survey; GiproRybFlot, Research and Engineering Institute for the Development and Operation of Fisheries; Chukot TINRO, Pacific Research Institute of Fisheries and Oceanography, 43 pp.

USDOI, MMS. 1986. Public Hearings, Official Transcript of Proceedings, Oil and Gas Lease Sale 97, Nuiqsut, Ak., Dec. 12, 1986. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

USDOI. MMS. 1987. Chukchi Sea Oil and Gas Lease Sale 109 Final Environmental Impact Statement. OCS EIS/EA, MMS 87-011. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

USDOI, MMS. 1995. Nuiqsut Public Hearing, Official Transcript of Proceedings, Beaufort Sea Sale 144 Draft EIS. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

USDOI, MMS. 1996. Beaufort Sea Planning Area Oil and Gas Lease Sale 144 Final Environmental Impact Statement. OCS EIS/EA, MMS 96-0012. 2 Volumes. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

USDOI, MMS. 2002. Liberty Development and Production Plan, Final Environmental Impact Statement. OCS EIS/EA, MMS 2002-019. Anchorage, AK: USDOI, MMS, Alaska OCS Region, 3 Vols.

USDOI, MMS. 2003. Beaufort Sea Planning Area Sales 186, 195, and 202 Oil and Gas Lease Sale Final EIS. OCS EIS/EA, MMS 2003-001. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

USDOI, MMS. 2004. Proposed Oil and Gas Lease Sale 195 Beaufort Sea Planning Area Environmental Assessment. OCS EIS/EA, MMS 2004-028. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

USDOI, MMS. 2005a. Tenth Information Transfer Meeting, Barrow Information Update Meeting, Anchorage, Ak., Mar. 143-16, 2005. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

USDOI, MMS. 2005b. MMS Chukchi Sea Science Update, Anchorage, Ak., Oct. 31, 2005. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

USDOI, MMS. 2006a. Draft Programmatic Environmental Assessment Arctic Ocean Outer Continental Shelf Seismic Surveys - 2006. OCS EIS/EA, MMS 2006-019. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

USDOI, MMS. 2006b. Biological Evaluation of the Potential Effects of Oil and Gas Leasing and Exploration in the Alaska OCS Beaufort Sea and Chukchi Sea Planning Areas on Endangered Bowhead Whales *(Balaena mysticetus)*, Fin Whales (*Balaenoptera physalus)*, and Humpback Whales (*Megaptera novaeangliae)*. L.M. Rotterman, Prep. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

USEPA. 2006. Environmental Justice. http://www.epa.gov/compliance/environmentaljustice/: Environmental Protection Agency.

Varanasi, U. and D.C. Malins. 1977. Metabolism of Petroleum Hydrocarbons: Accumulation and Biotransformation in Marine Organisms. *In: Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms,* D.C. Malins, ed. Vol. II. New York: Academic Press, Inc., pp. 175-270.

Vinnikov, K.Y., A. Robock, R.J. Stouffer, J.E. Walsh, C.L. Parkinson, D.J. Cavalieri, J.F.B. Mitchell, D. Garrett, and V.F. Zakharov. 1999. Global Warming and Northern Hemisphere Sea Ice Extent. *Science* 2895468:1934-1937.

Wartzok, D., W.A. Watkins, B. Wursig, and C.I. Malme. 1989. Movements and Behavior of Bowhead Whales in Response to Repeated Exposures to Noises Associated with Industrial Activities in the Beaufort Sea. Anchorage, AK: AMOCO Production Company.

Wartzok, D., W.A. Watkins, B. Wursig, R. Maiefski, K. Fristrup, and B. Kelley. 1990. Radio Tracking Studies of the Behavior and Movements of Bowhead Whales in the Beaufort Sea, Fall 1988-1989. *In:* Fifth Conference on the Biology of the Bowhead Whale *Balaena Mysticetus*. Anchorage, AK: AMOCO Production Company.

Weber, D.D., D.J. Maynard, W.D. Gronlund, and V. Konchin. 1981. Avoidance Reactions of Migrating Adult Salmon to Petroleum Hydrocarbons. *Can. J. Fish. Aquat. Sci.* 38:779-781.

Weller, G., P. Anderson, and G. Nelson. 1998. Alaska and the Bering Sea Regional Workshop on Climate Change Impacts. http://www.gcrio.org/ASPEN/science/EOC97/eoc97session2/Weller.html. Aspen, CO: Aspen Global Change Institute.

Weller, D.W., B. Wursig, A.L. Bradford, A.M. Burdin, S.A. Blokhin, H. Minakuchi, and R.L. Brownell. 1999. Gray Whales (*Eschrichtius robustus*) off Sakhalin Island, Russia: Seasonal and Annual Patterns of Occurrence. *Marine Mammal Science* 153:4.

Whissom, D.A. and J.Y. Takekawa. 1998. Testing the Effectiveness of an Aquatic Hazing Device on Waterbirds in San Francisco Bay, California. Unpubl. report. Davis, CA: University of California, Davis, 41 pp.

Wiedmer, M., M.J. Fink, J.J. Stegeman, R. Smolowitz: G.D. Marty, and D.E. Hinton. 1996. Cytochrome P-450 Induction and Histopathology in Preemergent Pink Salmon from Oiled Locations of Western Prince William Sound after the *Exxon Valdez* Oil Spill. *Amer. Fish. Soc. Symp.* 19:509-517.

Wiig, O., V. Berg, I. Gjertz, D.J. Seagars, and J.U. Skaare. 2000. Use of Skin Biopsies for Assessing Levels of Organochlorines in Walruses (*Odobenus rosmarus*). *Polar Biology* 23:272-278.

Wisniewski, J. 2005. Subsistence and Sociocultural Resources. In: MMS Chukchi Sea Science Update, Anchorage, Ak., Oct. 31, 2005. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Woodgate R.A., K. Aagaard, R.D. Muench, J. Gunn, G. Bjork, B. Rudels, A.T. Roach, and U. Schauer. 2001. The Arctic Ocean Boundary Current along the Eurasian Slope and the Adjacent Lomonosov Ridge: Water Mass Properties, Transports and Transformations from Moored Instruments . *Deep Sea Research* Part I: Oceanographic Research Papers 488:1757-1792.

Würsig, B., E.M. Dorsey, M.A. Fraker, R.S. Payne, and W.J. Richardson. 1985. Behavior of Bowhead Whales (*Balaena mysticetus*) Summering in the Beaufort Sea: A Description. *Fisheries Bulletin* 833:357-377.

Wursig, B., E.M. Dorsey, W.J. Richardson, and R.S. Wells. 1989. Feeding, Aerial and Play Behaviour of the Bowhead Whale, *Balaena mysticetus*, Summering in the Beaufort Sea. *Aquatic Mammals* 151:27-37.

Zeh, J.E. and A.E. Punt. 2004. Updated 1978-2001 Abundance Estimates and their Correlation for the Bering-Chukchi-Beaufort Sea Stock of Bowhead Whales. Unpublished Report.

Zeh, J.E., A.E. Raftery, and A.A. Schaffner. 1995. Revised Estimates of Bowhead Population Size and Rate of Increase. Report of the International Whaling Commission 46 SC/47/AS10. Cambridge, UK: IWC, pp. 670-696.

Zeh, J.E., C.W. Clark, J.C. George, D. Withrow, G.M. Carroll, and W.R. Koski., 1993. Current Population Size and Dynamics. *In*: The Bowhead Whale, J.J. Burns, J.J. Montague, and C.J. Cowles, eds. Special Publication of the Society for Marine Mammalogy 2. Lawrence, KS: The Society for Marine Mammalogy, pp. 409-489.

Zeh, J.E., D. Poole, G. Miller, W.R. Koski, L. Baraff, and D. Rugh. 2002. Survival of Bowhead Whales, *Balaena mysticetus,* Estimated from 1981-1998 Photoidentification Data. *Biometrics* 584:832-840.

Zhang, J., D.A. Rothrock, and M. Steele. 1998. Warming of the Arctic Ocean by a Strengthened Atlantic Inflow: Model Results. *Geophysical Research Letters* 25:1745-1748.

Table III-1
Possible Sales-Related Activities, Updated with the Percentage of Leases Issued during Sales 186 and 195

	Near/Shallow Zone		Midrange/Medium Zone		Far/Deepwater Zone		Total Projects
	Leasing and Exploration	Development Projects	Leasing and Exploration	Development Projects	Leasing and Exploration	Development Projects	
Sale 186	70% (25%)	2	20% (16%)	1	10% (59%)	0	3
Sale 195	50%	1	30%	1	20%	0	2
Sale 202	40%	0	30%	0	30%	1	1
Total	53%	3	27%	2	20%	1	6

Table III-2
Representative Development Schedule for Sale 202

Year	Exploration Wells	Delineation Wells	Exploration Drilling Rigs	Production Platforms	Production Wells	Injection Wells	Production Drilling Rigs	Offshore Pipelines (miles)	New Shorebases	Field #1 Oil Production (MMbbl)	Cumulative Oil Production (MMbbl)
2003	—	—	—	—	—	—	—	—	—	—	—
2004	—	—	—	—	—	—	—	—	—	—	—
2005	—	—	—	—	—	—	—	—	—	—	—
2006	—	—	—	—	—	—	—	—	—	—	—
2007	—	—	—	—	—	—	—	—	—	—	—
2008	—	—	—	—	—	—	—	—	—	—	—
2009	—	—	—	—	—	—	—	—	—	—	—
2010	1	—	1	—	—	—	—	—	—	—	—
2011	—	—	—	—	—	—	—	—	—	—	—
2012	1	—	1	—	—	—	—	—	—	—	—
2013	1	1	1	—	—	—	—	—	—	—	—
2014		2	1	—	—	—	—	—	—	—	—
2015	1	2	1	—	—	—	—	—	1	—	—
2016	—	—	—	—	—	—	—	—	—	—	—
2017	1	—	1	—	—	—	—	—	—	—	—
2018	1	—	1	1	4	4	1	35	—	—	—
2019	—	—	—	1	14	8	2	—	—	30.8	30.8
2020	—	—	—	—	20	8	2	—	—	38.6	69.4
2021	—	—	—	—	20	9	2	—	—	38.6	108.0
2022	—	—	—	—	10	5	1	—	—	38.6	146.6
2023	—	—	—	—	—	—	—	—	—	38.6	185.2
2024	—	—	—	—	—	—	—	—	—	38.6	223.8
2025	—	—	—	—	—	—	—	—	—	34.0	257.8
2026	—	—	—	—	—	—	—	—	—	29.9	287.7
2027	—	—	—	—	—	—	—	—	—	26.3	314.0
2028	—	—	—	—	—	—	—	—	—	23.2	337.2
2029	—	—	—	—	—	—	—	—	—	20.4	357.6
2030	—	—	—	—	—	—	—	—	—	17.9	375.5
2031	—	—	—	—	—	—	—	—	—	15.8	391.3
2032	—	—	—	—	—	—	—	—	—	13.9	405.2
2033	—	—	—	—	—	—	—	—	—	12.2	417.4
2034	—	—	—	—	—	—	—	—	—	10.8	428.2
2035	—	—	—	—	—	—	—	—	—	9.5	437.7
2036	—	—	—	—	—	—	—	—	—	8.3	446.0
2037	—	—	—	—	—	—	—	—	—	7.3	453.3
2038	—	—	—	—	—	—	—	—	—	6.7	460.0
2039	—	—	—	—	—	—	—	—	—	—	—
—	6	5	—	2	68	34	—	35	1	460.0	—

.

Table III-3
Summary of Basic Exploration Development, Production, and Transportation Assumptions for All Alternatives[1]

Phase Activity/Event	Sale 186 Timeframe and Assumed Number	Sale 195 Timeframe and Assumed Number	Sale 202 Timeframe and Assumed Number
Exploration			
Well Drilling	**2004-2010**	**2007-2014**	**2010-2018**
Exploration Rigs	1-2	1-2	1
Exploration Wells	6	6	6
Delineation Wells	6	6	5
Drilling Discharges			
Drilling Muds (short tons, dry)	1,040	1,040	935
Cuttings (short tons, dry)	6,300	6,300	5,775
Support Activities (Annual)			
Helicopter Flights [2]	155	155	140
Supply-Boat Trips	0-14	0-14	0-7
Surface Transport[3]	see footnote [3]	see footnote [3]	see footnote [3]
Shallow-Hazards Site Surveys			
Blocks Surveyed	6	6	6
Total Area Covered[4] (mi^2)	54	54	54
Development And Production			
Platforms Installed	**2009-2014**	**2012-2017**	**2018-2019**
—	3	3	2
Production and Injection Service Wells	2009-2016	2012-2019	2018-2022
—	102	102	102
Number of Fields	3	2	1
Oil Production	2010-2033	2013-2036	2019-2038
Total (MMbbl)	460	460	460
Peak Yearly (MMbbl)	2016	2018	2020-2024
—	43.8	39.4	38.6
Monthly Support Activities			
Helicopter Flights: Construction[5]	300-600	300-600	600
Helicopter Flights: Development	28-56	28-56	56
Helicopter Flights: Production	12-28	12-28	28
Supply-Boat Trips	see Footnote[6]	see Footnote[6]	see Footnote[6]
Surface Transport[7]			
Construction Phase	12,000	6,000	N/A
Operation Phase	30-60	25-30	N/A
Drilling Discharges			
Drilling Muds (short tons, dry)	13,300	13,300	13,300
Cuttings (short tons, dry)	84,000	84,000	84,000
Shallow-Hazard Surveys [8]	—	—	—
Total Area Covered (mi^2)	105	105	70
Transportation			
Oil Pipeline Installation	2008-2014	2012-2016	2018
Offshore Length (miles)	40	40	35
Onshore Length (miles)	—	—	85[9]
Tanker Transport			
Peak Years of Production	2016	2018	2020-2024
Number of Loadings [10]	63	56	55
Oil Spills	**See Table IV.A-5**		

Most of the information in this table may be found in Appendix B of this EIS.
[1] The figures presented in this table forecast activities beginning and ending in discrete time periods. This is done for the purpose of a consistent and methodical and based on a situational average. [2] Helicopter trips are expressed in an annual average. [3] Surface transport estimates vary according to the location of the exploration platform. Even if the exploration platform is located in the landfast-ice zone, surface transport volumes by ice road to the drill site will be less than half on the volumes forecast for a postfind construction phase. During the operations phase, vehicle trips could decline 100-200 per season. [4]An OCS block is 8.9 mi^2. [5]Helicopter support trips will decline sharply after the construction phase; however, Far Zone structures will consistently require greater levels of air support. [6] Marine support traffic for the construction phase will vary from 150-200 per open-water season for each nearshore platform to as many as 250 for structures beyond the landfast-ice zone. Vessel traffic will decline into the production phase, with 4-6 trips per season for nearshore platforms. [7]Based on a 90 day ice-road season. Estimates for Sale 195 are based on one platform in landfast ice zone. The platform assumed for Sale 202 will be beyond the landfast-ice zone. [8] The MMS's site-clearance seismic-survey requirements specify a minimum of 35 mi^2 (92 km^2) for a block-wide survey. Three days would be required for a 54 mi^2 site-clearance survey and 7 days for a 105 mi^2 survey. [9]The portrayed mileage is a rough estimate of a pipeline route from Smith Bay to the Kuparuk mainline. Should the pipeline landfall occur at Point Thomson, it would connect at the Badami field 12 miles distance. [10]Assuming 100,000 deadweight-ton tankers. Please note that all vessel trips inherently round trips. In reality, these periods may blend with and overlap each other. Estimates made in this table are speculative.

Table III-4. Projected number of State of Alaska and OCS seismic surveys in the Beaufort and Chukchi seas between 2006 and 2010.

Year	2D/3D Seismic Surveys		High-resolution, Site-clearance Surveys		State Water Surveys 2D/3D Seismic Surveys[3]	
	Beaufort [1] Sea	Chukchi[2] Sea	Beaufort Sea	Chukchi Sea	Beaufort Sea	Chukchi Sea
2006	4	4	3	0	1	0
2007	3	4	2	0	0	0
2008	3	4	2	0	1	0
2009	2	3	2	1	0	0
2010	2	3	2	1	1	0

Source: USDOI, MMS, 2006a

1. Survey is likely to be a streamer type, but ocean-bottom-cable surveys also could occur.
2. Because of deeper water, surveys are more likely to be all streamer type.
3. No high-resolution site-clearance surveys are predicted to occur.

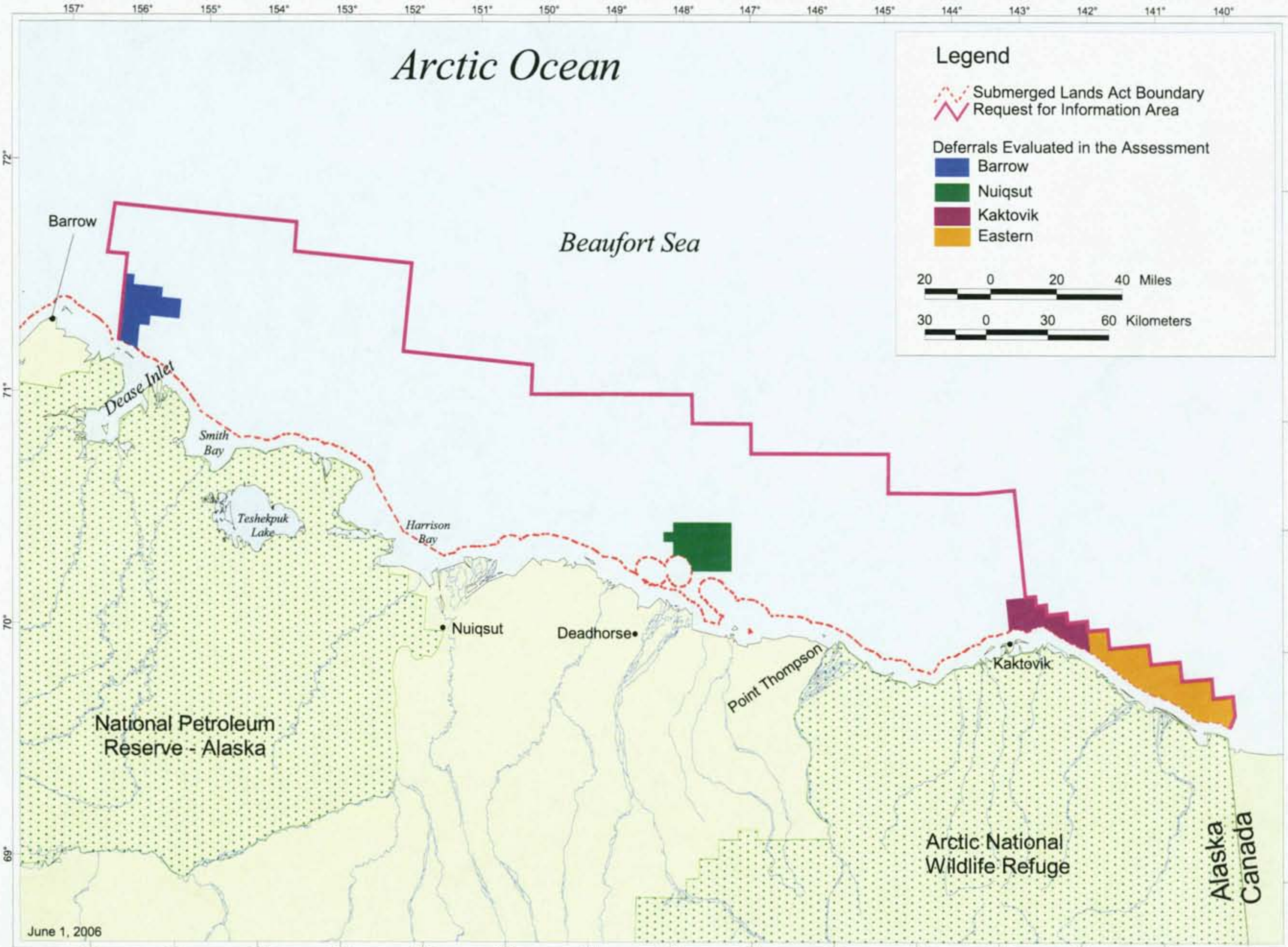
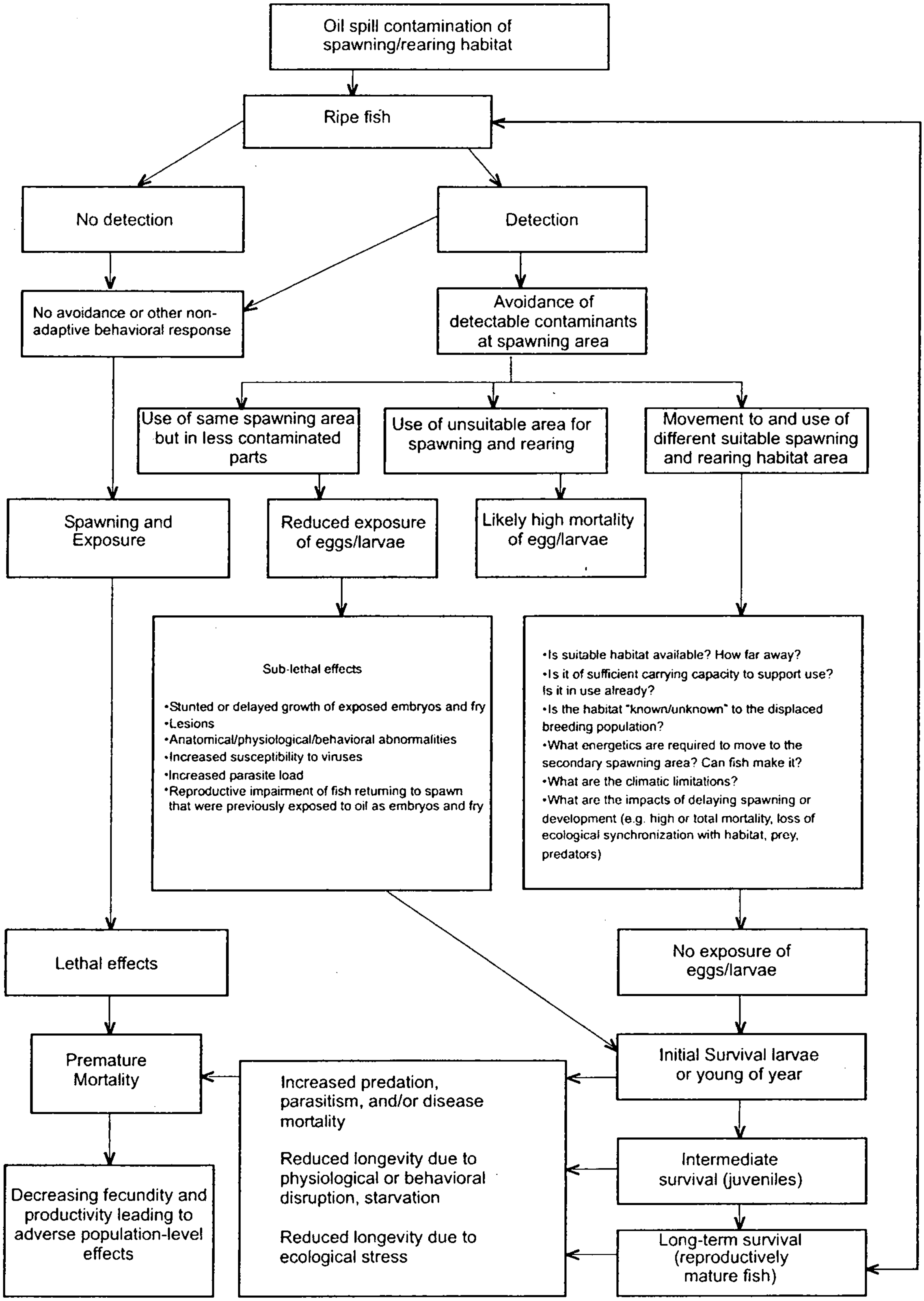


Figure 1. Proposed Action and Alternatives, Proposed Sale 202, March 2007.



Source: USDOI, MMS

Figure 2. Oil Spill Impacts Model for Selected Fishes using Nearshore/Intertidal Substrates as Spawning and/or Rearing Habitats (e.g., pink or chum salmon, Pacific herring, capelin).

Appendix A

LETTERS COMMENTING ON PROPOSED SALE 202

This section contains copies of the following letters:

Alaska Eskimo Whaling Commission letter to MMS, dated December 12, 2005
Alaska Coalition letter to MMS, dated December 12, 2005

Alaska Eskimo Whaling Commission
P.O. Box 570 • Barrow, Alaska 99723
(907) 852-2392 • Fax: (907) 852-2303 • Toll Free: 1-800-478-2392

December 12, 2005

Via Fax 907-334-5242
Paul Stang
Regional Supervisor, Leasing and Environment
Minerals Management Service
3801 Centerpoint Drive, Suite 500
Anchorage, Alaska 99503-5823

RE: Comments on Request for Information and Notice of Intent to Prepare Environmental Assessment for Beaufort Sea Sale 202

Dear Mr. Stang:

The Alaska Eskimo Whaling Commission (AEWC) appreciates the opportunity to submit the enclosed comments on the U.S. Minerals Management Service's (MMS's) request for information for Beaufort Sea Lease Sale 202.

If you have any questions or would like to discuss these matters, please call me at my office.

Sincerely,

Harry Brower Jr.

Harry Brower, Jr.
Chairman

cc: Maggie Ahmaogak, Executive Director
AEWC Commissioners
The Honorable Edward Itta, Mayor, North Slope Borough
John Goll, Director, Alaska Regional Office

COMMENTS OF THE ALASKA ESKIMO WHALING COMMISSION ON THE U.S. MINERALS MANAGEMENT SERVICE'S REQUEST FOR INFORMATION AND NOTICE OF INTENT TO PREPARE AN ENVIRONMENTAL ASSESSMENT FOR BEAUFORT SEA LEASE SALE 202

December 12, 2005

INTRODUCTION

The U.S. Minerals Management Service (MMS) has requested information from the public on proposed Lease Sale 202 in order to "identify impact types and levels that may have changed" since MMS analyzed Lease Sales 186 and 195. The agency will use the information to design the area it will include in Sale 202, and base its environmental assessment (EA) on that lease sale area. 70 FR 62139.

Lease Sale 195 yielded an unprecedented positive response from industry in March of this year. Companies bid on leases in the near, mid and far zones in numbers MMS' analyses of Sales 186 and 195 did not anticipate. Consequently, MMS must analyze the impacts of Sale 202 in light of the intensity of bidding for Sale 195. The agency must prepare for a potentially similar response to Sale 202 by considering stronger lease sale stipulations, expanded whaling deferral areas, and a new cumulative impacts analysis. In addition, MMS must take seriously and respond to the AEWC's request that it develop relevant, appropriate significance thresholds for arctic subsistence communities.

Communities in the Arctic are dealing with a level of offshore and onshore exploration and development that threatens to overwhelm them. The National Environmental Policy Act (NEPA), and Executive Order 12898 on Environmental Justice require that MMS carefully consider and incorporate mitigation measures preferred by those bearing the greatest risk from MMS' activities on the OCS. 42 U.S.C. 4331.

However, MMS has yet to incorporate fully the mitigation measures we have prescribed, namely, deferral areas broad enough to prevent whales from becoming spooked by industrial noise, and a deferral area–of any kind–around Cross Island.

In light of the explosive bidding that took place for Lease Sale 195, MMS must approach its analysis for Lease Sale 202 with a view to strengthening protections for our subsistence communities. This should include the expansion of existing deferral areas around Kaktovik and Barrow, and the implementation of a deferral area around Cross Island in order to protect the whaling village of Nuiqsut.

Further, MMS must abandon its arbitrary significance thresholds and work with our community to develop relevant, realistic and defensible standards of significance for the evaluation of impacts to North Slope subsistence communities. Finally, MMS must conduct a cumulative impacts analysis that incorporates the unexpectedly intense bidding for Sale 195, industry interest and planning revisions for the National Petroleum Reserve-Alaska (NPR-A), and accompanying implications for increased vessel traffic in the Arctic Ocean.

I. **MMS Must Expand Deferral Areas it Set in Sales 186 and 195, and Delineate a Deferral Area Around Cross Island to Protect Nuiqsut Whaling.**

MMS is responsible for managing the OCS in a manner that achieves the "widest range of beneficial uses" of the OCS and "a balance between population and resource use" on the OCS. 43 U.S.C. 1344(a)(1), 42 U.S.C. 4331(b). Even with its arbitrarily low standard of significance, MMS concludes, in its EA for Lease Sale 195, that "potential cumulative effects on subsistence and sociocultural systems would be significant, warrant continued close attention, and effective mitigation measures." Sale 195 EA Section IV.E.2(b)(2), p. 64. To achieve the balance required by the OCSLA, MMS must work with our community to develop mitigation measures that expand current deferrals and that add areas where industrial activities are seasonally restricted to avoid disturbance of migrating bowhead whales and the subsistence hunt.

During scoping for the Multiple Sale Environmental Impact Statement (analyzing Sales 186, 195, and 202), MMS collapsed the whaling captains' recommended deferral areas into patches of ocean that ultimately could provide little protection for our subsistence whaling activities. These activities include areas of pursuit that range well beyond the boundaries of the deferral areas that MMS submitted for analysis in the EIS. As a result, deferral areas included for analysis in Sales 186 and 195 were dramatically smaller than what AEWC would consider minimally necessary to protect the hunt. With the heightened interest in the Arctic Ocean exhibited by the unprecedented response to Lease Sale 195, MMS must reconsider the size of the current deferral areas and must act to protect Cross Island.

MMS did not incorporate a deferral area for Cross Island in either Sale 186 or 195, despite strenuous urging from the AEWC and the North Slope Borough to do so. Instead, in its Final Notice of Sale for Lease Sale 186, MMS applied an "optional" lease sale stipulation that would prohibit permanent facilities from begin sited within ten miles of Cross Island. By the time MMS finalized Lease Sale 195 two years later, the agency had eliminated even the optional stipulation.

Today, Cross Island is almost completely encircled by leased blocks. There is every chance that Sale 202 would entirely enclose the island, making it useless as a staging area for Nuiqsut hunters as vessel traffic and other noise-generating oil and gas operations drive bowhead whales away.

It therefore is incumbent on MMS to provide, in its design and analysis for Lease Sale 202, protection for our human environment, sociocultural systems and subsistence harvest patterns in particular. The most effective and feasible way to do this is to retain and expand current deferral areas around Barrow and Kaktovik, and to develop a deferral area around Cross Island in consultation with the Nuiqsut whaling captains.

II. **It is Crucial That MMS Revise its Current Significance Thresholds to Provide a Realistic Measure of Adverse Impacts to Subsistence and to Enable the Agency to Implement Appropriate Mitigation.**

The extraordinary response to Lease Sale 195 should alert MMS to the trend of ever increasing industrial activity in the Beaufort Sea and underscore the importance of revising its significance thresholds for our subsistence harvest patterns and culture. MMS' current significance thresholds for sociocultural systems and subsistence harvest patterns bear no relation to the real needs of our subsistence arctic community. If MMS does not use relevant criteria to evaluate potential adverse effects, its analysis will fail to reveal impacts to the human environment as NEPA requires. Therefore, MMS must revise the thresholds it has applied in the past to evaluate the impacts of oil and gas development on subsistence resources and uses, working with the AEWC and community leaders to develop criteria for evaluating impacts that reflect the actual needs of the community and that are consistent with federal law.

1. <u>The current significance thresholds are arbitrary and capricious.</u>

In its analysis of Lease Sale 202, MMS must revise its significance thresholds so that they rest on the actual needs of the local community. The current criteria that MMS uses to judge whether a given impact on arctic subsistence culture is "significant" are fundamentally illogical and unrealistic when applied to real life in a subsistence community. The thresholds amount to a results-oriented test of what effects the MMS can identify as significant without hindering development. The agency has set thresholds for judging significance that require an impact to be profoundly disruptive for years before the agency will deem it "significant" for NEPA purposes.[1]

Therefore, when MMS applies these thresholds to determine levels of impacts for subsistence culture, MMS inevitably finds that routine OCS activities will produce only a minor or moderate impact on our community, so long as the effects fall short of multiple years of disturbance--even if the real-world result is hunger and a sense of displacement from tradition and heritage. If these impacts do not last for years, MMS deems the effect insignificant.
MMS continues to conclude that routine program operations will have a "minor to moderate" effect on sociocultural systems, and that environmental justice would only be a concern if onshore infrastructure affected subsistence foods or harvest patterns.[2] This is an irresponsible assessment because it ignores the opportunistic nature of subsistence hunting, which is the principal economic activity of the North Slope Native community. It also devalues the cultural significance of the bowhead subsistence hunt to the Native community.

2. <u>MMS should judge significance of an activity by its potential to cause an unmitigable adverse impact on the availability of bowhead whales for subsistence uses.</u>

MMS can correct its analysis by bringing its significance thresholds into line with the standard articulated by Congress in the Marine Mammal Protection Act 16 U.S.C. §1371 (a)(5)(A &D). Through this standard, Congress prohibits any activity that has the potential to disrupt the behavior of subsistence resources in a way that causes an "unmitigable adverse

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[1] Subsistence Harvest Patterns: One or more important subsistence resources would become unavailable, undesirable for use, or available only in greatly reduced numbers for a period of 1-2 years.

Sociocultural Systems: Chronic disruption of sociocultural systems occurs for a period of 2-5 years, with a tendency toward the displacement of existing social patterns.

Environmental Justice: Any disproportionate, high adverse human health or environmental effects on minority or low-income populations. These would occur if significance thresholds defined above for subsistence harvest patterns and sociocultural systems is reached.

[2] Outer Continental Shelf Oil & Gas Leasing Program: 2002-2007, Final Environmental Impact Statement, Vol 1, p. 4-294, April 2002.

impact on the availability of [a] species or stock for taking for subsistence uses" in a given season. *Id.* Under this analysis, an activity whose impacts have the potential to reduce the availability of a resource below the level necessary to meet subsistence need for the season are allowed only if those impacts can be mitigated so as to preserve availability of the resource at the necessary level.[3]

This threshold depicts honestly the fact that when subsistence resources become unavailable to meet subsistence need, people go hungry. No measure of years should be the benchmark for hunger in Native people.

Whenever the potential exists for the take of subsistence resources to fall below the level required to meet subsistence need for a season, the impacts must be considered to be "significant", and significant impacts must be categorized as "major" in the programmatic analysis. This more realistic approach will provide motivation for the use of mitigation measures that can satisfy the needs of all stakeholders in the Arctic.

III. MMS Must Completely Revamp its Cumulative Effects Analysis to Account for the Increased Industrial Interest in the Beaufort Sea, as Evidenced by the Response to Lease Sale 195.

MMS must revamp its cumulative effects analysis for Sale 202 because the cumulative effects analysis in the multiple sale EIS and the EA for Sale 195 do not account for the dramatic escalation in bidding that accompanied Lease Sale 195 and which is now likely to result from Sale 202. In addition to the response from Sale 195, cumulative adverse effects to subsistence are likely to intensify, given the level of industry interest in NPR-A and the prospect of a re-invigorated Liberty project. Inevitably, vessel traffic in support of onshore activities will only grow heavier.

Although MMS has disclaimed responsibility for vessel traffic associated with onshore resource development, the agency must acknowledge, and include in a revised cumulative effects analysis, that adverse effects from offshore industrial activity occur in concert with vessel traffic supporting onshore activity in a way that could alter the migration path and behavior of bowhead whales so that they effectively become unavailable to our communities for subsistence use.

MMS did not contemplate cumulative effects at the level of intensity that is likely to result from the combination of Sale 195, NPR-A, Liberty, and even state lease sales in the Beaufort Sea. . The NEPA analysis for Lease Sale 202 is a chance for MMS to conduct a thorough, searching analysis of cumulative effects, given existing new information regarding industrial interest in the North Slope, on and offshore, and the likelihood that wide-reaching adverse cumulative effects will alter our subsistence resources and communities unless MMS implements appropriate mitigation measures informed by a thorough cumulative effects analysis.

CONCLUSION

The overwhelming response to Lease Sale 195 constitutes new information upon which MMS

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[3] Our community's subsistence need for bowhead whales has been documented and quantified, and is accepted by the International Whaling Commission as the basis for setting the bowhead whale subsistence quota. *See*, "Quantification of Subsistence and Cultural Need for Bowhead Whales by Alaska Eskimos," Braund, Stephen R., Sam W. Stoker, John A. Kruse, International Whaling Commission document *TC/40/A52*, 1988.

must revise sections of its previous analyses, both in anticipation of an enthusiastic response to Sale 202, and given the recent onslaught of industrial activity on the North Slope, onshore and offshore. Inevitably, the heightened intensity of oil and gas operations will compound adverse impacts to our subsistence bowhead whale hunt and to our way of life.

Accordingly, MMS must consult with the AEWC and individual whaling villages to expand existing deferral areas around Kaktovik and Barrow, and to design a deferral area around Cross Island to protect whaling activities in Nuiqsut. MMS must also revise its significance thresholds to conform with the standard in the Marine Mammal Protection Act prohibiting activity in a single hunting season, that has the potential to disrupt the behavior of subsistence resources in a way that causes an "unmitigable adverse impact on the availability of [a] species or stock for taking for subsistence uses."

Finally, MMS must undertake a new, rigorous cumulative impacts analysis in its environmental review of Lease Sale 202 to account for the trend of dramatically increased industrial activity that the agency failed to anticipate in its earlier analyses. The response to Lease Sale 195 is a harbinger of the level of bidding that is likely to accompany Sale 202. MMS must consider that probability in conjunction with the pace of concurrent development related to NPR-A and the impending revival of the Liberty Project.

ALASKA COALITION * ALASKA WILDERNESS LEAGUE *ARCTIC CONNECTIONS * GWICH'IN STEERING COMMITTEE * NATURAL RESOURCES DEFENSE COUNCIL* SIERRA CLUB * THE WILDERNESS SOCIETY *

December 12, 2005

VIA E-MAIL

Alaska OCS Region
Minerals Management Service
3801 Centerpoint Drive, Suite 500
Anchorage, AK 99503-5823
akrfi@mms.gov

RE: Comments on Request for Information and Notice of Intent to Prepare an Environmental Assessment – Lease Sale 202

Dear Sir/Madame:

Thank you for this opportunity to comment in response to the Minerals Management Service's (MMS) Request for Information and Notice of Intent to Prepare an Environmental Assessment for Lease Sale 2002. 70 Fed. Reg. 62,139 (Oct. 28, 2005). These comments are submitted on behalf of the Alaska Coalition, Alaska Wilderness League, Arctic Connections, Gwich'in Steering Committee, Natural Resources Defense Council, Sierra Club, and The Wilderness Society.

I. COMMENTS IN RESPONSE TO THE REQUEST FOR INFORMATION

We are deeply concerned about the risks posed to sensitive marine and coastal environments from the proposed oil and gas activities on the Outer Continental Shelf (OCS) of the Beaufort Sea. The Beaufort Sea is home to a rich variety of marine life and is adjacent to some of the most important and spectacular terrestrial public resources in the United States. Because of the serious risks to these ecologically important areas and the nearby communities that depend on coastal resources, we believe MMS should not proceed with Lease Sale 202.

The coastal communities along the Beaufort Sea depend on a variety of subsistence food sources, including bowhead whale, seal, polar bear, walrus, grayling, and whitefish. Subsistence use of fish and marine mammals is an established economy of Native coastal communities and is absolutely central to the survival of Alaska's indigenous cultures. Unlike oil and gas resources, the marine resources of the Beaufort OCS can last indefinitely and should therefore not be jeopardized by non-renewable resource development.

Oil and gas activities endanger the fragile marine environment off the coast of Alaska. Marine mammals, seabirds, fish and their habitat, and coastal communities are at risk from potential blowouts and pipeline oil spills. The risks from unprecedented new technology of buried sub-sea oil and gas pipelines raise major questions about development in the Beaufort Sea. We are also concerned about the chronic effects from smaller spills of dozens of toxic substances typical of North Slope oil field operations (not just spills of crude oil or spills greater than 100 bbl) and from disposal of drilling muds and cuttings in the ocean during exploratory drilling. Even small amounts of oil can negatively affect marine life. Oil pollution increases susceptibility to diseases in fish, inhibits phytoplankton productivity, and interferes with reproduction, development, growth, and behavior of many species throughout the food chain. Marine life is also threatened by noise pollution generated by air and vessel traffic, drilling, platform work and seismic testing, the construction of causeways and docks, and the laying of miles of pipelines in or on the seafloor.

The Beaufort Sea is adjacent to two critically important areas: the Arctic National Wildlife Refuge (Arctic Refuge) and the National Petroleum Reserve-Alaska (Reserve). Lease sales offshore from the Arctic Refuge jeopardize the integrity of its wilderness, wildlife and coastal habitats as well as the marine ecosystem itself. Development off the coast of the Arctic Refuge poses risks to the Porcupine Caribou Herd, bowhead whales, fish, and migratory birds which use areas along or near the Arctic Refuge coastline, lagoons, and barrier islands.

Internationally important polar bear habitat is also at risk, both within the Arctic Refuge and off its coast. Protection of polar bears and their habitat is a specified purpose of the Arctic Refuge, which provides the most important denning habitat for polar bears in the United States. Offshore exploration and development would create intense pressure to construct sprawling onshore airports, pipelines, roads, docks, and other support facilities within the Arctic Refuge. Offshore exploration and development would also cause pollution, aircraft and vessel noise and related industrial activity, and potential oil spills would degrade the Refuge and threaten the integrity of this protected conservation unit, even if there is no construction of infrastructure within its boundaries.

The Reserve is an area of international environmental significance. The biological importance of the area off the coast of Dease Inlet and Smith Bay, from Barrow to the Teshekpuk Lake Special Area, has been documented in Audubon Alaska's report reviewing the exceptional ecosystems of the Western Arctic. *See* Alaska's Western Arctic, a summary and synthesis of resources, Audubon Alaska, December 2002, edited by John Schoen and Stanley Senner (hereinafter "Audubon Report"). This region, especially the area north of Teshekpuk Lake, is particularly important to a number of bird species. For example, it includes a high percentage of the Alaskan breeding population of yellow-billed loons, is the center of the breeding distribution for threatened Steller's eiders, and contains high concentrations of nests for the threatened spectacled eiders. *See* Audubon Report Figures II.2-1, IV.5-2, and II.2-4, respectively. The area also includes high breeding densities and highly populated colonies of black brants. *See* Audubon Report Figure II.2-3.

The Dease Inlet and Smith Bay region is important to marine mammals. For example, the offshore area contains a feeding area for bowhead whales during their fall migration and a late summer use area for beluga whales. *See* Audubon Report Figure II.1-13. Onshore, it provides the most consistently used wintering area for the Teshekpuk Lake Caribou Herd and is part of the outer range of the Western Arctic Caribou Herd. *See* Audubon Report figure II.1-1.

Given the importance of the Beaufort Sea and the adjacent areas onshore, we believe MMS should not hold Lease Sale 202.

II. COMMENTS ON THE NOTICE OF INTENT TO PREPARE AN ENVIRONMENTAL ASSESSMENT

A. MMS Should Prepare An Environmental Impact Statement

If MMS decides to proceed with Lease Sale 202, National Environmental Policy Act (NEPA) requires that it prepare an Environmental Impact Statement (EIS).

The Notice of Intent (NOI) for Lease Sale 202 indicates that MMS intends to continue its flawed approach of leasing essentially the entire Beaufort Sea OCS (approximately 9.7 million acres) and, at the same time, refusing to do any site-specific analysis because of the "limited information . . . about where and what leasing, exploration, and development is likely occur." Multi-Sale FEIS at VII-31. NEPA requires MMS to prepare a separate EIS for each lease sale in order to compensate, in part, for the enormous scope of the area at stake and the difficulty of preparing an adequate site-specific assessment of impacts in such a large region.

Further, MMS should prepare a full EIS for Lease Sale 202 because the Multi-Sale FEIS, as we have previously commented, is inadequate in several respects regarding the effects of oil leasing. MMS cannot tier the EA to an inadequate EIS.

The Multi-Sale FEIS failed to consider the effects that seismic surveys have on fish. Recent studies indicate seismic activities related to oil and gas exploration can have substantial impacts on fish, such as harm to fishes' auditory functions. Attached to this comment letter is a list of studies that MMS should consider and discuss in an EIS.

The Multi-Sale FEIS also failed to include an adequate discussion of current and potential cumulative impacts for all offshore industrial activities in the marine environment in Alaska and Canada, and for all industrial activities on land and coastal waters across Alaska's North Slope, particularly in the Reserve. MMS has not adequately considered the cumulative impacts from past, present, and reasonably foreseeable on-shore activities. MMS also has not analyzed the effects of exploration or development activities in the Northwest Reserve or in the areas to be opened by the amendment to the Northeast Plan.

The Multi-Sale FEIS did not consider adequately the cumulative impacts from activities in the Canadian Beaufort Sea. In describing the reasonably foreseeable projects that might contribute to cumulative impacts, the Multi-Sale FEIS did not include Canadian activities. MMS should prepare an EIS that describes the extent of activities in the Canadian Beaufort Sea, past and present, and analyzes the cumulative effects that would result from them.

Finally, MMS has not yet considered sufficiently the effects from global climate change. For example, MMS has not analyze adequately how global climate change will affect the Beaufort Sea area and how those impacts may be compounded by subsequent oil and gas activities, which will be occurring in a changing environment. There is evidence that melting permafrost is causing a massive slump on the seafloor of the Mackenzie shelf that could cause major problems for companies with oil and gas leases in that area. MMS should analyze how these changes will affect oilfield infrastructure and how these impacts will in turn affect Arctic resources. Attached to this comment letter is a list of climate change studies that MMS should consider and discuss in an EIS.

B. New Biological Opinions Are Required

MMS should prepare Biological Evaluations of eiders and bowhead whales for Lease Sale 202 and re-initiate consultation with the United States Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS), respectively. FWS and NMFS should then prepare new biological opinions.

The 2002 Biological Opinion on eiders is incomplete. For example, the cumulative effects analysis ignores onshore and offshore activities by the State of Alaska. Substantial activities have occurred on state lands and waters since the release of the Multi-Sale FEIS. The Endangered Species Act requires that FWS analyze the cumulative impacts from these activities. Accordingly, FWS, in consultation with MMS, should prepare a new biological opinion.

The 2001 Biological Opinion on bowhead whales is outdated. It states that it is based on the "resource estimates and exploration scenario information" from Lease Sale 170. 2001 Arctic Regional Biological Opinion at 4. NMFS should therefore prepare a new biological opinion in consultation with MMS.

Thank you for considering these comments.

Sincerely,

Demian A. Schane

Demian A. Schane
Layla A. Hughes
Earthjustice

ARTICLES ON EFFECTS OF SEISMIC SURVYES NOISE ON FISH

Anon. 1974. BOLT PAR Air Gun. Manual. Bolt Associates, Inc., Norvalk Conn., USA.

Anon. 1981. High Pressure Airgun. Manual. Western Geophysical, Houston, Texas, USA.

Anon. 1989. Sleeve Gun. Manual. Haliburton Geophysical Services, Inc. Houston, Texas, USA.

Anon. 1985. Tillatelse til undersøkelse etter petroleum (Undersøkelsestillatelsen). Oljedirektoratet. S 12-16 i *Fiskerikyndig person ombord i seismisk fartøy.* Fiskeridirektoratet, Bergen, 1992. (Permission for investigation for petroleum. The Norwegian Petroleum Directorate. P 12 - 16 in *Fishery-proficient person aboard seismic vessel.* The Directorate of Fisheries, Bergen, 1992.)

Anon. 1990. Rutiner ved behandling av samfunnsmessige og budsjettmessige sider ved forberedelse og forhandlinger av multilaterale miljøavtaler. Rundskriv med vedlegg (vedtatt av Regjeringen 24.sept 1990) til departementene fra statsministerens kontor av 20. nov. 1990, Oslo, 3 s. (Routines concerning social and budgetary aspects at the preparing and negotiating of multilateral environmental agreements. Circular letter with attachment (passed by the Government on Sept. the 24th 1990) for the Ministries from the Prime Minister's Office of Nov. the 20th 1990. 3 p.)

Anon. 1992. Fiskeriaktivitet i de ulike områdebetegnelser nord for Stad. Fiskeriaktivitet og fiskeriintensive områder i norsk økonomisk sone i Nordsjøen sør for 62° 00′. Fiskeriaktivitet og fiskeriintensive områder i Skagerak. S. 27-43 i *Fiskerikyndig person ombord i seismisk fartøy.* Fiskeridirektoratet, Bergen, 1992. (Fishing activities in different designated areas north of Stad. Fishing activities and fishery-intensive areas in the Norwegian economical zone south of 62° 00′. Fishing activities and fishery-intensive areas in Skagerak. P 27-43 in *Fishery-proficient person aboard seismic vessel.* The Directorate of Fisheries, Bergen, 1992.)

Anon. 1995. Forskrift til lov om petroleumsvirksomhet. Oljedirektoratet, YA-005, Stavanger: 16 s. (Regulations to the Law of Petroleum Activity. The Norwegian Petroleum Directorate, YA-005, Stavanger, 16 p.)

Blaxter, J.H.S., Gray, J.A.B., and Denton, E.J. 1981. Sound and startle response in herring shoals. *J. Mar. Biol. Assoc. UK* 61: 851-869.

Blaxter, J.H.S., and Hoss, D.E. 1981. Startle response in herring: The effect of sound stimulus frequency, size of fish and selective interference with the acoustic-Lateralis system. *J. Mar. Biol. Assoc. UK* 61: 871-879.

Booman, C., Dalen, J., Leivestad, H., Levsen, A., Van der Meeren, T. and Toklum, K. 1996. Effekter av luftkanonskyting på egg, larver og yngel. Undersøkelser ved Havforsk-ningsinstituttet og Zoologisk Laboratorium, Universitetet i Bergen. *Fisken og Havet,* 3 (1996): 83 s. (Effects from airgun shooting on eggs, larvae and fry. Investigations by The Institute of Marine Research and the Laboratory of Zoology, the Bergen University. *The Fish and the Sea,* 3 (1996): 83 p.)

Chapman, C.J. and Hawkins, A.D. 1969. The importance of sound in fish behaviour in relation to capture by trawls. FAO Fisheries Report 62(3): 717-729.

Chapman, C.J. and Hawkins, A.D. 1973. A field study of hearing in cod (Gadus morhua) L.). Journal of Comparative Physiology 85: 147-167.

Dalen, J. 1973. Stimulering av sildestimer. Forsøk i Hopavågen og Imsterfjorden/ Verrafjorden 1973. Rapport for NTNF, NTH nr 73-143-T, Trondheim: 36 s. (Stimulating herring shoals. Experiments in Hopavågen and Imsterfjorden/ Verrafjorden 1973. Report to NTNF, NTH no. 73-143-T, Trondheim: 36 p.)

Dalen, J., and Knutsen, G. M. 1987. Scaring effects in fish and harmful effects on eggs, larvae and fry by offshore seismic explorations. S. 93-102 in MERKLINGER, H.M. red. *Progress in Underwater Acoustics.* Plenum Publishing Corporation.

Engås, A., Løkkeborg, S., Ona, E. and Soldal, A.V. 1996. Effects of seismic shooting on local abundance and catch rates of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*). Canadian Journal of Fisheries and Aquatic Sciences 53(10): 2238-2249.

Fitch, J.E. & Young, P.H. 1948. Use and effect of explosives in California coastal waters. *Calif. Fish Game*, 34, 53-70.

Greene, C.R. 1985. A pilot study of possible effects of marine seismic airgun array operations on rockfish plumes. Prepared for the Seismic Steering Committee by Greeneridge Sciences, Inc., Santa Barbara, California.

Hassel, A., Knutsen, T., Dalen, J., Skaar, K., Løkkeborg, S., Misund, O.A., Østensen, Ø., Fonn, M. and Haugland, E.K. 2004. Influence of seismic shooting on the lesser sandeel (*Ammodytes marinus*). ICES Marine Science Symposia 61: 1165-1173.

Hastings, M. C., Popper, A. N., Finneran, J. J., and Lanford, P. J. 1996. Effect of low frequency underwater sound on hair cells of the inner ear and lateral line of the teleost fish *Astronotus ocellatus*, J. Acoust. Soc. Am. 99: 1759–1766.

Hawkins, A.D. 1981. The hearing abilities of fish. In: W.N. Tavolga, A.N. Popper and P.R. Fay (eds). *Hearing and sound communication*. Springer-Verlag, New York, pp. 109-133.

Holliday, D.V., Pierer, R.E., Clarke, M.E. and Greenlaw, C.F. 1987. Effect of airgun energy releases on the northern anchovy. API Publ. No 4453, American Petr. Inst. Health and Environmental Sciences Dept. Washington, DC.

Holmstrøm, S. 1993. Effekter av luftkanonseismikk på larver og yngel til havs – modellering og simulering. (Effects from offshore airgun seismics on larvae and fry – modelling and simulations). SINTEF Report STF48 A93007, Trondheim, Norway.

Kosheleva, V. 1992. The impact of air guns used in marine seismic explorations on organisms living in the Barents Sea. Contr. Petro Piscis II `92 Conference F-5, Bergen, 6-8 April, 1992: 6 p.

Kostyuchenko, L.P. 1973. Effects of elastic waves generated in marine seismic prospecting of fish eggs in the Black Sea. *Hydrobiological Journal* 9 (5): 45-48.

Kramer, F.S., Peterson, R.A. and Walter, W.C. 1968. *Seismic Energy Sources 1968 Handbook*. United Geophysical Corp., Pasadena, USA.

Løkkeborg, S., and Soldal A.V. 1993. The influence of seismic exploration with air guns on cod (*Gadus morhua*) behaviour and catch rates. ICES mar. Sci. Symp., 196: 62-67.

McCauley, R.D., Fewtrell, J., and Popper, A.N. 2003. High intensity anthropogenic sound damages fish ears. J. Acoust. Soc. Am, 113: 638-642.

McCauley, R. D. *et al.*, 2000. Marine Seismic Surveys: Analysis and Propagation of Air-Gun Signals; and Effects of Air-Gun Exposure on Humpback Whales, Sea Turtles, Fishes and Squid, prepared for the Australian Petroleum Production Exploration Ass'n.

McCauley, R. D. ''Seismic surveys,'' in *Environmental Implications of Offshore Oil and Gas Development in Australia—The Findings of an Independent Scientific Review*, edited by J. M. Swan, J. M. Neff, and P. C. Young, Australian Petroleum Exploration Association, Sydney, pp. 19–122 (1994).

Malme, C.I., Smith , P.W. and Miles, P.R. 1986. Characterization of geophysical acoustic survey sounds. OCS Study MMS-86-0032. Prepared by BBN Laboratories Inc., Cambridge, Mass., for Battelle Memorial Institute under contract No. 14-11-001-30274 to the Department of the Interior, Mineral Management Service, Pacific Outer Continental Shelf Region, Los Angeles, California.

Malme, C.I., P.R. Miles, C.W. Clark, P. Tyak, and J.E. Bird. 1983. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior/Phase II: January 1984 migration. BBN Report 5851, Report from BBN Laboratories Inc., Cambridge, MA for US Minerals Management Service, Anchorage, AK, NTIS PB86-218385.

Matishov, R.D. 1992. The reaction of bottom-fish larvae to airgun pulses in the context of the vulnerable Barents Sea ecosystem. Fisheries of Offshore Petroleum Exploitation 2nd International Conference, Bergen Norway, 6-8 April 1992.

National Research Council. *Marine Mammals and Low Fre-quency Sound: Progress Since 1994.* National Academy, Washington, DC (2000).

Newman, P. 1978. Water gun fills marine seismic gap. The Oil and the Gas Journal, Aug. 1978, pp. 138-150.

O'Hara, J. and J.R. Wilcox. 1990. Avoidance responses of loggerhead turtles, *Caretta caretta*, to low frequency sound. Copeia; (1990) 2:564-567.

Parkes, G., and Hatton, L. *The Marine Seismic Source.* Reidel, Dor-drecht (1986).

Pearson, W.H., Skalski, J.R., Sulkin, S.D., and Malme, C.I. 1994. Effects of Seismic Releases on the Survival and Development of Zoeal Larvae of Dungeness Crab (*Cancer magister*). Mar.Envir. Res. 38: 93-113.

Pearson, W.H., Skalski, J.R. and Malme, C.I. 1992. Effects of sounds from a geophysical survey device on behavior of captive rockfish (*Sebastes* spp). Canadian Journal of Fisheries and Aquatic Sciences 49(7): 1343-1356.

Picket, G.D., D.R. Eaton, R.M.H. Seaby, and G.P Arnold. 1994. Results of bass tagging in Poole Bay during 1992. Laboratory Leaflet Number 74. Ministry of Agriculture, Fisheries and Food Directorate of Fisheries Research, 12 pp.

Platt, C. and Popper, A.N. 1981. Fine structure and function of the ear. *In*: W.N. Tavolga, A.N. Popper and R.R. Fay (eds.), Hearing and sound communication in fishes. Springer Verlag, New York, pp. 3-36.

Popper, A.N. and Carlson, T.J. 1998. Application of sound and other stimuli to control fish behavior. Transactions of the American Fisheries Society 127(5): 673-707.

Popper, A.N., Smith, M.E., Cott, P.A., Hanna, B.W., MacGillivray, A.O., Austin, M.E., and Mann, D.A. 2005. Effects of exposure to seismic airgun use on hearing of three fish species. J. Acoust. Soc. Am. 117 (6): 3958-3971.

Richardson, W.J., Greene, C.R. Jr., Malme, C.I. and Thomson, D.H. 1995. Marine Mammals and Noise. Academic Press, San Diego, 576 pp.

Sand, O. and Karlsen, H.E. 1986. Detection of infrasound by the Atlantic Cod. *J. Exp. Biol.*, 125:197-204.

Santulli, A., Modica, A., Messina, C., Deffa, L., Curatolo, A., Rivas, G. Fabi, G. and D'Amello, V. 1999. Biochemical responses of European sea bass (Dicentrarchus labrax L.) to the stress induced by off shore experimental seismic prospecting. Marine Pollution Bulletin 36(12): 1105-1114.

Skalski, J.R., Pearson, W.H. and Malme, C.I. 1992. Effects of sound from a geophysical survey device on catch-per-unit-effort in a hook-and-line fishery for rockfish

(Sebastes spp.). Canadian Journal of Fisheries and Aquatic Sciences 49(7): 1357-1365.

Sverdrup, A., Kjellsby, E., Krüger, P.G., Fløysand, R., Knudsen, F.R., Enger, P.S., Serck-Hanssen, G. and Helle, K.B. 1994. Effects of experimental seismic shock on vasoactivity of arteries, integrity of the vascular endothelium and on primary stress hormones of the Atlantic salmon. Journal of Fish Biology 45: 973-995.

Sætre, R., and Ona, E. 1996. Seismiske undersøkelser og skader på fiskeegg og -larver. En vurdering av mulige effekter på betandsnivå. *Fisken og Havet,* 8 (1996): 25 s. (Seismic investigations and damage to fish eggs and larvae. An assessment of possible effects on a population level). *The Fish and the Sea*, 8 (1996): 25 p.

Wardle, C.S., Carter, T.J., Urquhart, G.G., Johnstone, A.D.F., Ziolkowski, A.M., Hampson, G. and Mackie, D. 2001. Effects of seismic air guns on marine fish. Continental Shelf Research 21: 1005-1027.

ARTICLES ON GLOBAL CLIMATE CHANGE

ACIA, *Impacts of a Warming Arctic* (2004) <http://amap.no/acia> (accessed Oct. 11, 2005).

Center for Biological Diversity, *Petition to List the Polar Bear (Ursus maritimus) As A Threatened Species Under the Endangered Species Act* (Feb. 16, 2005) <http://www.biologicaldiversity.org/swcbd/species/polarbear/petition.pdf > (accessed Oct. 11, 2005).

Cicerone, R. J., Pres., Natl. Acad. of Sci., *Climate Change Science and Research: Recent and Upcoming Studies from the National Academies* (July 20, 2005) (available at <http://www7.nationalacademies.org/ocga/testimony/Global_Climate_Change_Policy_and_Budget_Review.asp>) (citing various reports of the National Academies).

Derocher et al., *Polar bears in a warming climate* (2004).

Gibson, M.A. and S.B. Schullinger. 1998. *Answers from the Ice Edge: The consequences of climate change on life in the Bering and Chukchi Seas*. Greenpeace. 32 pp.

Intergovernmental Panel on Climate Change, *Third Assessment Report – Climate Change 2001* (2001) <http://www.ipcc.ch/pub/reports.htm> (accessed Apr. 29, 2005).

Millennium Ecosystem Assessment, *Millennium Ecosystem Assessment Synthesis Report* 119 (Mar. 23, 2005) <http://www.millenniumassessment.org/en/products.aspx> (accessed Oct. 11, 2005).

NASA, Press Release, *Satellites Continue to See Decline in Arctic Sea Ice in 2005* (Sept. 28, 2005).

National Academy of Sciences, *Joint science academies' statement: Global response to climate change* (June 7, 2005).

NSIDC, Press Release, *Arctic Alaskan Shrubs Reveal Changing Climate* (Sept. 14, 2005).

NSIDC, Press Release, *Sea Ice Decline Intensifies* (Sept. 28, 2005).

PBSG, Press Release, *14th Meeting of the IUCN/SSC Polar Bear Specialist Group* (June 2005).

Pew Center on Global Climate Change, *Observed Impacts of Global Climate Change in the U.S.* (Nov. 9, 2004).

The Wildlife Society, *Global Climate Change and Wildlife in North America* (2004).

U.N. Env. Programme, *GEO Year Book 2004/5: An Overview of Our Changing Environment* 42-46, 80-84 (2005).

Appendix B

STANDARD MITIGATION

The mitigation for Sale 202 would be the same as for Sales 186 and 195. The mitigation is described fully in the Beaufort Sea multiple-sale final EIS (USDOI, MMS, 2003:Sec. II.H.1) and on the MMS website: *Lease Stipulations for Oil and Gas Lease Sale 202* (http://www.mms.gov/alaska/cproject/beaufortsale/FNOS%20186%20Package/FNIS202Package.htm).

B.1. Standard Stipulations.

No. 1 Protection of Biological Resources
No. 2 Orientation Program
No. 3 Transportation of Hydrocarbons
No. 4 Industry Site-Specific Bowhead Whale-Monitoring Program
No. 5 Conflict Avoidance Mechanisms to Protect Subsistence Whaling & Other Subsistence Activities
No. 6 Pre-Booming Requirements for Fuel Transfers
No. 7 Lighting of Lease Structures to Minimize Effects to Spectacled and Steller's Eiders
No. 8a Permanent Facility Siting in the Vicinity Seaward of Cross Island
No. 8b Permanent Facility Siting in the Vicinity Shoreward of Cross Island

The stipulation on lighting of lease structures led to the preparation of a protocol specifying standards for lighting on structures. After preparation of the assessment for Sale 195, the protocol was revised slightly. The new protocol specifies performance-based objectives for lighting rather than predetermined prescriptive standards. It recognizes that different types of structures (size, height, configuration, etc.) make it difficult to specify a single common lighting standard. The performance-based objective is to minimize the radiation of light outward from exploration/delineation structures. Measures to be considered include but need not be limited to the following:

- Shading and/or light-fixture placement to direct light inward and downward to living and work structures while minimizing light radiating upward and outward.
- Types of lights.
- Adjustment of the number and intensity of lights as needed during specific activities.
- Dark paint colors for selected surfaces.
- Low reflecting finishes or coverings for selected surfaces.
- Facility or equipment configuration.

The new protocol encourages lessees to consider other technical, operational, and management approaches to reduce light radiation. The new protocol will be used for Sale 202 leases.

B.2. Information to Lessees (ITL) Clauses that Apply to Beaufort Sea Sales.

These ITL clauses are described fully in the multiple-sale EIS (USDOI, MMS 2003:Sec. II.H.3).

No. 1 - Information on Community Participation in Operations Planning
No. 2 - Information on Kaktovikmiut Guide *In this Place*
No. 3 - Information on Nuiqsutmiut Paper
No. 4 - Information on Bird and Marine Mammal Protection
No. 5 - Information to Lessees on River Deltas
No. 6 - Information on Endangered Whales and the MMS Monitoring Program
No. 7 – Information on the Availability of Bowhead Whales for Subsistence-Hunting Activities
No. 8 - Information on High-Resolution Geological and Geophysical Survey Activity
No. 9 - Information on Polar Bear Interaction
No. 10 - Information on the Spectacled Eider and the Steller's Eider
No. 11 - Information on Sensitive Areas to be Considered in Oil-Spill-Contingency Plans
No. 12 - Information on Coastal Zone Management
No. 13 - Information on Navigational Safety

No. 14 - Information on Offshore Pipelines
No. 15 - Information on Discharge of Produced Waters
No. 16 - Information on Use of Existing Pads and Islands
No. 17 - Information to Lessees on Archaeological and Geological Hazards Reports and Surveys.

APPENDIX C

OIL-SPILL ANALYSIS

This appendix clarifies information presented in Appendix A of the Beaufort Sea multiple-sale final EIS (USDOI, MMS, 2003a) regarding the estimates of large oil-spill occurrence and updates those estimates specific to Sale 202. The changes in the spill-rate estimates were precipitated by a rerun of the fault-tree model incorporating some of the recommendations made by the North Slope Borough Science Advisory Committee (2003). Information regarding the source, type, and sizes of oil spills, their behavior and the estimated path they follow, and the conditional probabilities remain the same as discussed in the multiple-sale final EIS and is summarized in Section IV.A.2 of this Environmental Assessment (EA). Readers should recognize that the following analysis is based partly on assumptions of future oil production, including the size, location, and production rates from fields that are undiscovered.

C.1. Large Oil-Spill-Analysis.

The definition of a large spill is greater than or equal to (≥)1,000 barrels (bbl). The following elaborates on how the chance of one or more large oil spills occurring was derived for this EA. To estimate large oil-spill occurrence for future exploration, development, and production in the Beaufort Sea OCS, and to identify their principal causal factors and sensitivities to these, a fault-tree analysis was used.

C.1.a. Chance of One or More Large Spills Occurring. The chance of one or more large spills occurring is derived from two components: (1) the spill rate and (2) the assumed resource-volume estimates. The spill rate is multiplied by the resource volume to estimate the mean number of spills. Oil spills are treated statistically as a Poisson process, meaning that they occur independently of one another. If we constructed a histogram of the chance of exactly 0 spills occurring during some period, the chance of exactly 1 spill, 2 spills, and so on, the histogram would have a shape known as a Poisson distribution. An important and interesting feature of this distribution is that it is entirely described by a single parameter, the mean number of spills. Given its value, you can calculate the entire histogram and estimate the chance of one or more large spills occurring. The assumed oil production volume remains 460 million barrels for Alternative I, as discussed in Section II.B of the multiple-sale final EIS (USDOI, MMS, 2003a). Resource volumes for Alternatives III, IV, V, VI and VII are reduced by 1%, 5%, 3%, 3%, and 4%, respectively, from 460 million barrels. The following sections elaborate on how the spill rates were estimated and applied for Sale 202.

C.1.a(1) Spill-Rate Foundation. We derived the spill rates for large spills from a fault-tree study done by the Bercha Group, Inc. (2006). This study examined alternative oil-spill-occurrence estimators for the Beaufort Sea using a fault-tree method. Because sufficient historical data on offshore Arctic oil spills for the Beaufort Sea region do not exist, a model based on fault-tree methodology was developed and applied for the Beaufort multiple-sale EIS (Bercha Group, Inc., 2006). Using fault trees, oil-spill data from the offshore Gulf of Mexico and California were modified and incremented to represent expected Arctic performance. The Bercha Group Inc. (2006) fault-tree methodology differs from the Bercha Group Inc. (2002) work by including the non-arctic variability of spill size and spill frequency.

C.1.a(2) Fault-Tree Analysis. Fault-tree analysis is a method for estimating the spill rate resulting from the interactions of other events. Fault trees are logical structures that describe the causal relationship between the basic system components and events resulting in system failure. Fault-tree models are a graphical technique that provides a systematic description of the combinations of possible occurrences in a system, which can result in an undesirable outcome. Figure C-1 shows the generalized parts of a fault tree starting with the top event. The top event is defined as the failure under investigation. In this case, it is either a large pipeline or platform spill. A series of events that lead to the top event are described and connected by logic gates. Logic gates define the mathematical operations conducted between events.

Figure C-2 shows a typical fault tree for large pipeline spills. The most serious undesirable outcome, such as a large pipeline spill, was selected as the top event. A fault tree was constructed by relating the sequences of events that, individually or in combination, could lead to the leak or spill. The tree was constructed by deducing, in turn, the preconditions for the top event and then successively for the next levels of events, until the basic causes were identified. Figure C-2 illustrates these events included corrosion, third-party impact, operation impact, mechanical failure, natural hazards, unknown and Arctic.

These subresultant events were further elucidated to determine their base cause. For example, corrosion could be internal or external corrosion; third-party impact could be due to fishing, trawling, jackup, or anchor impact. Figure C-3 shows a typical fault tree for a large platform spill. The most serious undesirable outcome, such as a large platform spill, was selected as the top event. Events include a process facility release, a storage tank release, structural failure, hurricane or storm, collision, and Arctic. The subresultant events that make up the Arctic include ice force, low temperature, and others.

Probabilities were assigned to each event so that the probability of the top event was estimated. This required knowledge of the probable failure rates for each event. At an OR gate in a fault tree, the probabilities were added to give the probability of the next event. The fault trees in the Bercha Group, Inc. (2006) report were composed entirely of OR gates. The computation of resultant events consisted of the addition of the probabilities of events at each level of the fault tree to obtain the resultant probability at the next higher value.

In the Bercha Group Inc. (2006) study, fault trees were used to transform historical spill statistics for non-Arctic regions to predictive spill-occurrence estimates for the Beaufort Sea program area. The Bercha Group, Inc. fault-tree analysis focused on Arctic effects, but also looked at the variability in non Arctic effects such as spill size and spill frequency. Arctic effects were treated as a modification of existing spill causes as well as unique spill causes. Modification of existing spill causes included those that also occur in other OCS regions but at a different frequency, such as trawling accidents. Unique spill causes included events that occur only in the Arctic, such as ice gouging, strudel scour, upheaval buckling, thaw settlement, and other for pipelines. For platforms, unique spill causes included ice force, low temperature, and other.

The treatment of uncertainties in the probabilities assigned to each arctic event was estimated as discussed in the following.

C.1.a(3) Treatment of Uncertainties: The measures of uncertainty calculated included the Arctic effects in each fault-tree event as well as the historic variability in spill size and spill frequency. The treatment of uncertainties was examined through numerical simulation. To assess the impact of uncertainties in the Arctic effects incorporated fault trees, ranges around the expected value were estimated for all the Arctic effects, both modified and unique for Arctic effects. The numerical distributions generated through these perturbations in the expected values were modeled as triangular distributions and input to the numerical simulation analysis conducted as part of the result generation (Bercha Group Inc., 2006).

Numerical simulation methods are tools for evaluating the properties of complex, as well as nondeterministic processes. Problems can have an enormous number of dimensions or a process that involves a path with many possible branch points, each of which is governed by some fundamental probability of occurring.

A type of numerical simulation, called Monte Carlo simulation, was used to obtain the outcome of a set of interactions for equations in which the independent variables are described by distributions of any arbitrary form. The Monte Carlo simulation is a systematic method for selecting values from each of the independent variable distributions and computing all valid combinations of these values to obtain the distribution of the dependent variable. This was done using a computer, so that thousands of combinations could be rapidly computed and assembled to give the output distribution.

Consider the example of the following equation:

$X = X_1S + X_2$

Where, X is the dependent variable (such as spill persistence in days), S is the size of the spill in barrels, and X_1 and X_2 are correlation coefficients. Suppose now that X_1 and X_2 are some arbitrary distributions that can be described by a collection of values X_1 and X_2. What we do in the Monte Carlo process, figuratively, is to put the collection of the X_1 values into one hat, the X_1 hat, and the X_2 values into an X_2 hat. We then randomly draw one value from each of the hats and compute the resultant value of the dependent variable, X. This is done several thousand times. Thus, a resultant or dependent variable distribution, X, is estimated from the computations of all valid combinations of the independent variables (X_1 and X_2), for a given S.

Generally, the resultant can be viewed as a cumulative distribution function as illustrated in Figure C-4. Such a cumulative distribution function (CDF) also is a measure of the accuracy or, conversely, the variance of the distribution. As can be seen from this figure, if the distribution is a vertical line, no matter where one draws on the vertical axis, the same value of the variable will result, that is, the variable is a constant. At the other extreme, if the variable is completely random, the distribution will be represented as a diagonal straight line between the minimum and maximum value. Intermediate qualitative descriptions of the randomness of the variable follow from inspection of the CDF in Figure C-4. For example, if we are interested in confidence intervals, we simply take the value of the abscissa corresponding to the appropriate confidence interval, say 0.95 or 95%.

C.2. Fault-Tree Input Data and Their Uncertainty Variations. There are two basic approaches to the assessment of the variability of non-Arctic spill rates, and consequently the Arctic spill rates, using the fault tree method. The first method utilizes the historical variability of the non-Arctic base data and distributes it in direct proportion throughout the Arctic fault tree. This method is a relatively high level, approximate method, and is called the First Order Approach. In this method, the non-Arctic variable distribution is multiplied by a point value to obtain the Arctic variable distribution. The second method consists of systematically perturbing the variability of all the causal events, plus that of the Arctic unique effects. This method is more detailed and specific, and is termed the Second Order Approach. In the Second Order Approach, the non-Arctic variable distribution is multiplied by an adjustment or correction distribution to obtain the Arctic variable distribution. The First Order Approach, when used individually, did not adequately represent trends in the variability of the Arctic effects. The Second Order Approach, if not used in conjunction with the First Order Approach, resulted in arbitrary mean or expected values, because it was not tied directly to any real historical data. The optimal approach was to use the two methods, with the First Order Approach utilized to give the initial level of first order variability, and the Second Order Approach utilized to better reflect Arctic effects on the variability of causal events. In what follows, the discussion is based on the use of both methods in a complimentary fashion.

The arctic effects include modifications to events associated with the historical data set from other OCS regions, hereafter called arctic modified effects, and adding spill events unique to the arctic environment, hereafter called Arctic unique effects. Arctic modified effects are those changing the frequency component of certain contributions to events such as anchor impacts that could occur both in the arctic and temperate zones. Arctic modified effects for pipelines apply to external corrosion, internal corrosion, anchor impact, jack up rig or spud barges, trawl/fishing net, rig anchoring, workboat anchoring, mechanical connection failure or material failure, and mudslide events. Table C-1 shows the input rationalization of the arctic modified effects for pipelines. Arctic modified effects for platforms apply to process facility release, storage tank release, structural failure, hurricane/storm and collision events. Table C-2 shows the input rationalizations of the Arctic modified effects for platform events. The frequency increments in this table are given as the median values calculated using the Monte Carlo method with inputs as the low, expected, and high values.

Arctic unique effects are additive components that are unique to the Arctic environment. Quantification of existing events for the Arctic was done in a relatively cursory way restricted to engineering judgment. For pipelines Arctic unique effects included ice gouging, strudel scour, upheaval buckling, thaw settlement, and other. Table C-3 shows the input rationalization of the arctic unique effects for pipelines. A reproducible but relatively elementary analysis of gouging and scour effects was carried out. The ice-gouge failure rate was calculated using an exponential failure distribution for a 2.5 meter (m) cover, 0.2 m average gouge depth, and 4-gouges-per-kilometer-year flux. Strudel scour was assumed to occur only in shallow water with an average frequency of 4 scours per square mile and 100 feet of bridge length with a 10% conditional pipeline failure probability. Upheaval-buckling and thaw-settlement effect assessments were included on the basis of professional judgment; no engineering analysis was carried out for the assessment of frequencies to be expected for these effects. Upheaval buckling was assumed to have a failure frequency of 20% of that of strudel scour. Thaw settlement was assumed to have a failure frequency of 10% of that of strudel scour. Table C-4 shows the variance in the pipeline arctic effect inputs. The existing MMS databases on pipeline mileage were used as they stood with all their inherent inaccuracies.

Arctic unique effects for platforms included ice force, low temperature, and other effects. Table C-5 shows the variance in the platform arctic unique effect inputs. No arctic unique effects were estimated for the wells, which were considered to blow out with frequencies the same as those for the Gulf of Mexico.

The above information summarizes the input data to the fault trees and their uncertainty variation. For further information the reader is directed to Bercha Group Inc. (2006).

C.3. Results for Large Spill Rates for Sale 202. Based on the Bercha Group, Inc. (2006) fault-tree analysis for Sale 202, MMS estimates the mean spill rates for platforms, pipelines, and platforms and pipelines total over the life of the project as follows:

Platforms	0.33 spills per billion barrels produced
Pipelines	0.20 spills per billion barrels produced
Total	0.53 spills per billion barrels produced

The annual rates were weighted by the annual production over the total production or the year over the total years, and the prorated rates were summed to determine the rates over the life of the project as shown above. Confidence intervals were calculated on the total spill rate per billion barrels at the 95% confidence level as follows:

Type	Mean	95%
Total	0.53	0.35-0.73

These confidence limits include the variance in the arctic effects as well as the variance in spill size and spill frequency. The recent inclusion of the variance in the spill size and spill frequency has increased the spill rate previously reported in USDOI, MMS 2003a, 2004.

C.4. Estimates for the Number of Large Spills Occurring for Sale 202. The spill rates discussed in this section are all based on spills per billion barrels. Using the above mean large spill rates, Table C-6 shows the estimated mean number of large oil spills for Alternative VII, the Proposed Action and alternatives. Using the mean spill rates for the Proposed Action and alternatives, we estimate 0.09 pipeline spills and 0.14-0.15 platform (and well) spills for a total over the life of Sale 202 production of 0.23-0.24 spills. Table C-7 shows the estimated total number of oil spills for the Proposed Action and alternatives using spill rates at the 95% confidence interval. For the Proposed Action and alternatives, total spills over the life of the Sale 202 production at the 95% confidence interval spill rates range from 0.15-0.34 spills; that is, approximately one seventh to a third of a spill. For purposes of analysis, one large spill was assumed to occur and was analyzed in the Beaufort multiple-sale EIS, Sale 195 EA and this EA.

C.5. Method for Estimating the Chance of One or More Spills Occurring. The Poisson distribution is used for estimating oil-spill occurrence. Spill occurrence has been modeled previously as a Poisson process (Smith et al., 1982; Lanfear and Amstutz, 1983; Anderson and LaBelle, 1990, 1994; 2000). Because spill occurrences meet the criteria for a Poisson process, the following equations were used in our estimation of spill occurrence. The estimated volume of oil handled is the exposure variable.

Smith et al. (1982), using Bayesian inference techniques, presented a derivation of this process, assuming the probability of n spills over some future exposure t is expected to occur at random with a frequency specified by equation (1):

$$\text{P (n spills over future exposure t)} = \frac{(\lambda t)^n e^{-\lambda t}}{n!} \quad (1)$$

where λ is the true rate of spill occurrence per unit exposure. The predicted probability takes the form of a negative binomial distribution specified by equation (2):

$$P(n) = \frac{(n+v-1)!\,t^n \tau^v}{n!(v-1)!(t+\tau)^{n+v}} \quad (2)$$

where τ is past exposure and v is the number of spills observed in the past. The negative binomial is then shown to converge over time to the Poisson, with λ estimated using equation (3) (Smith et al., 1982):

$$\lambda = v / \tau \quad (3)$$

Using the spill rate and the volume of oil assumed to be produced, the estimated mean number of spills is calculated. That number of spills is distributed as a Poisson distribution. The probability of one or more is equal to 1 minus the probability of zero spills. The probability of one or more spills occurring is calculated using the following equations.

$$P(n) = \frac{e^{-\lambda} * \lambda^n}{n!}$$

P(n) = probability of n spills occurring
n = specific number of spills
e = base of the natural logarithm
λ = parameter of the Poisson distribution (mean number of spills)

C.6. Estimates for the Chance of One or More Large Spills Occurring. The frequency distribution of large oil spills, when corrected for decreasing spill rate in more recent decades, can be modeled as Poisson distribution (see the following section). An assumption of Poisson distribution allows the calculation of the chance of one or more oil spills occurring. Using the above mean spill rates, Table C-8 shows the chance of one or more large pipeline spills is 9%, and the chance of one or more large platform spills is 13-14% for the Proposed Action and alternatives over the life of the project. The chance of no large pipeline spills is 91% and the chance of no large platform spills is 86-87%. The total is the sum of the platform and pipeline spills. The chance of one or more large spills total is 21% for the Proposed Action and alternatives based on the mean spill rate over the life of the project (Figure C-5 through C-9). Table C-9 shows the chance of one or more large spills total for the Proposed Action and alternatives using spill rates at the 95% confidence interval. For the Proposed Action and alternatives, the percent chance of one or more large spills occurring total ranges from 14-29% using the spill rates at the 95% confidence interval over the life of the project.

C.7. Background Statistical Work. The basis for using a Poisson process for determining the probability of spill occurrence is found within the peer-reviewed literature. Anderson and LaBelle (2000) is the fourth of a series of independently peer-reviewed papers presented in support of oil-spill-rate assumptions used for oil-spill-occurrence estimates, with two earlier Anderson and LaBelle efforts (1994, 1990) and Lanfear and Amstutz (1983). The Lanfear and Amstutz (1983) report examines the cumulative frequency distributions of oil spills, tests pipeline miles as an alternative exposure variable for pipeline spills, and discusses the trend analysis of offshore spills performed by Nakassis (1982). These spill-rate papers tier off earlier work performed by Department of the Interior in support of the Oil-Spill-Risk Analysis (OSRA) Model, and work performed by other oil-spill researchers, as referenced in the papers.

The Smith et al. (1982) report documents the fundamentals of the Department of the Interior's OSRA Model. It describes the approach of using lambda, the unknown spill-occurrence rate for a fixed class of spills, as a parameter in a Poisson process, with volume of oil handled as an exposure variable to predict the probability of spill occurrence (Smith et al., 1982:18-24). A Bayesian methodology, described in detail in

Appendix A of Smith et al., *Distribution Theory of Spill Incidence*, provides one way to weight the different possible values of lambda given the past frequency of spill occurrence for a fixed class of spills. Smith et al. (1982) selects volume as an exposure variable in that it is a quantity that would be more practical to estimate future exposure (a necessity for using it to forecast future spill occurrence) than the other exposure variables considered.

In support of using the Poisson process for spill occurrence and examinations of different exposure variables, Smith et al. (1982) references the works of Devanney and Stewart (1974), Stewart (1976), and Stewart and Kennedy (1978). These references, and other pertinent ones, can be found at Oil Spill Rates - Additional References on the MMS Web site located at http://www.mms.gov/eppd/sciences/osmp/spillraterefs.htm.

C.8. Summary. The chance of one or more large pipeline spills is 9%, and the chance of one or more large platform spills ranges from 13-14% for the Proposed Action and alternatives over the life of the project. The total is the sum of the platform and pipeline spills. The chance of one or more large spills total is 21% for the Proposed Action and alternatives based on the mean spill rate over the life of the project. Using spill rates at the 95% confidence interval for the Proposed Action and alternatives, the percent chance of one or more large spills total ranges from 14-29% over the life of the Proposal.

C.9. Results of the Oil-Spill-Risk Analysis: Combined Probabilities. Tables C-11 through C-21 show the annual combined probabilities for the Proposal and the alternatives for Sale 202. The combined probabilities were recalculated using the updated spill rates for Sale 202. For the most part, the chance of one or more spills occurring and contacting resources and land segments is less than (<) 0.5% for spill durations <30 days. The OSRA model estimates a <0.5-5% chance of one or more spills greater than or equal to (≥) 1,000 bbl occurring and contacting environmental resources areas (ERA's), land segments, and land within 30 days, over the production life of the Proposed Action. The OSRA model estimates a <0.5-5% chance of one or more spills ≥1,000 bbl occurring and contacting ERA's and land within 360 days, over the production life of the Proposed Action. The OSRA model estimates a 14% chance of one or more spills ≥1,000 bbl occurring and contacting land within 360 days, over the production life of the Proposed Action.

The relative risk from the Proposal and alternatives is low (<10%), because we estimate that one or more oil spills occurring and contacting environmental resource areas ranges from <0.5-5% over 360 days or coastline up to 30 days. Because the combined probabilities are similar to one another it is difficult to distinguish differences between the Proposal and alternatives based on combined probabilities.

BIBLIOGRAPHY

Anderson, C.M. and R.P. LaBelle. 1990. Estimated Occurrence Rates for Analysis of Accidental Oil Spills on the U.S. Outer Continental Shelf. *Oil and Chemical Pollution* 6(1): 21-35.

Anderson, C.M. and R.P. LaBelle. 1994. Comparative Occurrence Rates for Offshore Oil Spills. *Spill Science and Technology Bulletin* 2(1):131-141.

Anderson, C.M. and R.P. Labelle. 2000. Update of Comparative Occurrence Rates for Offshore Oil Spill. *Spill Science and Technology* 65/6: 303-321.

Bercha Group Inc. 2002. Alternative Oil Spill Occurrence Estimators for the Beaufort and Chukchi Seas – Fault Tree Method. 2 Vols. OCS Study, MMS 2002-047. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Bercha Group Inc. 2006. Alternative Oil Spill Occurrence Estimators and their Variability for the Beaufort Sea – Fault Tree Method. 2 Vols. OCS Study, MMS 2005-061. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

Devanney, J.W., III and R.J. Stewart. 1974. Analysis of Oilspill Statistics. Washington, DC: Council on Environmental Quality,.

Lanfear, K.J. and D.E. Amstutz. 1983. A Reexamination of Occurrence Rates for Accidental Oil Spills on the U.S. Outer Continental Shelf. *In*: Proceedings of the 1983 Oil Spill Conference, San Antonio, Tex., Feb. 28-Mar. 3, 1983. Washington, DC: USCG, API, and USEPA, pp. 355-365.

Nakassis, A. 1982. Has Offshore Oil Production Become Safer? Open-File Report 82-232. Menlo Park, CA: U.S. Geological Survey, 26 pp.

North Slope Borough Science Advisory Committee (2003) A Review of Oil Spill Risk Estimates Based on Current Offshore Development Technologies. NSB-SAC-OR-130. Barrow, AK. North Slope Borough.

Smith, R.A., J.R. Slack. T. Wyant, and K.J. Lanfear. 1982. The Oilspill Risk Analysis Model of the U.S. Geological Survey. Geological Survey Professional Paper 1227. Washington, DC: U.S. Government Printing Office, 40 pp.

Stewart, R.J. 1976. Survey and Critical Review of U.S. Oil Spill Data Resources with Application to the Tanker/Pipeline Controversy A Report to Office of Policy Analysis. Washington, DC: USDOI, 74 pp. http://www.mms.gov/eppd/sciences/osmp/spillraterefs.htm

Stewart, R.J. and M.B. Kennedy. 1978. Analysis of U.S. Tanker and Offshore Petroleum Production of Oil Spillage through 1975: Report to Office of Policy Analysis. Washington, DC: USDOI, 115 pp. plus appendices. http://www.mms.gov/eppd/sciences/osmp/spillraterefs.htm.

USDOI, MMS. 2003. Beaufort Sea Planning Area Sales 186, 195, and 202 Oil and Gas Lease Sale Final EIS. OCS EIS/EA, MMS 2003-001. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

USDOI, MMS. 2004. Proposed Oil and Gas Lease Sale 195 Beaufort Sea Planning Area. Environmental Assessment. OCS EIS/EA, MMS 2004-028. Anchorage, AK: USDOI, MMS, Alaska OCS Region.

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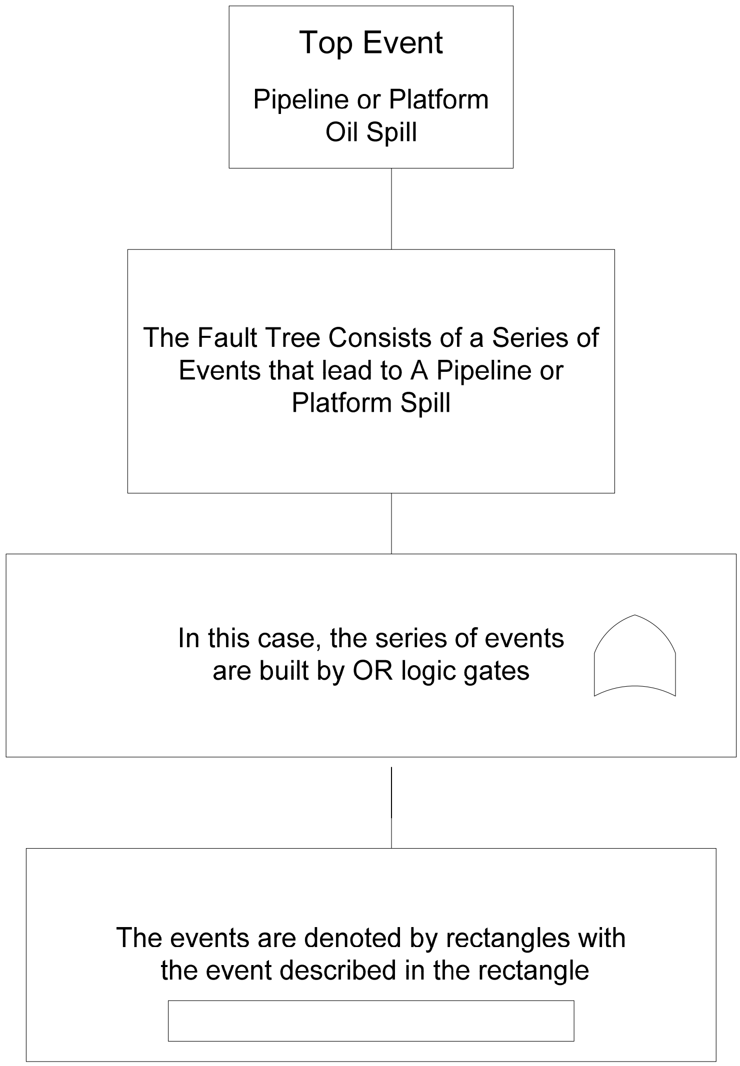


Figure C-1. Basic Parts of a Fault Tree

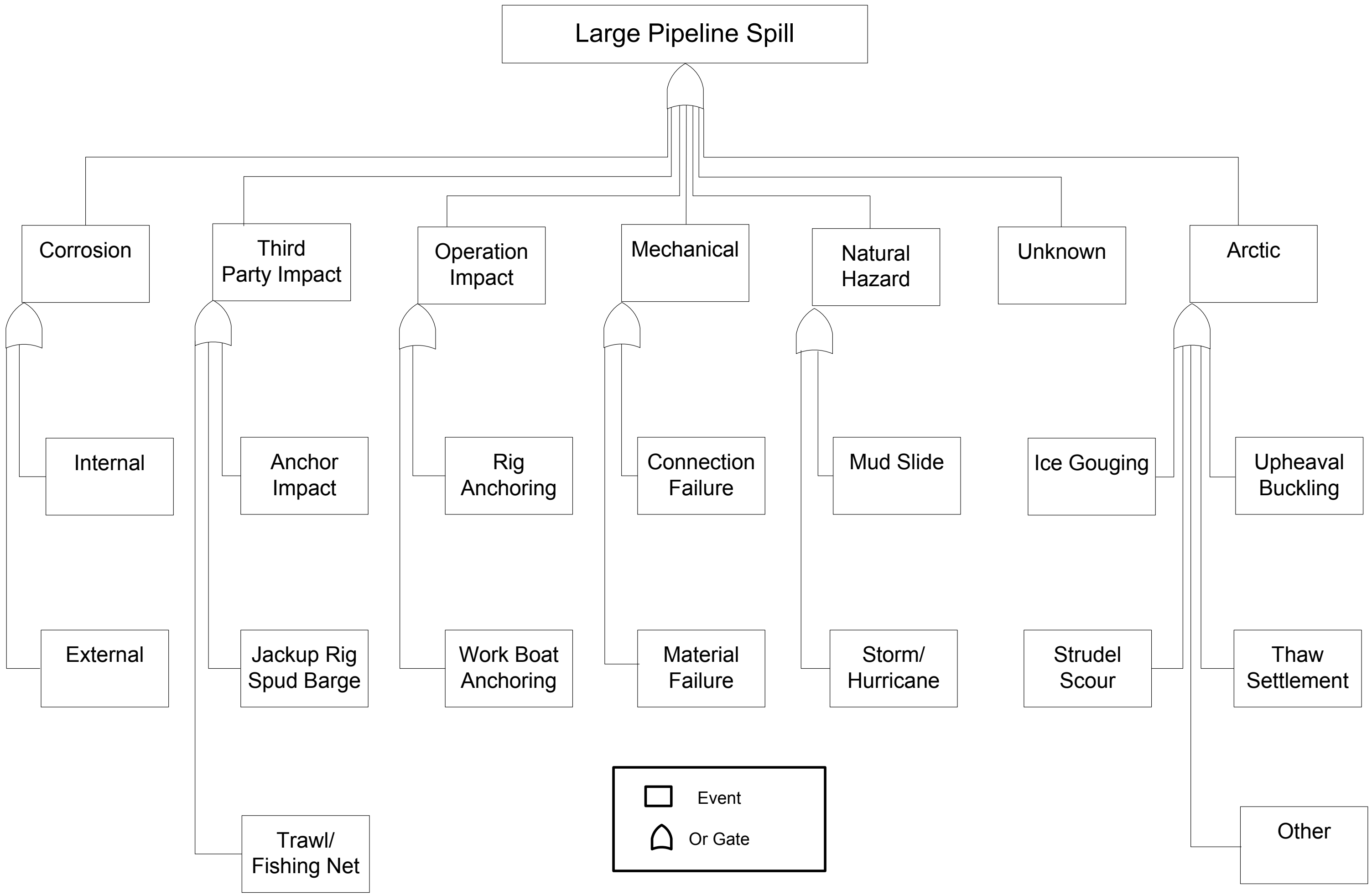


Figure C-2. Typical Fault Tree for A Pipeline Spill

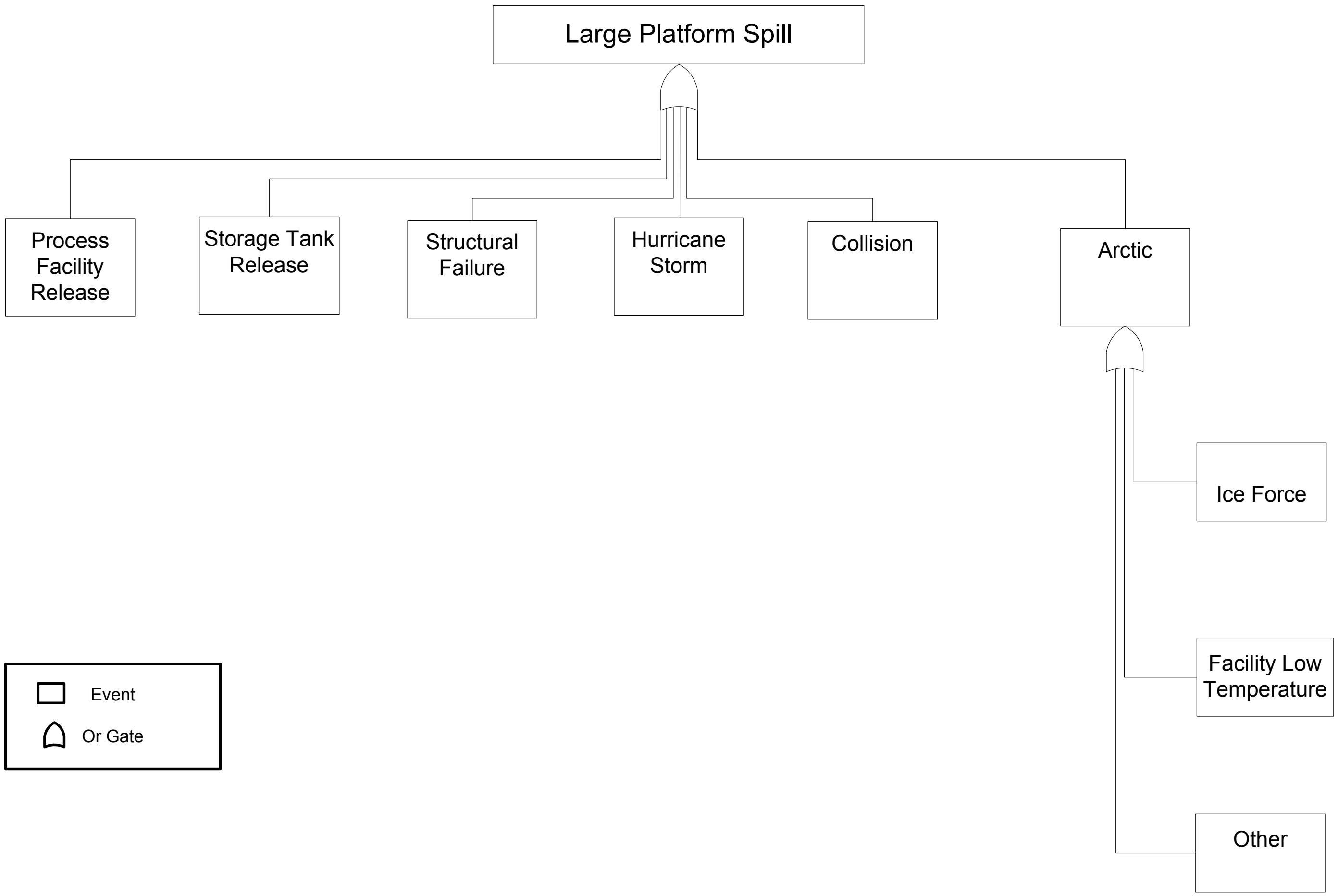


Figure C-3. Typical Fault Tree for a Platform Spill

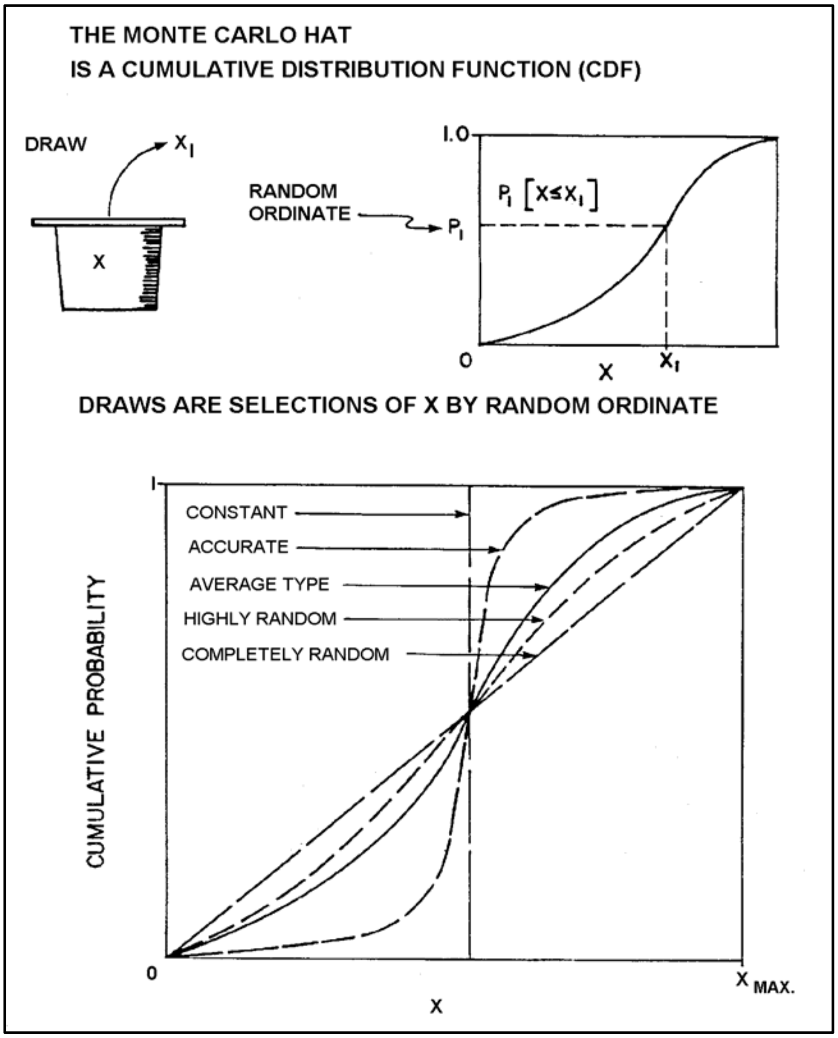
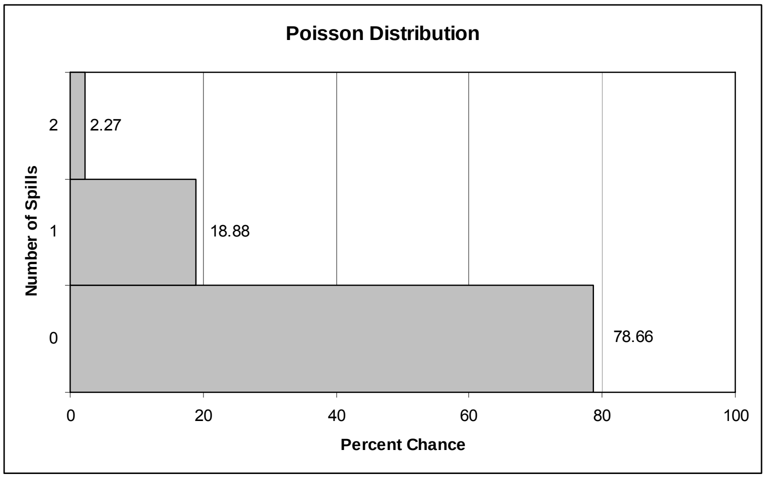


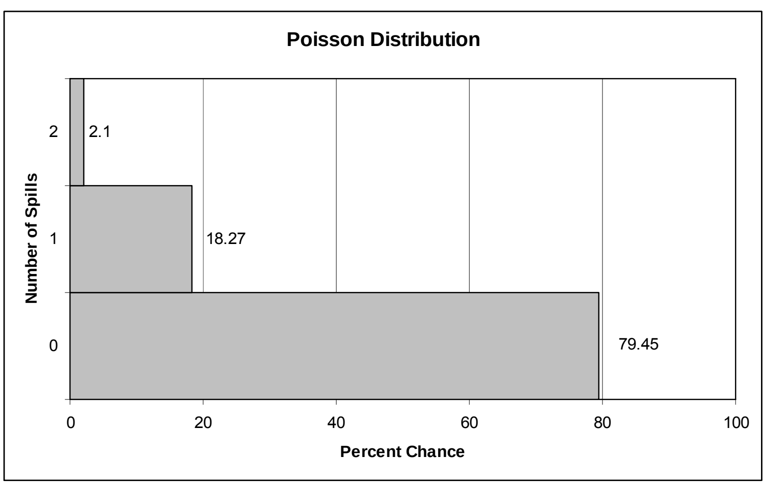
Figure C-4. Schematic of Monte Carlo Process as a Cumulative Distribution Function

Figure C-5. Poisson Distribution: Alternatives I, II, V, and VI Total (Pipeline and Platform)



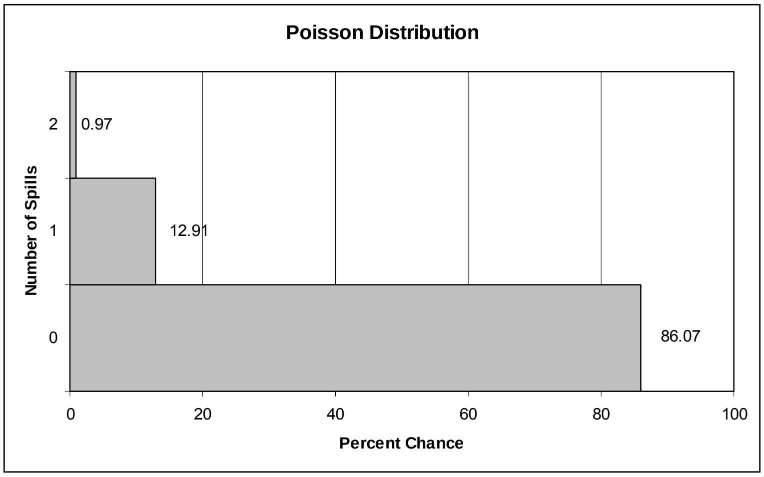
Mean Number of Spills = 0.24
Percent Chance of One or More = 21%
Percent Chance of No Spills = 79%

Figure C-6. Poisson Distribution Alternatives IV and VII Total (Pipeline and Platform)



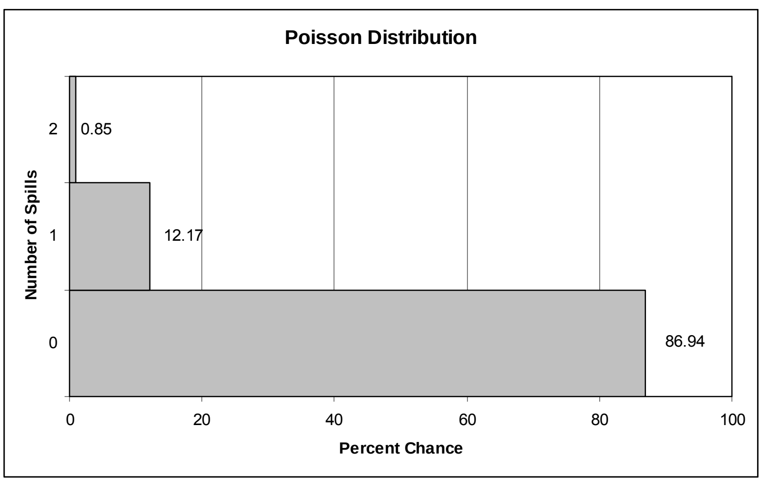
Mean Number of Spills = 0.23
Percent Chance of One or More = 21%
Percent Chance of No Spills = 79%

Figure C-7. Poisson Distribution Alternatives I, III, V, VI and VII Platform



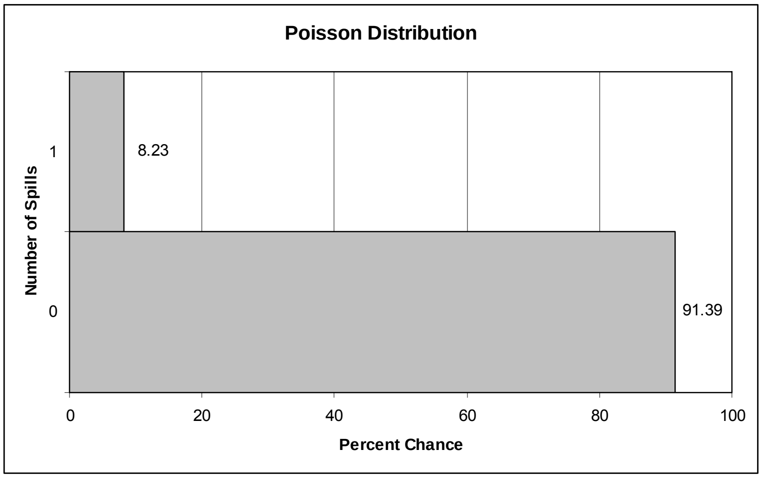
Mean Number of Spills = 0.15
Percent Chance of One or More =14%
Percent Chance of No Spills = 86%

Figure C-8. Poisson Distribution Alternative IV Platform



Mean Number of Spills = 0.14
Percent Chance of One or More =14%
Percent Chance of No Spills = 86%

Figure C-9. Poisson Distribution Alternatives I, III, IV, V, VI and VII Pipeline



Mean Number of Spills = 0.09
Percent Chance of One or More =9%
Percent Chance of No Spills = 91%

Table C-1
Pipeline Fault Tree Analysis Input Rationalization for Arctic Modified Events

Event Classification	Spill Size	Shallow	Medium	Deep	Reason
		Frequency Change %			
Arctic Modified					
Corrosion					
External	**All**	(30)	(30)	(30)	Lower temperature and biological effects. Extra smart pigging. State of art coatings
Internal	**All**	(30)	(30)	(30)	Additional inspection and smart pigging above historical levels.
Third Party Impact					
Anchor Impact	**All**	(50)	(50)	(50)	Low vessel traffic of third party shipping.
Jackup Rig or Spud Barge	**All**	(50)	(50)	(50)	Low facility density than historic data population in other OCS areas.
Trawl/Fishing Net	**All**	(50)	(60)	(70)	Low commercial fishing activity.
Operation Impact					
Rig Anchoring	**All**	(20)	(20)	(20)	No marine traffic during ice season (8 months).
Work Boat Anchoring	**All**	(20)	(20)	(20)	No work boat traffic during ice season (8 months).
Mechanical					
Connection Failure	**All**	—	—	—	No change was made to account for Arctic effects.
Material Failure	**All**	—	—	—	No change was made to account for Arctic effects.
Natural Hazard					
Mud Slide	**All**	(60)	(50)	(40)	Gradient low. Mud slide potential (gradient) increases with water depth.
Storm/ Hurricane	**All**	(50)	(50)	(50)	Fewer severe storms. Damping of ocean surface by ice cover for 8 months.

Note:
All = All spill sizes combined

Table C-2
Platform Fault Tree Input Rationalization

Event Classification	Spill Size	Frequency Change % Shallow	Medium	Deep	Reason
Arctic Modified					
Process Facility Rls.	All	(30)	(30)	(30)	State of the art now, High QC, High Inspection and Maintenance Requirements
Storage Tank Rls.	All	(30)	(30)	(30)	State of the art now, High QC, High Inspection and Maintenance Requirements
Structural Failure	All	(20)	(20)	(20)	High safety factor, Monitoring Programs
Hurricane/Storm	All	(50)	(40)	(30)	Less severe storms.
Collision	All	(50)	(50)	(50)	Very low traffic density.
—		**Freq. Increment per 10^4 well-year**			—
		Median Expected	**Median Expected**	***Median* Expected**	
Arctic Unique					
Ice Force	SM	0.1447 0.0340	0.2170 0.0510	0.3256 0.0765	Assumed 10,000 year return period ice force causes spill 4% of occu. 85% of the spills are SM.
	HL	0.0255 0.0060	0.0383 0.0090	0.0575 0.0135	
Facility Low Temperature	SM	0.1000 0.1000	0.1000 0.1000	0.1000 0.1000	Assumed 10% of Historical Process Facilities release frequency and corresponding spill size distribution.
	HL	0.0080 0.0080	0.0080 0.0080	0.0080 0.0080	
—	SM	0.0244	0.0316	0.0424	10% of above
		0.0134	0.0151	0.0177	
	HL	0.0033	0.0046	0.0065	
		0.0014	0.0017	0.0022	

Note:
All = All spill sizes combined
SM = Small (≥50and < 100 bbl) and M = Medium (≥100and < 1000 bbl)
LH= Large (≥1000and < 10,000 bbl) and H = Huge (≥10,000)

Table C-3
Pipeline Fault Tree Analysis Input Rationalization for Arctic Unique Events

Arctic Unique Event Classification		Freq. Inc. per 10^5 km-yr			Reason
		Median	Median	Median	
Ice Gouging	S	0.3495	0.2796		Ice gouge failure rate calculated using exponential failure distribution Hnatiuk & Brown, 1983; Weeks et al, 1983) for 2.5-m cover, 0.2-m average gouge depth, 2 gouges per km-yr flux. Frequency is distributed among different spill sizes.
	M	0.0680	0.0544		
	L	0.6178	0.4943		
	H	0.1210	0.0968		
Strudel Scour	S	1.3438	1.0750		Only in shallow water. Average frequency of 4 scours/mile^2 and 100 ft of bridge length with 10% conditional pipeline failure probability. The same spill size distribution as above.
	M	0.2610	0.2088		
	L	0.3762	0.3010		
	H	0.0730	0.0584		
Upheaval Buckling	S	0.0021			All water depth. The failure frequency is 20% of that of Strudel Scour (Paulin et al., 2001).
	M	0.0012			
	L	0.0038			
	H	0.0020			
Thaw Settlement	S	0.0082			All water depth. The failure frequency is 10% of that of Strudel Scour (Paulin et al., 2001).
	M	0.0045			
	L	0.0023			
	H	0.0012			
Other	S	0.0004	0.0004	0.0004	To be assessed as 25% of the sum of above.
	M	0.0002	0.0002	0.0002	
	L	0.0008	0.0008	0.0008	
	H	0.0004	0.0004	0.0004	

Note:
S = Small (≥50and < 100 bbl)
M = Medium (≥100and < 1000 bbl)
L = Large (≥1000and < 10,000 bbl)
H = Huge (≥10,000)

Table C-4
Arctic Pipeline Effects Uncertainty Variations

Event Classification	Spill Size	Water Depth: Shallow – Frequency Change % Low	Shallow Expected	Shallow High	Medium Low	Medium Expected	Medium High	Deep Low	Deep Expected	Deep High
Arctic Modified										
Corrosion										
External	**All**	(90)	(30)	(10)	(90)	(30)	(10)	(90)	(30)	(10)
Internal	**All**	(90)	(30)	(10)	(90)	(30)	(10)	(90)	(30)	(10)
Third Party Impact										
Anchor Impact	**All**	(90)	(50)	(10)	(90)	(50)	(10)	(90)	(50)	(10)
Jackup Rig Or Spud Barge	**All**	(90)	(50)	(10)	(90)	(50)	(10)	(90)	(50)	(10)
Trawl/Fishing Net	**All**	(90)	(50)	(10)	(90)	(60)	(10)	(90)	(70)	(10)
Operation Impact										
Rig Anchoring	**All**	(50)	(20)	(10)	(50)	(20)	(10)	(50)	(20)	(10)
Work Boat Anchoring	**All**	(50)	(20)	(10)	(50)	(20)	(10)	(50)	(20)	(10)
Mechanical										
Connection Failure	**All**									
Material Failure	**All**									
Natural Hazard										
Mud Slide	**All**	(90)	(60)	(10)	(90)	(50)	(10)	(90)	(40)	(10)
Storm/ Hurricane	**All**	(90)	(50)	(10)	(90)	(50)	(10)	(90)	(50)	(10)
Ice Gouging	**S**	0.0060	0.0680	0.8290	0.0048	0.0544	0.6632			
	M	0.0090	0.1210	1.4670	0.0072	0.0968	1.1736			
	L	0.0210	0.2610	3.1900	0.0168	0.2088	2.5520			
	H	0.0060	0.0730	0.8930	0.0048	0.0584	0.7144			
Strudel Scour	**S**	0.0004	0.0012	0.0044						
	M	0.0006	0.0020	0.0078						
	L	0.0014	0.0045	0.0170						
	H	0.0004	0.0012	0.0048						
Upheaval Buckling	**S**	0.00007	0.00023	0.00088	0.00007	0.00023	0.00088	0.00007	0.00023	0.00088
	M	0.00013	0.00041	0.00156	0.00013	0.00041	0.00156	0.00013	0.00041	0.00156
	L	0.00028	0.00089	0.00340	0.00028	0.00089	0.00340	0.00028	0.00089	0.00340
	H	0.00008	0.00025	0.00095	0.00008	0.00025	0.00095	0.00008	0.00025	0.00095
Thaw Settlement	**S**	0.00004	0.00012	0.00044	0.00004	0.00012	0.00044	0.00004	0.00012	0.00044
	M	0.00006	0.00020	0.00078	0.00006	0.00020	0.00078	0.00006	0.00020	0.00078
	L	0.00014	0.00045	0.00170	0.00014	0.00045	0.00170	0.00014	0.00045	0.00170
	H	0.00004	0.00012	0.00048	0.00004	0.00012	0.00048	0.00004	0.00012	0.00048
Other	**S**	0.00162	0.01738	0.20869	0.00123	0.01369	0.16613	0.00003	0.00009	0.00033
	M	0.00246	0.03092	0.36929	0.00185	0.02435	0.29399	0.00005	0.00015	0.00059
	L	0.00571	0.06670	0.80303	0.00431	0.05253	0.63928	0.00011	0.00033	0.00128
	H	0.00163	0.01865	0.22480	0.00123	0.01469	0.17896	0.00003	0.00009	0.00036

Note:
All = All spill sizes combined
S = Small (≥50and < 100 bbl)
M = Medium (≥100and < 1000 bbl)
L = Large (≥1000and < 10,000 bbl)
H = Huge (≥10,000)

Table C-5
Arctic Platform Effects Uncertainty Variations

Cause Classification	Spill Size	Shallow			Medium			Deep		
		Frequency Change %								
		Low	Expected	High	Low	Expected	High	Low	Expected	High
Arctic Modified										
Process Facility Rls.	**All**	(60)	(30)	(10)	(60)	(30)	(10)	(60)	(30)	(10)
Storage Tank Rls.	**All**	(60)	(30)	(10)	(60)	(30)	(10)	(60)	(30)	(10)
Structural Failure	**All**	(60)	(20)	(10)	(60)	(20)	(10)	(60)	(20)	(10)
Hurricane/Storm	**All**	(90)	(50)	(10)	(90)	(40)	(10)	(90)	(30)	(10)
Collision	**All**	(90)	(50)	(10)	(90)	(50)	(10)	(90)	(50)	(10)
Ice Force	**SM**	0.003	0.034	0.340	0.005	0.051	0.510	0.008	0.077	0.765
	HL	0.001	0.006	0.060	0.001	0.009	0.090	0.001	0.014	0.135
Facility Low Temperature	**SM**	0.050	0.100	0.150	0.050	0.100	0.150	0.050	0.100	0.150
	HL	0.004	0.008	0.012	0.004	0.008	0.012	0.004	0.008	0.012
Other	**SM**	0.005	0.013	0.049	0.006	0.015	0.066	0.006	0.018	0.092
	HL	0.000	0.001	0.007	0.000	0.002	0.010	0.001	0.002	0.015

Note:

All = All spill sizes combined
SM = Small (≥50and < 100 bbl) and M = Medium (≥100and < 1000 bbl)
LH= Large (≥1000and < 10,000 bbl) and H = Huge (≥10,000)

Table C-6

Estimated Mean Number of Large Platform, Pipeline and Total Spills for Alternative VII, the Proposed Action (Sale 202) and its Alternatives

Alternative		Mean Number of Platform Spills	Mean Number of Pipeline Spills	Mean Number of Spills Total
I	Area of the Call	0.15	0.09	0.24
II	No Sale	0	0	0
III	Barrow Subsistence Whale Deferral	0.15	0.09	0.24
IV	Nuiqsut Subsistence Whale Deferral	0.14	0.09	0.23
V	Kaktovik Subsistence Whale Deferral	0.15	0.09	0.24
VI	Eastern Deferral	0.15	0.09	0.24
VII	Proposed Action	0.15	0.09	0.24

Note:

Mean number of spills is rounded to two decimal places after multiplying the spill rate times the oil resource volume.

Table C-7

Estimated Number of Total Spills for Alternative VII, the Proposed Action (Sale 202) and its Alternatives Using Spill Rates at the 95% Confidence Interval

Alternative		Number of Spills Total
I	Alternative I	0.16-0.34
II	No Sale	0
III	Barrow Subsistence Whale Deferral	0.16-0.33
IV	Nuiqsut Subsistence Whale Deferral	0.15-0.32
V	Kaktovik Subsistence Whale Deferral	0.16-0.33
VI	Eastern Deferral	0.16-0.33
VII	Proposed Action	0.16-0.32

Note:

Mean Number is rounded to the two decimal places after multiplying the spill rate times the resource volume.

Table C-8

Estimated Percent Chance of One or More Large Platform, Pipeline and Total Spills for Alternative I, the Proposed Action (Sale 202) and it's Alternatives over the Life of the Project

Alternative		Percent Chance of One or More Pipeline Spills	Percent Chance of One or More Platform Spills	Percent Chance of One or More Spills Total
I	Alternative I	9	14	21
II	No Sale	0	0	0
III	Barrow Subsistence Whale Deferral	9	14	21
IV	Nuiqsut Subsistence Whale Deferral	9	13	21
V	Kaktovik Subsistence Whale Deferral	9	14	21
VI	Eastern Deferral	9	14	21
VII	Proposed Action	9	14	21

Table C-9

Estimated Percent Chance of One or More Total Spills for Alternative VII, the Proposed Action (Sale 202) and its Alternatives Using the Spill Rates at the 95% Confidence Interval

Alternative		Percent Chance of One or More Spills Total
I	Alternative I	15 - 29
II	No Sale	0
III	Barrow Subsistence Whale Deferral	15 - 28
IV	Nuiqsut Subsistence Whale Deferral	14 - 27
V	Kaktovik Subsistence Whale Deferral	15 - 28
VI	Eastern Deferral	15 - 28
VII	Proposed Action	15 - 27

Table C-10 Combined Probabilities (Expressed as Percent Chance) of One or More Spills Greater than or Equal to 1,000 Barrels, and the Estimated Number of Spills (Mean), Occurring and Contacting a Certain Environmental Resource over the assumed Production Life of the Lease Area Within 3 Days, Beaufort Sea Sale 202

ID	Environmental Resource Area Name	Full Sale Area		Barrow Subsistence Whale Deferral		Nuiqsut Subsistence Whale Deferral		Kaktovik Subsistence Whale Deferral		Eastern Deferral		Proposed Action	
		% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean
	Land	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
1	Kasegaluk Lagoon	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
2	Point Barrow, Plover Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
3	Thetis and Jones Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
4	Cottle & Return Islands, West Dock	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
5	Midway Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
6	Cross and No Name Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
7	Endicott Causeway	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
8	McClure Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
9	Stockton Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
10	Tigvariak Island	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
11	Maguire Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
12	Flaxman Island	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
13	Barrier Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
14	Anderson Point Barrier Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
15	Arey and Barter Islands, Bernard Spit	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
16	Jago and Tapkaurak Spits	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
17	Angun and Beaufort Lagoons	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
18	Icy Reef	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
19	Chukchi Spring Lead 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
20	Chukchi Spring Lead 2	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
21	Chukchi Spring Lead 3	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
22	Chukchi Spring Lead 4	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
23	Chukchi Spring Lead 5	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
24	Beaufort Spring Lead 6	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
25	Beaufort Spring Lead 7	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
26	Beaufort Spring Lead 8	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
27	Beaufort Spring Lead 9	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
28	Beaufort Spring Lead 10	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
29	Ice/Sea Segment 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
30	Ice/Sea Segment 2	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
31	Ice/Sea Segment 3	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
32	Ice/Sea Segment 4	1	0.0	1	0.0	:	0.0	1	0.0	1	0.0	1	0.0
33	Ice/Sea Segment 5	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
34	Ice/Sea Segment 6	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
35	Ice/Sea Segment 7	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
36	Ice/Sea Segment 8	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
37	Ice/Sea Segment 9	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
38	Point Hope Subsistence Are	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
39	Point Lay Subsistence Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
40	Wainwright Subsistence Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
41	Barrow Subsistence Area 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
42	Barrow Subsistence Area 2	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
43	Nuiqsut Subsistence Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
44	Kaktovik Subsistence Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0

Notes: ** = Greater than 99.5 percent; : = less than 0.5 percent

Table C-10 (continued) Combined Probabilities (Expressed as Percent Chance) of One or More Spills Greater than or Equal to 1,000 Barrels, and the Estimated Number of Spills (Mean), Occurring and Contacting a Certain Environmental Resource over the Assumed Production Life of the Lease Area Within 3 Days, Beaufort Sea Sale 202

ID	Environmental Resource Area Name	Full Sale Area		Barrow Subsistence Whale Deferral		Nuiqsut Subsistence Whale Deferral		Kaktovik Subsistence Whale Deferral		Eastern Deferral		Proposed Action	
		% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean
45	Whale Concentration Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
46	Herald Shoal Polynya	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
47	Ice/Sea Segment 10	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
48	Ice/Sea Segment 11	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
49	Hanna's Shoal Polynya	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
50	Ice/Sea Segment 12	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
51	Ice/Sea Segment 13	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
52	Ice/Sea Segment 14	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
53	Ice/Sea Segment 15	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
54	Ice/Sea Segment 16a	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
55	Ice/Sea Segment 17	2	0.0	2	0.0	1	0.0	2	0.0	2	0.0	2	0.0
56	Ice/Sea Segment 18a	2	0.0	2	0.0	1	0.0	2	0.0	2	0.0	2	0.0
57	Ice/Sea Segment 19	4	0.0	4	0.0	4	0.0	4	0.0	4	0.0	4	0.0
58	Ice/Sea Segment 20a	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
59	Ice/Sea Segment 21	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
60	Ice/Sea Segment 22	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
61	Ice/Sea Segment 22	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
62	Ice/Sea Segment 24a	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
63	Ledyard Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
64	Peard Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
65	ERA 1	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
66	ERA 2	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
67	Ice/Sea Segment 16b	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
68	Harrison Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
69	Harrison Bay/Colville Delta	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
70	ERA 3	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
71	Simpson Lagoon	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
72	Gwyder Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
73	Prudhoe Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
74	Cross Island ERA	1	0.0	1	0.0	:	0.0	1	0.0	1	0.0	1	0.0
75	Water over Boulder Patch 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
76	Water over Boulder Patch 2	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
77	Foggy Island Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
78	Mikkelsen Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
79	ERA 4	1	0.0	1	0.0	:	0.0	1	0.0	1	0.0	1	0.0
80	Ice/Sea Segment 18b	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
81	Simpson Cove	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
82	ERA 5	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
83	Kaktovik ERA	1	0.0	1	0.0	1	0.0	:	0.0	1	0.0	:	0.0
84	Ice/Sea Segment 20b	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
85	ERA 6	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
86	ERA 7	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
87	ERA 8	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
88	Ice Sea Segment 24b	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0

Notes: ** = Greater than 99.5 percent;: = less than 0.5 percent

Table C-11 Combined Probabilities (Expressed as Percent Chance) of One or More Spills Greater than or Equal to 1,000 Barrels, and the Estimated Number of Spills (Mean), Occurring and Contacting a Certain Environmental Resource over the assumed Production Life of the Lease Area Within 10 Days, Beaufort Sea Sale 202

ID	Environmental Resource Area Name	Full Sale Area		Barrow Subsistence Whale Deferral		Nuiqsut Subsistence Whale Deferral		Kaktovik Subsistence Whale Deferral		Eastern Deferral		Proposed Action	
		% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean
	Land	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
1	Kasegaluk Lagoon	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
2	Point Barrow, Plover Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
3	Thetis and Jones Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
4	Cottle & Return Islands, West Dock	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
5	Midway Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
6	Cross and No Name Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
7	Endicott Causeway	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
8	McClure Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
9	Stockton Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
10	Tigvariak Island	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
11	Maguire Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
12	Flaxman Island	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
13	Barrier Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
14	Anderson Point Barrier Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
15	Arey and Barter Islands, Bernard Spit	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
16	Jago and Tapkaurak Spits	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
17	Angun and Beaufort Lagoons	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
18	Icy Reef	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
19	Chukchi Spring Lead 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
20	Chukchi Spring Lead 2	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
21	Chukchi Spring Lead 3	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
22	Chukchi Spring Lead 4	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
23	Chukchi Spring Lead 5	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
24	Beaufort Spring Lead 6	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
25	Beaufort Spring Lead 7	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
26	Beaufort Spring Lead 8	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
27	Beaufort Spring Lead 9	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
28	Beaufort Spring Lead 10	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
29	Ice/Sea Segment 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
30	Ice/Sea Segment 2	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
31	Ice/Sea Segment 3	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
32	Ice/Sea Segment 4	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
33	Ice/Sea Segment 5	1	0.0	1	0.0	:	0.0	1	0.0	1	0.0	1	0.0
34	Ice/Sea Segment 6	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
35	Ice/Sea Segment 7	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
36	Ice/Sea Segment 8	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
37	Ice/Sea Segment 9	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
38	Point Hope Subsistence Are	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
39	Point Lay Subsistence Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
40	Wainwright Subsistence Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
41	Barrow Subsistence Area 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
42	Barrow Subsistence Area 2	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
43	Nuiqsut Subsistence Area	1	0.0	1	0.0	:	0.0	1	0.0	1	0.0	1	0.0
44	Kaktovik Subsistence Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0

Notes: ** = Greater than 99.5 percent; : = less than 0.5 percent

Table C-11 (continued) Combined Probabilities (Expressed as Percent Chance) of One or More Spills Greater than or Equal to 1,000 Barrels, and the Estimated Number of Spills (Mean), Occurring and Contacting a Certain Environmental Resource over the Assumed Production Life of the Lease Area Within 10 Days, Beaufort Sea Sale 202

ID	Environmental Resource Area Name	Full Sale Area		Barrow Subsistence Whale Deferral		Nuiqsut Subsistence Whale Deferral		Kaktovik Subsistence Whale Deferral		Eastern Deferral		Proposed Action	
		% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean
45	Whale Concentration Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
46	Herald Shoal Polynya	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
47	Ice/Sea Segment 10	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
48	Ice/Sea Segment 11	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
49	Hanna’s Shoal Polynya	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
50	Ice/Sea Segment 12	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
51	Ice/Sea Segment 13	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
52	Ice/Sea Segment 14	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
53	Ice/Sea Segment 15	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
54	Ice/Sea Segment 16a	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
55	Ice/Sea Segment 17	3	0.0	3	0.0	2	0.0	3	0.0	3	0.0	3	0.0
56	Ice/Sea Segment 18a	3	0.0	3	0.0	2	0.0	3	0.0	3	0.0	3	0.0
57	Ice/Sea Segment 19	4	0.0	4	0.0	4	0.0	4	0.0	4	0.0	4	0.0
58	Ice/Sea Segment 20a	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
59	Ice/Sea Segment 21	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
60	Ice/Sea Segment 22	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
61	Ice/Sea Segment 22	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
62	Ice/Sea Segment 24a	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
63	Ledyard Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
64	Peard Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
65	ERA 1	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
66	ERA 2	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
67	Ice/Sea Segment 16b	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
68	Harrison Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
69	Harrison Bay/Colville Delta	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
70	ERA 3	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
71	Simpson Lagoon	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
72	Gwyder Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
73	Prudhoe Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
74	Cross Island ERA	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
75	Water over Boulder Patch 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
76	Water over Boulder Patch 2	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
77	Foggy Island Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
78	Mikkelsen Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
79	ERA 4	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
80	Ice/Sea Segment 18b	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
81	Simpson Cove	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
82	ERA 5	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
83	Kaktovik ERA	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
84	Ice/Sea Segment 20b	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
85	ERA 6	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
86	ERA 7	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
87	ERA 8	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
88	Ice Sea Segment 24b	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0

Notes: ** = Greater than 99.5 percent;: = less than 0.5 percent

Table C-12 Combined Probabilities (Expressed as Percent Chance) of One or More Spills Greater than or Equal to 1,000 Barrels, and the Estimated Number of Spills (Mean), Occurring and Contacting a Certain Environmental Resource over the assumed Production Life of the Lease Area Within 30 Days, Beaufort Sea Sale 202

ID	Environmental Resource Area Name	Full Sale Area		Barrow Subsistence Whale Deferral		Nuiqsut Subsistence Whale Deferral		Kaktovik Subsistence Whale Deferral		Eastern Deferral		Proposed Action	
		% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean
	Land	4	0.0	4	0.0	4	0.0	4	0.0	4	0.0	4	0.0
1	Kasegaluk Lagoon	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
2	Point Barrow, Plover Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
3	Thetis and Jones Islands	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
4	Cottle & Return Islands, West Dock	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
5	Midway Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
6	Cross and No Name Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
7	Endicott Causeway	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
8	McClure Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
9	Stockton Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
10	Tigvariak Island	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
11	Maguire Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
12	Flaxman Island	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
13	Barrier Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
14	Anderson Point Barrier Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
15	Arey and Barter Islands, Bernard Spit	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
16	Jago and Tapkaurak Spits	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
17	Angun and Beaufort Lagoons	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
18	Icy Reef	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
19	Chukchi Spring Lead 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
20	Chukchi Spring Lead 2	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
21	Chukchi Spring Lead 3	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
22	Chukchi Spring Lead 4	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
23	Chukchi Spring Lead 5	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
24	Beaufort Spring Lead 6	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
25	Beaufort Spring Lead 7	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
26	Beaufort Spring Lead 8	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
27	Beaufort Spring Lead 9	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
28	Beaufort Spring Lead 10	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
29	Ice/Sea Segment 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
30	Ice/Sea Segment 2	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
31	Ice/Sea Segment 3	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
32	Ice/Sea Segment 4	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
33	Ice/Sea Segment 5	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
34	Ice/Sea Segment 6	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
35	Ice/Sea Segment 7	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
36	Ice/Sea Segment 8	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
37	Ice/Sea Segment 9	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
38	Point Hope Subsistence Are	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
39	Point Lay Subsistence Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
40	Wainwright Subsistence Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
41	Barrow Subsistence Area 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
42	Barrow Subsistence Area 2	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
43	Nuiqsut Subsistence Area	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
44	Kaktovik Subsistence Area	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0

Notes: ** = Greater than 99.5 percent; : = less than 0.5 percent+

Table C-12 (continued) Combined Probabilities (Expressed as Percent Chance) of One or More Spills Greater than or Equal to 1,000 Barrels, and the Estimated Number of Spills (Mean), Occurring and Contacting a Certain Environmental Resource over the Assumed Production Life of the Lease Area Within 30 Days, Beaufort Sea Sale 202

ID	Environmental Resource Area Name	Full Sale Area		Barrow Subsistence Whale Deferral		Nuiqsut Subsistence Whale Deferral		Kaktovik Subsistence Whale Deferral		Eastern Deferral		Proposed Action	
		% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean
45	Whale Concentration Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
46	Herald Shoal Polynya	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
47	Ice/Sea Segment 10	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
48	Ice/Sea Segment 11	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
49	Hanna's Shoal Polynya	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
50	Ice/Sea Segment 12	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
51	Ice/Sea Segment 13	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
52	Ice/Sea Segment 14	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
53	Ice/Sea Segment 15	3	0.0	2	0.0	2	0.0	3	0.0	3	0.0	2	0.0
54	Ice/Sea Segment 16a	3	0.0	3	0.0	3	0.0	3	0.0	3	0.0	3	0.0
55	Ice/Sea Segment 17	4	0.0	4	0.0	3	0.0	4	0.0	4	0.0	4	0.0
56	Ice/Sea Segment 18a	3	0.0	3	0.0	2	0.0	3	0.0	3	0.0	3	0.0
57	Ice/Sea Segment 19	5	0.0	5	0.0	5	0.0	4	0.0	4	0.0	4	0.0
58	Ice/Sea Segment 20a	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
59	Ice/Sea Segment 21	1	0.0	1	0.0	1	0.0	:	0.0	:	0.0	:	0.0
60	Ice/Sea Segment 22	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
61	Ice/Sea Segment 22	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
62	Ice/Sea Segment 24a	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
63	Ledyard Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
64	Peard Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
65	ERA 1	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
66	ERA 2	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
67	Ice/Sea Segment 16b	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
68	Harrison Bay	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
69	Harrison Bay/Colville Delta	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
70	ERA 3	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
71	Simpson Lagoon	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
72	Gwyder Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
73	Prudhoe Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
74	Cross Island ERA	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
75	Water over Boulder Patch 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
76	Water over Boulder Patch 2	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
77	Foggy Island Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
78	Mikkelsen Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
79	ERA 4	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
80	Ice/Sea Segment 18b	2	0.0	2	0.0	1	0.0	2	0.0	2	0.0	2	0.0
81	Simpson Cove	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
82	ERA 5	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
83	Kaktovik ERA	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
84	Ice/Sea Segment 20b	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
85	ERA 6	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
86	ERA 7	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
87	ERA 8	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
88	Ice Sea Segment 24b	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0

Notes: ** = Greater than 99.5 percent;: = less than 0.5 percent

Table C-13 Combined Probabilities (Expressed as Percent Chance) of One or More Spills Greater than or Equal to 1,000 Barrels, and the Estimated Number of Spills (Mean), Occurring and Contacting a Certain Environmental Resource over the assumed Production Life of the Lease Area Within 60 Days, Beaufort Sea Sale 202

ID	Environmental Resource Area Name	Full Sale Area		Barrow Subsistence Whale Deferral		Nuiqsut Subsistence Whale Deferral		Kaktovik Subsistence Whale Deferral		Eastern Deferral		Proposed Action	
		% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean
	Land	6	0.1	6	0.1	6	0.1	6	0.1	6	0.1	6	0.1
1	Kasegaluk Lagoon	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
2	Point Barrow, Plover Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
3	Thetis and Jones Islands	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
4	Cottle & Return Islands, West Dock	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
5	Midway Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
6	Cross and No Name Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
7	Endicott Causeway	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
8	McClure Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
9	Stockton Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
10	Tigvariak Island	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
11	Maguire Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
12	Flaxman Island	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
13	Barrier Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
14	Anderson Point Barrier Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
15	Arey and Barter Islands, Bernard Spit	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
16	Jago and Tapkaurak Spits	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
17	Angun and Beaufort Lagoons	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
18	Icy Reef	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
19	Chukchi Spring Lead 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
20	Chukchi Spring Lead 2	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
21	Chukchi Spring Lead 3	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
22	Chukchi Spring Lead 4	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
23	Chukchi Spring Lead 5	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
24	Beaufort Spring Lead 6	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
25	Beaufort Spring Lead 7	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
26	Beaufort Spring Lead 8	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
27	Beaufort Spring Lead 9	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
28	Beaufort Spring Lead 10	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
29	Ice/Sea Segment 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
30	Ice/Sea Segment 2	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
31	Ice/Sea Segment 3	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
32	Ice/Sea Segment 4	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
33	Ice/Sea Segment 5	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
34	Ice/Sea Segment 6	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
35	Ice/Sea Segment 7	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
36	Ice/Sea Segment 8	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
37	Ice/Sea Segment 9	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
38	Point Hope Subsistence Are	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
39	Point Lay Subsistence Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
40	Wainwright Subsistence Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
41	Barrow Subsistence Area 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
42	Barrow Subsistence Area 2	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
43	Nuiqsut Subsistence Area	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
44	Kaktovik Subsistence Area	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0

Notes: ** = Greater than 99.5 percent; : = less than 0.5 percent

Table C-13 (continued) Combined Probabilities (Expressed as Percent Chance) of One or More Spills Greater than or Equal to 1,000 Barrels, and the Estimated Number of Spills (Mean), Occurring and Contacting a Certain Environmental Resource over the Assumed Production Life of the Lease Area Within 60 Days, Beaufort Sea Sale 202

ID	Environmental Resource Area Name	Full Sale Area		Barrow Subsistence Whale Deferral		Nuiqsut Subsistence Whale Deferral		Kaktovik Subsistence Whale Deferral		Eastern Deferral		Proposed Action	
		% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean
45	Whale Concentration Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
46	Herald Shoal Polynya	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
47	Ice/Sea Segment 10	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
48	Ice/Sea Segment 11	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
49	Hanna's Shoal Polynya	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
50	Ice/Sea Segment 12	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
51	Ice/Sea Segment 13	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
52	Ice/Sea Segment 14	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
53	Ice/Sea Segment 15	3	0.0	3	0.0	3	0.0	3	0.0	3	0.0	3	0.0
54	Ice/Sea Segment 16a	4	0.0	4	0.0	4	0.0	4	0.0	4	0.0	4	0.0
55	Ice/Sea Segment 17	4	0.0	4	0.0	4	0.0	4	0.0	4	0.0	4	0.0
56	Ice/Sea Segment 18a	3	0.0	3	0.0	3	0.0	3	0.0	3	0.0	3	0.0
57	Ice/Sea Segment 19	5	0.0	5	0.0	5	0.0	5	0.0	5	0.0	5	0.0
58	Ice/Sea Segment 20a	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
59	Ice/Sea Segment 21	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
60	Ice/Sea Segment 22	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
61	Ice/Sea Segment 22	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
62	Ice/Sea Segment 24a	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
63	Ledyard Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
64	Peard Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
65	ERA 1	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
66	ERA 2	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
67	Ice/Sea Segment 16b	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
68	Harrison Bay	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
69	Harrison Bay/Colville Delta	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
70	ERA 3	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
71	Simpson Lagoon	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
72	Gwyder Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
73	Prudhoe Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
74	Cross Island ERA	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
75	Water over Boulder Patch 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
76	Water over Boulder Patch 2	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
77	Foggy Island Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
78	Mikkelsen Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
79	ERA 4	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
80	Ice/Sea Segment 18b	2	0.0	2	0.0	1	0.0	2	0.0	2	0.0	2	0.0
81	Simpson Cove	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
82	ERA 5	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
83	Kaktovik ERA	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
84	Ice/Sea Segment 20b	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
85	ERA 6	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
86	ERA 7	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
87	ERA 8	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
88	Ice Sea Segment 24b	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0

Notes: ** = Greater than 99.5 percent;: = less than 0.5 percent

Table C-14 Combined Probabilities (Expressed as Percent Chance) of One or More Spills Greater than or Equal to 1,000 Barrels, and the Estimated Number of Spills (Mean), Occurring and Contacting a Certain Environmental Resource over the assumed Production Life of the Lease Area Within 180 Days, Beaufort Sea Sale 202

ID	Environmental Resource Area Name	Full Sale Area		Barrow Subsistence Whale Deferral		Nuiqsut Subsistence Whale Deferral		Kaktovik Subsistence Whale Deferral		Eastern Deferral		Proposed Action	
		% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean
	Land	10	0.1	10	0.1	10	0.1	10	0.1	10	0.1	10	0.1
1	Kasegaluk Lagoon	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
2	Point Barrow, Plover Islands	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
3	Thetis and Jones Islands	2	0.0	2	0.0	1	0.0	2	0.0	2	0.0	2	0.0
4	Cottle & Return Islands, West Dock	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
5	Midway Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
6	Cross and No Name Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
7	Endicott Causeway	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
8	McClure Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
9	Stockton Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
10	Tigvariak Island	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
11	Maguire Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
12	Flaxman Island	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
13	Barrier Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
14	Anderson Point Barrier Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
15	Arey and Barter Islands, Bernard Spit	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
16	Jago and Tapkaurak Spits	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
17	Angun and Beaufort Lagoons	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
18	Icy Reef	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
19	Chukchi Spring Lead 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
20	Chukchi Spring Lead 2	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
21	Chukchi Spring Lead 3	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
22	Chukchi Spring Lead 4	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
23	Chukchi Spring Lead 5	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
24	Beaufort Spring Lead 6	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
25	Beaufort Spring Lead 7	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
26	Beaufort Spring Lead 8	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
27	Beaufort Spring Lead 9	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
28	Beaufort Spring Lead 10	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
29	Ice/Sea Segment 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
30	Ice/Sea Segment 2	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
31	Ice/Sea Segment 3	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
32	Ice/Sea Segment 4	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
33	Ice/Sea Segment 5	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
34	Ice/Sea Segment 6	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
35	Ice/Sea Segment 7	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
36	Ice/Sea Segment 8	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
37	Ice/Sea Segment 9	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
38	Point Hope Subsistence Are	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
39	Point Lay Subsistence Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
40	Wainwright Subsistence Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
41	Barrow Subsistence Area 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
42	Barrow Subsistence Area 2	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
43	Nuiqsut Subsistence Area	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
44	Kaktovik Subsistence Area	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0

Notes: ** = Greater than 99.5 percent; : = less than 0.5 percent

Table C-14 (continued) Combined Probabilities (Expressed as Percent Chance) of One or More Spills Greater than or Equal to 1,000 Barrels, and the Estimated Number of Spills (Mean), Occurring and Contacting a Certain Environmental Resource over the Assumed Production Life of the Lease Area Within 180 Days, Beaufort Sea Sale 202

ID	Environmental Resource Area Name	Full Sale Area		Barrow Subsistence Whale Deferral		Nuiqsut Subsistence Whale Deferral		Kaktovik Subsistence Whale Deferral		Eastern Deferral		Proposed Action	
		% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean
45	Whale Concentration Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
46	Herald Shoal Polynya	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
47	Ice/Sea Segment 10	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
48	Ice/Sea Segment 11	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
49	Hanna's Shoal Polynya	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
50	Ice/Sea Segment 12	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
51	Ice/Sea Segment 13	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
52	Ice/Sea Segment 14	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
53	Ice/Sea Segment 15	4	0.0	4	0.0	4	0.0	4	0.0	4	0.0	4	0.0
54	Ice/Sea Segment 16a	5	0.1	5	0.1	5	0.0	5	0.1	5	0.1	5	0.1
55	Ice/Sea Segment 17	5	0.0	5	0.0	4	0.0	5	0.0	5	0.0	5	0.0
56	Ice/Sea Segment 18a	4	0.0	4	0.0	3	0.0	4	0.0	4	0.0	4	0.0
57	Ice/Sea Segment 19	5	0.1	5	0.1	5	0.1	5	0.1	5	0.1	5	0.1
58	Ice/Sea Segment 20a	3	0.0	3	0.0	3	0.0	3	0.0	3	0.0	3	0.0
59	Ice/Sea Segment 21	2	0.0	2	0.0	1	0.0	1	0.0	1	0.0	1	0.0
60	Ice/Sea Segment 22	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
61	Ice/Sea Segment 22	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
62	Ice/Sea Segment 24a	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
63	Ledyard Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
64	Peard Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
65	ERA 1	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
66	ERA 2	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
67	Ice/Sea Segment 16b	3	0.0	3	0.0	3	0.0	3	0.0	3	0.0	3	0.0
68	Harrison Bay	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
69	Harrison Bay/Colville Delta	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
70	ERA 3	3	0.0	3	0.0	3	0.0	3	0.0	3	0.0	3	0.0
71	Simpson Lagoon	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
72	Gwyder Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
73	Prudhoe Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
74	Cross Island ERA	2	0.0	2	0.0	1	0.0	2	0.0	2	0.0	2	0.0
75	Water over Boulder Patch 1	1	0.0	1	0.0	:	0.0	1	0.0	1	0.0	1	0.0
76	Water over Boulder Patch 2	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
77	Foggy Island Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
78	Mikkelsen Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
79	ERA 4	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
80	Ice/Sea Segment 18b	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
81	Simpson Cove	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
82	ERA 5	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
83	Kaktovik ERA	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
84	Ice/Sea Segment 20b	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
85	ERA 6	1	0.0	1	0.0	1	0.0	1	0.0	:	0.0	1	0.0
86	ERA 7	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
87	ERA 8	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
88	Ice Sea Segment 24b	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0

Notes: ** = Greater than 99.5 percent;: = less than 0.5 percent

Table C-15 Combined Probabilities (Expressed as Percent Chance) of One or More Spills Greater than or Equal to 1,000 Barrels, and the Estimated Number of Spills (Mean), Occurring and Contacting a Certain Environmental Resource over the assumed Production Life of the Lease Area Within 360 Days, Beaufort Sea Sale 202

ID	Environmental Resource Area Name	Full Sale Area		Barrow Subsistence Whale Deferral		Nuiqsut Subsistence Whale Deferral		Kaktovik Subsistence Whale Deferral		Eastern Deferral		Proposed Action	
		% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean
	Land	14	0.2	14	0.2	14	0.1	14	0.1	14	0.1	14	0.1
1	Kasegaluk Lagoon	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
2	Point Barrow, Plover Islands	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
3	Thetis and Jones Islands	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
4	Cottle & Return Islands, West Dock	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
5	Midway Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
6	Cross and No Name Islands	1	0.0	1	0.0	:	0.0	1	0.0	1	0.0	1	0.0
7	Endicott Causeway	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
8	McClure Islands	1	0.0	1	0.0	:	0.0	1	0.0	1	0.0	1	0.0
9	Stockton Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
10	Tigvariak Island	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
11	Maguire Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
12	Flaxman Island	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
13	Barrier Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
14	Anderson Point Barrier Islands	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
15	Arey and Barter Islands, Bernard Spit	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
16	Jago and Tapkaurak Spits	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
17	Angun and Beaufort Lagoons	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
18	Icy Reef	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
19	Chukchi Spring Lead 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
20	Chukchi Spring Lead 2	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
21	Chukchi Spring Lead 3	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
22	Chukchi Spring Lead 4	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
23	Chukchi Spring Lead 5	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
24	Beaufort Spring Lead 6	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
25	Beaufort Spring Lead 7	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
26	Beaufort Spring Lead 8	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
27	Beaufort Spring Lead 9	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
28	Beaufort Spring Lead 10	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
29	Ice/Sea Segment 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
30	Ice/Sea Segment 2	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
31	Ice/Sea Segment 3	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
32	Ice/Sea Segment 4	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
33	Ice/Sea Segment 5	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
34	Ice/Sea Segment 6	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
35	Ice/Sea Segment 7	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
36	Ice/Sea Segment 8	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
37	Ice/Sea Segment 9	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
38	Point Hope Subsistence Are	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
39	Point Lay Subsistence Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
40	Wainwright Subsistence Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
41	Barrow Subsistence Area 1	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
42	Barrow Subsistence Area 2	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
43	Nuiqsut Subsistence Area	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
44	Kaktovik Subsistence Area	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0

Notes: ** = Greater than 99.5 percent; : = less than 0.5 percent

Table C-15 (continued) Combined Probabilities (Expressed as Percent Chance) of One or More Spills Greater than or Equal to 1,000 Barrels, and the Estimated Number of Spills (Mean), Occurring and Contacting a Certain Environmental Resource over the Assumed Production Life of the Lease Area Within 360 Days, Beaufort Sea Sale 202

ID	Environmental Resource Area Name	Full Sale Area		Barrow Subsistence Whale Deferral		Nuiqsut Subsistence Whale Deferral		Kaktovik Subsistence Whale Deferral		Eastern Deferral		Proposed Action	
		% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean	% Chance	Mean
45	Whale Concentration Area	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
46	Herald Shoal Polynya	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
47	Ice/Sea Segment 10	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
48	Ice/Sea Segment 11	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
49	Hanna’s Shoal Polynya	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
50	Ice/Sea Segment 12	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
51	Ice/Sea Segment 13	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
52	Ice/Sea Segment 14	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
53	Ice/Sea Segment 15	4	0.0	4	0.0	4	0.0	4	0.0	4	0.0	4	0.0
54	Ice/Sea Segment 16a	5	0.1	5	0.1	5	0.1	5	0.1	5	0.1	5	0.1
55	Ice/Sea Segment 17	5	0.1	5	0.1	5	0.0	5	0.1	5	0.1	5	0.1
56	Ice/Sea Segment 18a	4	0.0	4	0.0	3	0.0	4	0.0	4	0.0	4	0.0
57	Ice/Sea Segment 19	5	0.1	5	0.1	5	0.1	5	0.1	5	0.1	5	0.1
58	Ice/Sea Segment 20a	4	0.0	4	0.0	4	0.0	3	0.0	3	0.0	3	0.0
59	Ice/Sea Segment 21	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
60	Ice/Sea Segment 22	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
61	Ice/Sea Segment 22	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
62	Ice/Sea Segment 24a	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
63	Ledyard Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
64	Peard Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
65	ERA 1	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
66	ERA 2	3	0.0	3	0.0	3	0.0	3	0.0	3	0.0	3	0.0
67	Ice/Sea Segment 16b	4	0.0	4	0.0	4	0.0	4	0.0	4	0.0	4	0.0
68	Harrison Bay	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
69	Harrison Bay/Colville Delta	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
70	ERA 3	4	0.0	4	0.0	3	0.0	4	0.0	4	0.0	4	0.0
71	Simpson Lagoon	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
72	Gwyder Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
73	Prudhoe Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
74	Cross Island ERA	2	0.0	2	0.0	1	0.0	2	0.0	2	0.0	2	0.0
75	Water over Boulder Patch 1	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
76	Water over Boulder Patch 2	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
77	Foggy Island Bay	1	0.0	1	0.0	:	0.0	1	0.0	1	0.0	1	0.0
78	Mikkelsen Bay	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
79	ERA 4	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
80	Ice/Sea Segment 18b	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
81	Simpson Cove	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0	:	0.0
82	ERA 5	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
83	Kaktovik ERA	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
84	Ice/Sea Segment 20b	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
85	ERA 6	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
86	ERA 7	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
87	ERA 8	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
88	Ice Sea Segment 24b	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0

Notes: ** = Greater than 99.5 percent;: = less than 0.5 percent

Table C-16 Combined Probabilities (Expressed as Percent Chance) of One or More Spills Greater than or Equal to 1,000 Barrels, and the Estimated Number of Spills (Mean), Occurring and Contacting a Certain Land Segment over the Assumed Production Life of the Lease Area Within 3 Days, Beaufort Sea Sale 202

ID	Land Segment Name	Full Sale Area		Barrow Subsistence Whale Deferral		Nuiqsut Subsistence Whale Deferral		Kaktovik Subsistence Whale Deferral		Eastern Deferral		Proposed Action	

Notes: All land segments have all values less than 0.5%; therefore the data are not shown and the tables are left blank.

Table C-17 Combined Probabilities (Expressed as Percent Chance) of One or More Spills Greater than or Equal to 1,000 Barrels, and the Estimated Number of Spills (Mean), Occurring and Contacting a Certain Land Segment over the Assumed Production Life of the Lease Area Within 10 Days, Beaufort Sea Sale 202

ID	Land Segment Name	Full Sale Area		Barrow Subsistence Whale Deferral		Nuiqsut Subsistence Whale Deferral		Kaktovik Subsistence Whale Deferral		Eastern Deferral		Proposed Action	

Notes: All land segments have all values less than 0.5%; therefore the data are not shown and the tables are left blank.

Table C-18 Combined Probabilities (Expressed as Percent Chance) of One or More Spills Greater than or Equal to 1,000 Barrels, and the Estimated Number of Spills (Mean), Occurring and Contacting a Certain Land Segment over the Assumed Production Life of the Lease Area Within 30 Days, Beaufort Sea Sale 202

ID	Land Segment Name	Full Sale Area		Barrow Subsistence Whale Deferral		Nuiqsut Subsistence Whale Deferral		Kaktovik Subsistence Whale Deferral		Eastern Deferral		Proposed Action	

Notes: All land segments have all values less than 0.5%; therefore the data are not shown and the tables are left blank.

Table C-19 Combined Probabilities (Expressed as Percent Chance) of One or More Spills Greater than or Equal to 1,000 Barrels, and the Estimated Number of Spills (Mean), Occurring and Contacting a Certain Land Segment over the Assumed Production Life of the Lease Area Within 60 Days, Beaufort Sea Sale 202

ID	Land Segment Name	Full Sale Area		Barrow Subsistence Whale Deferral		Nuiqsut Subsistence Whale Deferral		Kaktovik Subsistence Whale Deferral		Eastern Deferral		Proposed Action	
32	Cape Halkett, Esook Trading Post, Garry Creek	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0

Notes: ** = Greater than 99.5 percent; : = less than 0.5 percent. Rows with all values less than 0.5 percent are not shown.

Table C-20 Combined Probabilities (Expressed as Percent Chance) of One or More Spills Greater than or Equal to 1,000 Barrels, and the Estimated Number of Spills (Mean), Occurring and Contacting a Certain Land Segment over the Assumed Production Life of the Lease Area Within 180 Days, Beaufort Sea Sale 202

ID	Land Segment Name	Full Sale Area		Barrow Subsistence Whale Deferral		Nuiqsut Subsistence Whale Deferral		Kaktovik Subsistence Whale Deferral		Eastern Deferral		Proposed Action	
25	Barrow, Browerville, Elson Lagoon	1	0.0	n	0.0	n	0.0	1	0.0	1	0.0	n	0.0
28	Cape Simpson, Piasuk River, Sinclair River, Tulimanik Island	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
31	Lonely, Pitt Point, Pogik Bay, Smith River	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
32	Cape Halkett, Esook Trading Post, Garry Creek	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
36	Kalubik Creek, Oliktok Point, Thetis Mound	1	0.0	1	0.0	n	0.0	1	0.0	1	0.0	1	0.0
47	Bernard Harbor, Jago Lagoon, Kaktovik, Kaktovik Lagoon	1	0.0	1	0.0	1	0.0	n	0.0	1	0.0	n	0.0

Notes: ** = Greater than 99.5 percent; : = less than 0.5 percent. Rows with all values less than 0.5 percent are not shown.

Table C-21 Combined Probabilities (Expressed as Percent Chance) of One or More Spills Greater than or Equal to 1,000 Barrels, and the Estimated Number of Spills (Mean), Occurring and Contacting a Certain Land Segment over the Assumed Production Life of the Lease Area Within 360 Days, Beaufort Sea Sale 202

ID	Land Segment Name	Full Sale Area		Barrow Subsistence Whale Deferral		Nuiqsut Subsistence Whale Deferral		Kaktovik Subsistence Whale Deferral		Eastern Deferral		Proposed Action	
25	Barrow, Browerville, Elson Lagoon	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
28	Cape Simpson, Piasuk River, Sinclair River, Tulimanik Island	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
30	Drew Point, Kolovik, McLeod Point	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
31	Lonely, Pitt Point, Pogik Bay, Smith River	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
32	Cape Halkett, Esook Trading Post, Garry Creek	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
35	Anachlik Island, Colville River, Colville River Delta	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
36	Kalubik Creek, Oliktok Point, Thetis Mound	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
37	Beechey Point, Bertoncini Island, Bodfish Island, Cottle Island, Jones Islands, Milne Point, Simpson Lagoon	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
47	Bernard Harbor, Jago Lagoon, Kaktovik, Kaktovik Lagoon	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0

Notes: ** = Greater than 99.5 percent; : = less than 0.5 percent. Rows with all values less than 0.5 percent are not shown.

Appendix D

ADDITIONAL RESOURCE INFORMATION

This appendix contains detailed updates for the following resources:

1. Subsistence-Harvest patterns and Sociocultural Systems
2. Marine and Coastal Birds
3. Local Water Quality
4.a Bowhead Whales
4.b Polar Bears
4.c Other Marine Mammals
4.d Fish and Essential Fish Habitat
5. Environmental Justice
6. Land Use Plans and Coastal Zone Management

D.1. Subsistence-Harvest Patterns and Sociocultural Systems: Sale 202 Affected Environment.

D.1.a. Subsistence Resources and Harvests. This section updates the information on subsistence-harvest patterns, subsistence resources, and sociocultural systems that might be affected by proposed Beaufort Sea Lease Sale 202 and includes updates of information in the multiple-sale final EIS and Sale 195 EA (USDOI, MMS, 2003, 2004). The EIS and EA summarize information about subsistence and sociocultural systems in the villages of Barrow, Atqasuk, Nuiqsut, and Kaktovik that have offshore subsistence-harvest areas within the proposed Sale 202 lease-sale area. Any new information has been used to revise previous effects assessments contained in the multiple-sale EIS.

Subsistence-harvest patterns, subsistence resources that commonly occur on- and offshore, and sociocultural systems of communities in the North Slope region potentially could experience significant effects from oil and gas activities following proposed Sale 202. The entire marine subsistence-harvest areas of Nuiqsut and Kaktovik and most of Barrow's marine subsistence-harvest area lie within or near the boundary of the Beaufort Sea multiple-sale area; portions of Barrow's marine subsistence-harvest area in the Chukchi Sea lie to the west and outside the boundary of the Beaufort Sea multiple-sale area. Onshore, the caribou-hunting areas of Barrow, Nuiqsut, and Kaktovik would be most directly affected by potential pipelines and other onshore facilities associated with proposed actions. Long-term subsistence-harvest practices and subsistence cycles have not changed since the assessment provided in the multiple-sale final EIS (USDOI, MMS, 2003) and the Sale 195 EA (USDOI, MMS, 2004); nevertheless, harvest areas can be fluid and change from season to season. The BLM's Alpine Satellite Development Plan final EIS for potential expansion of Alpine field production near Nuiqsut (USDOI, BLM, 2004) has provided new information on contemporary harvest areas in some communities, particularly Nuiqsut. The primary sociocultural variables—population, social organization, cultural values, and institutional organization—have not altered since the Beaufort Sea multiple-sale EIS and Sale 195 EA were published.

Subsistence-harvest pattern information, along with new research on subsistence resources and sociocultural systems that might influence the previous effects' assessments, is summarized in the following. This summary also includes any new Native stakeholder concerns as they relate to these topics, as well as traditional knowledge updates. The discussions on subsistence-harvest patterns, subsistence resources, and sociocultural systems in MMS's Liberty Development and Production Plan final EIS (USDOI, MMS, 2002), the Bureau of Land Management's (BLM's) Northwest NPR-A final Integrated Activity Plan IAP/EIS (USDOI, BLM and MMS, 2003), and BLM's Northeast NPR-A Final Amended IAP/EIS (USDOI, BLM, 2005) also are summarized and incorporated by reference. Much of this information was updated recently in the draft Arctic seismic Programmatic Environmental Assessment (PEA) for proposed 2006 seismic operations in the Beaufort and Chukchi seas (USDOI, MMS, 2006a). The seismic PEA is available on the MMS web site at: (http://www.mms.gov/alaska/ref/EIS%20EA/DraftProgrammatic%20EA%20&%20Biological%20Eval/PEA_1.pdf).

This section will augment and summarize rather than repeat the PEA descriptive information.

D.1.a(1) Annual Cycle of Harvest Activities. Maps for the primary subsistence-harvest areas for Barrow, Atqasuk, Nuiqsut, and Kaktovik are shown on Map xx, a locator map showing the EIS or EA, and the web address for these maps. Very few Inupiat live outside the traditional communities, but the seasonal movement to hunting sites and camps for subsistence activities involves travel over and use of extensive areas around these settlements. The aggregate community subsistence-harvest areas for the primary subsistence resources of marine mammals (whales, seals, walruses, polar bears); caribou, fish, birds (and eggs); furbearers (for hunting and trapping); moose; Dall sheep; grizzly bears; small mammals; and invertebrates, as well as berries, edible roots, and fuel and structural material are extensive. Annual subsistence cycles for Barrow, Atqasuk, Nuiqsut, and Kaktovik are summarized in the following. The subsistence areas and activities of these four communities in or near the sale area could be affected by the activities evaluated in this EA.

D.1.a(1)(a) Barrow. Barrow residents (population 3,469 in 1990, 4,581 in 2000, and 4,351 in 2004 [USDOC, Bureau of the Census, 1991, 2001; NSB, 1995, 1999; State of Alaska, Dept. of Commerce, Community and Economic Development [DCED], 2005]) enjoy a diverse resource base that includes both marine and terrestrial animals. Barrow's location, at the demarcation point between the Chukchi and Beaufort seas, is unique among North Slope subsistence communities. This location offers superb opportunities for hunting a diversity of marine and terrestrial mammals and fishes. Barrow's subsistence-harvest areas are depicted in detail in maps included in MMS's Liberty Development and Production Plan final EIS (USDOI, MMS, 2002), BLM's Northwest NPR-A final IAP/EIS (USDOI, BLM and MMS, 2003), BLM's Alpine Satellite Development Plan final EIS for potential expansion of Alpine field production near Nuiqsut (USDOI, BLM, 2004), and BLM's Northeast NPR-A Final Amended IAP/EIS (USDOI, BLM, 2005). Subsistence resources used by Barrow are listed in tables provided in these same documents and in the draft seismic-survey PEA (USDOI, MMS, 2006a). No substantial changes to long-term subsistence-harvest practices, subsistence cycles, and types of resources harvested have occurred since MMS's Beaufort Sea multiple-sales EIS, Sale 195 EA, and the subsequent analyses mentioned herein.

For BLM's Alpine final EIS for potential expansion of Alpine field production near Nuiqsut (USDOI, BLM, 2004), S.R. Braund and Assocs. conducted eight interviews in August 2003. These interviews were coordinated with the Inupiat Community of the Arctic Slope and included hunters who were known to travel to the east of Barrow for their subsistence harvests. The use areas described in these eight interviews generally correlated with previously described subsistence land use areas to the east and southeast of Barrow. Some differences did surface with these hunters not going much farther east of the Itkillik River and many going father southeast than in the past to the Anaktuvuk River and into areas near the Titaluk and Kigalik rivers, 120 miles (mi) south of Barrow. Barrow hunters also described occasionally traveling to the Kalikpik-Kogru River areas for caribou, if animals were unavailable closer to Barrow. Winter snowmobile travel for caribou, wolf, wolverine, and fox as far east as Fish and Judy creeks also was reported.

D.1.a(1)(b) Atqasuk. Atqasuk, population 216 in 1990, 228 in 2000, and 247 in 2004 (USDOC, Bureau of the Census, 1991, 2001; State of Alaska, DCED, 2005), is an inland Inupiat community approximately 50 mi south of Barrow. The marine-resource areas used by Atqasuk residents include those used by Barrow residents, as explained in the Barrow subsistence discussion in the drafty seismic-survey PEA (USDOI, MMS, 2006a). Only a small portion of the marine resources used by Atqasuk residents is acquired on coastal hunting trips that are initiated in Atqasuk; most resources are acquired on coastal hunting trips initiated in Barrow or Wainwright with relatives or friends (ACI, Courtnage, and Braund, 1984). Nevertheless, the local connection with the coast and marine resources is important to the community. As one resident observed: "We use the ocean all the time, even up here; the fish come from the ocean; the whitefish as well as the salmon migrate up here" (ACI, Courtnage, and Braund, 1984). Atqasuk's subsistence-harvest areas are depicted in detail in maps included in USDOI, BLM and MMS (2003) and USDOI, BLM (2004, 2005). Subsistence resources used by Atqasuk are listed in tables provided in these same documents, as well as the seismic-survey PEA (USDOI, MMS, 2006a). No substantial changes to long-term subsistence-harvest practices, subsistence cycles, and types of resources harvested have occurred since the publication of the EIS analyses mentioned above.

D.1.a(1)(c) Nuiqsut. The Inupiat community of Nuiqsut had population figures of 354 in 1990, 433 in 2000, and 430 in 2004 (USDOC, Bureau of the Census, 1991, 2001; NSB, 1995, 1999; State of Alaska, DCED, 2005). Nuiqsut is located near the mouth of the Colville River, which drains into the Beaufort Sea. For Nuiqsut, important subsistence resources include bowhead whales, caribou, fish, waterfowl, ptarmigan and, to a lesser extent, seals, muskoxen, and Dall sheep. Polar bears, beluga whales, and walruses are seldom hunted but can be taken opportunistically while in pursuit of other subsistence species. Nuiqsut has subsistence-harvest areas in and adjacent to the Beaufort Sea multiple-sale area. Cross Island and vicinity is a crucially important region for Nuiqsut's subsistence-bowhead whale hunting. Before oil development at Prudhoe Bay, the onshore area from the Colville River Delta in the west to Flaxman Island in the east and inland to the foothills of the Brooks Range (especially up the drainages of the Colville, Itkillik, and Kuparuk rivers) was historically important to Nuiqsut for the subsistence harvests of caribou, waterfowl, furbearers, fishes, and polar bears. Offshore, in addition to bowhead whale hunting, seals historically were hunted as far east as Flaxman Island. Nuiqsut's subsistence-harvest areas are depicted in detail in maps included in USDOI, MMS (2002), USDOI, BLM and MMS (2003) and USDOI, BLM (2004, 2005). Subsistence resources used by Nuiqsut are listed in tables provided in these same documents, as well as the seismic-survey PEA (USDOI, MMS, 2006a). No substantial changes to long-term subsistence-harvest practices, subsistence cycles, and types of resources harvested have occurred since MMS's Beaufort Sea Multiple-Sale EIS, Sale 195 EA, and the subsequent analyses mentioned herein.

For BLM's Alpine final EIS (USDOI, BLM, 2004), S.R. Braund and Assocs. conducted 21 interviews in June and July 2003. These interviews included hunters of both genders and ranged in ages from young hunters to active elders. The subsistence-use area for all resources described in these interviews is similar in the most part to that described by Pedersen et al. (In prep.) for harvests conducted from 1973 thorough 1986. Some formerly used areas to the west and south were not described as presently used, although this could be due to the practices of the actual hunters interviewed. Areas in the vicinity of Prudhoe Bay are no longer used, because industrial development has rendered them inaccessible.

These interviews also included additional traditional and local knowledge testimony. In her testimony at a 2003 public hearing for the Alpine Satellite Development Plan, Nuiqsut's Mayor Rosemary Ahtuangaruak related that villagers were seeing changes in caribou and fish that left the animals with tumors and lesions; they believed these effects originated from pollution from nearby gas flares. She also noted that helicopter activity was diverting caribou away from the community. Jimmy Nukapigak related that Alpine development had contributed to fewer arctic cisco in the Fish Creek area. Frank Long, Jr. believed that developing CD-6 would threaten fishing in Niqliq Channel and other Colville River channels.

The MMS is conducting long-term environmental monitoring in the Nuiqsut subsistence-whaling area as part of its Continuation of Arctic Nearshore Impact Monitoring in Development Area (CANIMIDA) study. Part of this effort is a multiyear collaborative project with Nuiqsut whalers that describes present-day subsistence whaling practices at Cross Island to empirically verify any changes to whaling due to weather, ice conditions, and oil and gas activities. The project findings were summarized during a recent MMS Information Transfer Meeting (USDOI, MMS, 2005). Overall, the project has shown that Nuiqsut whalers have continued to obtain their quota of whales and that industry vessels have helped with the transportation of whale meat in a way that has not hindered the whale hunt. However, Nuiqsut whalers reported annually the following changes in whale behavior and whaling practices:

In 2001:

- More ice and marginal weather conditions due to ice and wind made whaling more difficult
- fewer whales in smaller groups were seen;
- the need to travel farther from Cross Island to find whales;
- whales observed were more skittish than in previous years, stayed more in the ice than in open water, spent more time on the surface, and followed more unpredictable paths underwater;
- whales were more difficult to spot, because blows were not as observable as in past years, and;
- whales appeared to be skinnier (not as round) than they had been in previous years.

Possible causes suggested by whalers for these behavioral changes were:

- Offshore seismic survey work being conducted for a natural gas-pipeline route.
- Barge traffic carrying supplies to Kaktovik for a water and sewer-construction project.
- Killer whales being present offshore and to the east of Cross island.
- Ice conditions present in Canadian waters.
- Air or water traffic located to the east of Cross Island (Galginaitis and Funk, 2004).

In 2002:

- More moderate ice conditions than 2001 contributed to not being able to follow certain whales, but not to the same extent as 2001 when ice conditions were more severe.
- More whales and in larger groups were seen in 2002 than in 2001 and, in Nuiqsut, whalers reported seeing more whales during hunting trips in 2002 than in 2001; this was reported to be more the "normal"case.
- Whales were observed closer to Cross Island, but whalers probably traveled as far on their trips in 2002 as in 2001.
- Some skittish or "spooky" whales were observed; but it seemed that crews were better able to track whales in 2002 than in 2001.
- Two whales sank after they were killed, but no consensus on why was reached by whalers.

Possible causes suggested by whalers for these behavioral changes were:

- better ice conditions and
- very little nonwhaling subsistence activity near Cross Island during the whaling season (Galginaitis and Funk, 2004).

In 2003:

- Ice conditions in 2003 were more moderate than in 2001 or 2002, but high winds and less ice to moderate the wind prevented scouting for whales more than 50%.
- Conditions were not as good as in 2000 and 2002, but they may have been better or about the same as 2001.
- More whales were observed by whalers during hunting trips in 2003 than in 2002, and quite a few more than in 2001. Whales were observed on every day that boats went scouting.
- Whalers found whales relatively close to Cross Island and were harvested closer to Cross Island in 2003 than in 2001 or 2002.
- No skittish or "spooky" whale behavior was observed.

Possible causes suggested by whalers for these behavioral changes were:

- High winds, and the lack of ice that could have moderated the effect of the wind, was a major weather factor cited by whalers (Galginaitis and Funk, 2005).

In 2004:

- Ice conditions in 2004 were even more moderate than in previous years.
- Weather prevented scouting a significant number of days but not as many days as in 2003.
- The level of whaling effort, as measured by time spent out on the water, was about twice that of 2003, but still much less than in 2002 or 2001.
- Whalers reported seeing many whales; whalers did not compare one year to another, but 2004 was probably comparable to 2003 in terms of whales sighted, and "better" than in 2002 or 2001.
- Whalers found whales relatively close to Cross Island; whales were harvested about the same distance from Cross Island in 2004 as in 2003 (which was closer than in 2001 or 2002).

- Whalers took shorter trips, both in terms of length and time duration, than in 2002 or 2001, but longer than in 2003 (which is why total effort was greater in 2004 than in 2003).
- No whaler explicitly mentioned observing skittish or "spooky" whale behavior.

Possible causes suggested by whalers for these behavioral changes were:

- The lack of ice that could have moderated the effects of the wind.
- Weather generally was poor, and whalers sometimes went scouting in relatively marginal conditions.
- Whales may have been more difficult to spot, due to wave height.
- Whales could have been traveling more rapidly than in past years (Galginaitis and Funk, 2006a).

In 2005:

- Whalers encountered a great deal of ice in 2005, which was a dramatic change from the previous four years.
- Weather also was very unfavorable and was dominated by strong east winds.
- Whalers saw relatively few whales in 2005 compared to previous years; swells and waves due to wind made spotting and observing difficult.
- In most cases, whalers were not able to follow or chase whales long enough to have a good opportunity for a strike.
- Whalers indicated that whales were traveling fast, not staying on the surface very long, and changing directions in unpredictable ways when first sighted.
- Ice and weather were not considered to be factors in making whales more "skittish."
- There were no reports of whale feeding behavior.

Possible causes suggested by whalers for these behavioral changes were:

- Heavy ice cover was encountered on most days.
- Significant ice cover allows whales to "hide" and makes them more difficult to spot.
- Significant ice cover allows whales that are seen to escape more easily and makes them more difficult to follow.
- "Spooked" behavior by whales was attributed to their reactions to encounters with barges and other vessel activity in the area.
- Whalers believed that the migration of whales in 2005 was similar to that of previous years, but that ice and weather conditions prevented them from reaching the whales.
- The same ice and weather conditions made nearshore waters the preferred operating areas for nonwhaling vessel traffic and increased potential encounters with whalers (Galginaitis and Funk, 2006b).

According to Galginaitis, "the need for a better mechanism to implement the common goal of conflict avoidance for years of extreme environmental conditions as 2005 is quite obvious" (Galginaitis and Funk, 2006b).

The Nuiqsut subsistence-whaling area is discussed in USDOI, MMS (2004:Appendix H). Appendix H illustrates the extent of Nuiqsut whaling crew voyages for the 2001 and 2002 whaling seasons. These data were gathered as part of the ongoing MMS ANIMIDA monitoring effort in the region and have been updated in this EA based on data gathered as part of the MMS CANIMIDA (Galginaitis and Funk, 2004, 2005), which reports on recent data about the level of subsistence activity around Cross Island. The most recent report explains that during 2001, the four whaling crews on Cross Island spent more than 10 hours on each scouting trip looking for whales. The total amount of time scouting was about 600 hours (Galginaitis and Funk, 2004). Rough weather prevented scouting during about one-third of the time that the whalers were on Cross Island during 2001 (Galginaitis and Funk, 2004) and about half of the time during 2003 (Galginaitis and Funk, 2005). See Figures X1 through X3 that track Nuiqsut whaling crew voyages for the 2003, 2004, and 2005 whaling seasons; Figure X4 is a composite map of all whaling tracks for the years 2001 through 2005 (Galginaitis and Funk, 2005).

The unusually rough water that restricted scouting for whales might have been related to the unusual retreat of the summer ice cover in the Beaufort Sea during recent years (see Sec. IV.A.1). The changes in the ice cover and some of its effects on coastal erosion were summarized by Comiso (2005) and Wisniewski (2005). Comiso (2005) showed the minimum extent and minimum area for the arctic ice cover from 1979-2003 depicted in a graph, as determined by satellite. The graph illustrated that the ice cover has been decreasing and was unusually small during 2003—the year when Nuiqsut subsistence-whaling activity was cut to half of its normal time by rough water. The autumn ice cover again was unusually far from the coast during 2004 (Stroeve et al., 2005). In summary, the recent offshore subsistence-whale hunts have been affected by the retreat of the ice cover far from the coast. This contrasts with the situation decades ago when the whale hunts were sometimes limited by heavy ice covers.

D.1.a(1)(d) Kaktovik. Kaktovik is situated on Barter Island off the Beaufort Sea coast (population 224 in 1990, 293 in 2000, and 284 in 2004 [USDOC, Bureau of the Census, 1991, 2001; NSB, Dept. of Planning and Community Services, 1994, 1999; State of Alaska, DCED, 2005]). Important Kaktovik subsistence resources are bowhead and beluga whales, seals, polar bears, caribou, fishes, and marine and coastal birds. Like Barrow and Nuiqsut, much of Kaktovik's marine subsistence-harvest area is within the Beaufort Sea multiple-sale area, and the western edge of the community's terrestrial mammal, fish, and bird subsistence-harvest areas overlap a possible landfall location at Point Thompson. Kaktovik's subsistence-harvest areas are depicted in detail in maps included in USDOI, MMS (2002), USDOI, BLM and MMS (2003), and USDOI, BLM (2004, 2005). Subsistence resources used by Kaktovik are listed in tables provided in these same documents, as well as the seismic-survey PEA (USDOI, MMS, 2006a). No substantial changes to long-term subsistence-harvest practices, subsistence cycles, and types of resources harvested have occurred since MMS's Beaufort Sea multiple-sales EIS, the Sale 195 EA, and the subsequent analyses mentioned herein. All of Kaktovik's marine subsistence-harvest area is within the Sale 202 area.

In 1992, the NSB surveyed subsistence harvests in eight NSB communities. The analysis of these surveys was not published until 1997 in the Fuller and George (1997) report *Evaluation of Subsistence Harvest Data from the NSB 1993 Census for Eight North Slope Villages: For the Calendar Year 1992*. Information from this report was incorporated in USDOI, BLM and MMS (2003) for Barrow and Nuiqsut; however, this final EIS did not include an analysis for Kaktovik, as the community was out of the potentially affected area of any Northwest NPR-A leasing. Harvest data were collected only anecdotally for Kaktovik by NSB personnel, because the Alaska Department of Fish and Game was administering a subsistence survey in the village at the same time. The NSB harvest data for this season should be considered primarily as comparative to State Fish and Game data collected the same year, as the overall survey response rate was low.

Fuller and George (1997) harvest estimates for the 1992 harvest season in Kaktovik—not used in the multiple-sale EIS—include:

(1) Three bowhead whales were harvested, representing 110,000 pounds of meat. Bearded seals and beluga whales were other important marine mammals taken. Five walruses also were harvested, a rare occurrence in the eastern Beaufort Sea. Marine mammals represented 66.2% of the total edible pounds harvested.

(2) For terrestrial mammals, 136 caribou, 53 Dall sheep, and 6 muskoxen were harvested in 1992, 13.9 % of the total edible pounds harvested.

(3) For fish resources, 7,900 arctic char (actually Dolly Varden), 7,100 arctic cisco, and 2,600 grayling were harvested, 18.3 % of the edible pounds harvested.

(4) Bird/waterfowl resources included 333 Pacific brant, 180 white-fronted geese, 11 snow geese, some Canada geese, and 11 Steller's eiders, 1.4 % of the edible pounds harvested.

Fifty-percent of the households surveyed participated often in fall whaling, and more than 40% participated in caribou hunting, sheep hunting, and fishing (Fuller and George, 1997). Pedersen (2005) conducted surveys of the Kaktovik subsistence fishery in 2000-2001 and 2001-2002, with estimated community harvests of fish at 5,970.0 pounds (lb) and 9,748.3 lb, respectively. Dolly Varden, lake trout, and arctic cisco were the only fishery resources reported harvested by Kaktovik households in this study. Dolly Varden was the most commonly harvested fish in terms of numbers harvested and estimated harvest weight, with arctic cisco and lake trout ranking second and third (Pedersen, 2005).

D.1.b. Sociocultural Systems. The following discussion describes the Alaskan North Slope communities that may be affected directly by oil and gas exploration and development in the sale area. These community-specific descriptions discuss factors relevant to the sociocultural analysis of each community in relation to industrial activities, population, and current socioeconomic conditions. Following these descriptions, the social organization, cultural values, and other issues common to all the communities are discussed. The primary sociocultural variables—population, social organization, cultural values, and institutional organization—have not altered since the Beaufort Sea multiple-sale final EIS (USDOI, MMS, 2003) and the Beaufort Sea Sale 195 EA (USDOI, MMS, 2004)

Sociocultural information, along with new research on sociocultural systems that might influence the previous effects' assessments is summarized in the following. This summary also includes any new Native stakeholder concerns as they relate to these topics, as well as traditional knowledge updates. The discussions on sociocultural systems in MMS's Liberty Development and Production Plan final EIS (USDOI, MMS (2002),the BLM's Northwest NPR-A Final IAP/EIS (USDOI, BLM and MMS, 2003), BLM's Northeast NPR-A Final Amended IAP/EIS (USDOI, BLM, 2005), as well as the seismic-survey PEA (USDOI, MMS, 2006a) also are summarized and incorporated by reference.

D.1.b(1) Barrow. Barrow is the largest community on the North Slope and is its regional center. The city already has experienced dramatic population changes as a result of increased revenues from onshore oil development and production at Prudhoe Bay and in other smaller oil fields; these revenues stimulated the NSB Capital Improvements Projects (CIP) in earlier years. In the 2000 Census, Barrow's Inupiat population remained undiminished at 64.0% of the total Barrow population; its population stood at 4,351 in 2004 (USDOC, Bureau of the Census, 1991, 2001; Harcharek, 1992; NSB, 1995, 1999; State of Alaska, DCED, 2005). Barrow's social characteristics, systems, and conditions are described in detail in USDOI, MMS (2002), USDOI, BLM and MMS (2003), and USDOI, BLM (2004, 2005) as well as the Arctic seismic (USDOI, MMS, 2006a). No substantial changes to long-term social characteristics have occurred since the Beaufort Sea multiple-sale EIS, the Sale 195 EA, and the subsequent analyses mentioned herein.

D.1.b(2) Atqasuk. Atqasuk is a small, predominantly Inupiat community on the Meade River, about 60 mi south of Barrow. The total 1990 community population was 216 (92% Inupiat). In 2000, there were 228 residents, 94.3% of whom were Inupiat; in 2004, there were 247 community residents (USDOC, Bureau of the Census, 1991, 2001; State of Alaska, DCED, 2005). The community was established in the mid-1970's under the 1971 Alaska Native Claims Settlement Act (ANCSA) by Barrow residents who had traditional ties to the area. People lived in tents until NSB-sponsored housing arrived in 1977. The 1980 Census tallied 107 residents; 2 years later, a Borough census recorded 210 residents. By July 1983, the population had risen to 231, a 166% increase since the first census in 1980. Atqasuk is an inland village and its subsistence preferences follow this trend, with caribou and fish being the primary subsistence resources. Social ties between Barrow and Atqasuk remain strong, and men from Atqasuk go to Barrow to join bowhead-whaling crews. To a large degree, Atqasuk has avoided the rapid social and economic changes experienced by Barrow and Nuiqsut brought on by oil-development activities, but future change could accelerate as a result of oil exploration and development in the Northwest NPR-A Planning Area. Possible new pipeline routes could cross Atqasuk's terrestrial subsistence-harvest areas, as most of its traditional subsistence-use area is within the NPR-A (USDOI, BLM and MMS, 2003). Atqasuk's social characteristics, systems, and conditions are described in detail in USDOI, BLM and MMS (2003) and USDOI, BLM (2004, 2005) as well as the seismic-survey PEA (USDOI, MMS, 2006a).

D.1.b(3) Nuiqsut. Nuiqsut sits on the west bank of the Nechelik Channel of the Colville River Delta, about 25 mi inland from the Arctic Ocean and approximately 150 mi southeast of Barrow. The population was 433 (89.1% Inupiat) in 2000 and 430 in 2004 (USDOC, Bureau of the Census, 1991, 2001; NSB, 1995, 1999; State of Alaska, DCED, 2005). Nuiqsut is experiencing rapid social and economic change due to the development of new local infrastructure, including natural gas hookups soon to come to all community households, the development of the Alpine facility and potential Alpine Satellite development, and potential oil development in the NPR-A. Nuiqsut's social characteristics, systems, and conditions are described in detail in USDOI, MMS (2002), USDOI, BLM and MMS (2003), and USDOI, BLM (2004, 2005) as well as the seismic-survey PEA (USDOI, MMS, 2006a). No substantial changes to long-term social characteristics have occurred since the Beaufort Sea multiple-sale EIS, the Sale 195 EA, and the subsequent analyses mentioned herein.

In her testimony at a 2003 public hearing for the Alpine Satellite Development Plan (USDOI, BLM, 2004), Rosemary Ahtuangaruak, Mayor of Nuiqsut, observed that although the village ethnic makeup had not changed, and that oil-development infrastructure was creeping closer to the community and bringing with it new health issues, including an increasing number of asthma cases. Testifying at the same meeting, Bernice Kaigelak commented that the qualifications for Natives to get local oil-industry jobs had gotten more prohibitive. Testing used to be restricted to passing a urinary analysis but recently had been extended to other licensing requirements, many of which were hard to get certification for in a small community like Nuiqsut.

D.1.b(4) Kaktovik. Kaktovik, incorporated in 1971, is the easternmost village in the NSB. In 2000, Kaktovik's population was 293, and in 2004, it was 284 (84.0% Inupiat) (USDOC, Bureau of the Census, 1991, 2001; NSB, Dept. of Planning and Community Services, 1994, 1999; State of Alaska, DCED, 2005). Kaktovik is located on the north shore of Barter Island situated between the Okpilak and Jago rivers on the Beaufort Sea coast. Barter Island is one of the largest of a series of barrier islands along the north coast and is about 300 mi east of Barrow. Kaktovik abuts the Arctic National Wildlife Refuge. Kaktovik's social characteristics, systems, and conditions are described in detail in USDOI, MMS (2002) and in the seismic-survey PEA (USDOI, MMS, 2006a). No substantial changes to long-term social characteristics have occurred since the Beaufort Sea multiple-sale EIS the Sale 195 EA, and the subsequent analyses mentioned herein.

- **Summary.** The MMS is conducting long-term environmental monitoring in the Nuiqsut subsistence-whaling area and, as part of this effort, has conducted a multiyear collaborative project with Nuiqsut whalers that describe present-day subsistence-whaling practices at Cross Island to empirically verify any changes to whaling due to weather, ice conditions, and oil and gas activities. The project findings were summarized during a recent MMS Information Transfer Meeting (USDOI, MMS, 2005). Overall, the project has shown that the Nuiqsut whalers have continued to obtain their quota of whales, and that industry vessels have helped with the transportation of whale meat in a way that has not hindered the whale hunt. However, Nuiqsut whalers reported changes in whale behavior and whaling practices during 2001 and suggested possible causes for those changes.

The ongoing MMS ANIMIDA study (Galginaitis and Funk, 2004, 2005), reported on recent data about the level of subsistence activity around Cross Island. That report stated that during 2001, the four whaling crews on Cross Island spent more than 10 hours on each scouting trip looking for whales, and that the total amount of time scouting was about 600 hours. Rough weather prevented scouting during about one-third of the time that the whalers were on Cross Island during 2001 and about half of the time during 2003.

In summary, the recent offshore subsistence-whale hunts have been affected by the retreat of the ice cover far from the coast. This contrasts with the situation decades ago, when the whale hunts were sometimes limited by heavy ice covers.

D.2. Marine and Coastal Birds.

This section updates new information that has become available since publication of the multiple-sale EIS, incorporating information from recent research, the 195 EA, and the seismic-survey PEA (USDOI, MMS, 2003, 2004, 2006a). The MMS also hosted an information exchange meeting October 31-November 1, 2005, (Appendix F) that included presentations by researchers on the latest information on bird species of concern in the Beaufort and Chukchi seas. The updated information includes recently obtained research results on size, status, trends, and distribution of eiders, the long-tailed duck, the yellow-billed loon, and other bird (species/guilds) populations potentially at risk of substantial effects from this action. Also included is new information on breeding biology, habitat use, and migratory patterns that may help to improve our understanding of the vulnerability of these species to oil and gas exploration and development activities. Where pertinent, this new information has been used to refine the previous assessment of potential effects contained in the EIS. The MMS recently sent a memorandum to the Fish and Wildlife Service (FWS) requesting concurrence on an updated assessment that concluded no new relevant information would necessitate reinitiation of formal consultation on listed species (Appendix E).

As described in the multiple-sale EIS, spectacled and Steller's eiders are listed as threatened under the Endangered Species Act (ESA). The Kittlitz's murrelet (*Brachyramphus brevirostris*) now is designated a candidate species under the ESA (69 *FR* 69 24876-24904) and is thought "likely to occur" in the Beaufort Sea by the FWS (USDOI, FWS, 2006). The MMS, however, has no records of its occurrence in the Beaufort Sea Sale 202 project area. If any Kittlitz's murrelets occur in or near the project area, their numbers would be expected to be very small and there would be a low potential for effects on this species.

D.2.a. Species with Higher Potential for Substantial Effects. Principal bird species seasonally occurring in the Alaskan Beaufort Sea vicinity that are considered to have a high potential for substantial effects from oil and gas activities following proposed Sale 202 included spectacled eider, Steller's eider, king eider, common eider, long-tailed duck, black guillemot, and yellow-billed loon. Recent information on the yellow-billed loon range, population size, habitat requirements, and perceived threats to breeding and wintering habitat indicates that the yellow-billed loon is experiencing a population decline, and certain population segments are particularly vulnerable to impacts. Similarly, recent studies indicate certain Beaufort Sea coastal locales host large concentrations of postbreeding and juvenile shorebirds. Certain shorebird species could undergo population-level changes from a low-probability oil spill. Yellow-billed loons and shorebirds (as a group) were considered to have a greater potential for substantial effects from oil and gas exploration than was concluded by the multiple-sale EIS. Updated information for each species or species group follows.

D.2.a(1) Spectacled Eider. As explained in the USDOI, MMS (2003, 2004), the breeding population on the North Slope currently is the largest breeding population of spectacled eiders in North America. The spectacled eider was listed throughout its range as a threatened species on May 10, 1993 (58 *FR* 27474-27480). The primary reason for listing was the dramatic decline (from ~50,000 pairs in 1971 to an estimated 1,721 pairs in 1992) documented for the Yukon-Kuskokwim (Y-K) Delta breeding population as well as the apparent decline in the North Slope breeding population (Stehn et al., 1993; Ely, Dau, and Babcock, 1994). At the time of listing, the Y-K Delta breeding population was considered to represent roughly half of the world population (Stehn et al., 1993; USDOI, FWS, 1996, 1999). An estimated 363,000 (95% CI 333,526-392,532) spectacled eiders were later discovered south of St. Lawrence Island, Alaska, during late winter (March 1996 and 1997) aerial surveys in the Bering Sea (Larned and Tiplady, 1997; Petersen, Larned, and Douglas, 1999), which apparently represents the entire world population.

Spectacled eiders were surveyed in marine waters within 100 kilometers (km) of the Beaufort Sea shoreline between Barrow and Demarcation Point during the summers 1999-2001 (Fischer and Larned, 2004). Overall, spectacled eiders were observed in low densities throughout the survey area but were all seen offshore of the Colville River Delta while staging for migration during the 1999 and 2000 summers.

Aerial surveys of spectacled eiders conducted in June 2005 on the Arctic Coastal Plain resulted in a population index of 7,820, which was above the 2004 index of 5,985 and the long-term average of 6,916 (Larned, Stehn, and Platte, 2005). The 13-year trend has remained level, and the mean annual population growth rate for the last 7 years was not significantly different than 1.0 (a stable population = 1.00) (Larned, Stehn, and Platte, 2005). For 2005, one can extrapolate crude estimates of relative contributions (%) for each of the breeding populations. Using North Slope (n = 7,820) aerial survey estimates (Larned et al., 2005) and corrected Y-K Delta nest estimates from ground plots (n = 5,822) (in Platte and Stehn, 2005), and dividing by the Arctic Russian "population" estimate (146,000; USDOI, FWS, 1999), roughly 5.1% and 3.8% of the world's spectacled eiders nested on the North Slope and Y-K Delta, respectively ($\leq$2% if one considers Petersen, Larned, and Douglas, 1999 estimates).

Spectacled eiders winter in the Bering Sea (Petersen, Larned, and Douglas, 1999). Bump and Lovvorn (2004) evaluated the potential for changing lead structure to alter flight costs for wintering spectacled eiders. Increased flight costs beyond a certain threshold could be a source of population change in spectacled eiders. Bump and Lovvorn concluded that there were leads available to eiders under most conditions in the Bering Sea, and that long-term trends in the extent and timing of Bering Sea pack ice may have altered food webs involving the spectacled eider.

Changes in benthic habitats of the wintering area also have been suggested as one cause of interannual population changes in spectacled eiders. Petersen and Douglas (2004) developed annual indices based on historic, remotely-sensed ice conditions and weather patterns and literature-based descriptions of benthic communities. In general, Petersen and Douglas (2004) found that annual population estimates on the breeding grounds can be negatively impacted by extended periods of dense sea ice and weather during the previous winter, but the examination of population indices did not support the hypothesis that changes in the benthic community on the wintering grounds has contributed to the decline or inhibited the recovery of spectacled eiders breeding in western Alaska.

D.2.a(2) Steller's Eider. When the Steller's eider was petitioned in December 1990 to be listed as endangered under the ESA, listing the species rangewide did not appear to be warranted given the relatively large number (~138,000) of Steller's observed on the wintering area(s) in southwest Alaska. However, the Alaska breeding population of Steller's was listed as threatened on June 11, 1997, based on an apparent contraction of the species' breeding range in Alaska (e.g., Kertell [1991] reported that Steller's breeding was virtually absent from 1975-1990) and due to a perceived increase in its vulnerability to extirpation (62 *FR* 31748-31757).

Qualitative information on nesting effort in Alaska has indicated apparent declines on the Y-K Delta (Kertell, 1991; Flint and Herzog, 1999) and the Arctic Coastal Plain (Quakenbush et al., 2002, 2004). The 2005 Steller's spring migration-survey estimate of 79,022 was 6% below the long-term average of 84,458 (Larned et al., 2005). For the same year, larger declines in Steller's estimates were documented during spring (22.3%; n = 41,095) and fall (50%; n = 36,373) emperor goose (*Chen canagica*) aerial surveys, respectively (Dau and Mallek, 2005; Mallek and Dau, 2005). It is likely that <5% of the world population of Steller's eider annually breeds in Alaska, with >95% of the Alaskan breeding Steller's eider occurring on the Arctic Coastal Plain near Barrow (USDOI, FWS, 1999, 2002a; Quakenbush et al., 2004).

The Steller's eider once nested across the North Slope but is suspected to have abandoned the eastern North Slope in recent decades (USDOI, FWS, 2005). It still occurs at low densities from Wainwright to at least Prudhoe Bay. The majority of sightings in the last decade have occurred west of Nuiqsut on the Colville River and within 90 km (56 mi) of the coast. Near Barrow, Steller's eiders still regularly occur but do not nest annually. Up to several dozen pairs breed in a few square kilometers (USDOI, FWS, 2005).

So few Steller's eiders were detected during the annual eider-breeding-population survey of the Arctic Coastal Plain in 2005 that Larned, Stehn, and Platte (2005) concluded it was of little value in calculating a population trend. Similarly, very few Steller's eiders are observed during annual aerial population surveys designed for common eiders in nearshore and along barrier islands (Dau and Larned 2004, 2005).

Steller's eiders were surveyed in marine waters within 100 km of the Beaufort Sea shoreline east of Barrow to Demarcation Point by Fischer and Larned (2004) during the summers 1999-2001. Steller's eiders were the least numerous (n=3) of all the birds (27, 517 total) observed during the surveys (Fischer and Larned 2004).

D.2.a(3) King Eider. Aerial surveys of king eiders conducted on the Arctic Coastal Plain during June 2005 yielded a population index of 14,934, which was 14% above the 13-year mean and contributed towards a significantly positive long-term growth rate of 1.021 (Larned, Stehn, and Platte, 2005). The index also was above the 2004 index of 13,461 (Larned, Stehn, and Platte 2005). Distributions during the 2005 surveys were similar to previous years.

Fischer and Larned (2004) surveyed king eiders in marine waters within 100 km of the Beaufort Sea shoreline between Barrow and Demarcation Point during the summers 1999-2001. King eiders were the second most abundant species counted during the survey periods. King eider densities varied according to water depth, offshore distance, and percent of ice cover. Large flocks of king eiders concentrated in the mid-depth (10- to 20-meter [m]) zone offshore of Barrow and Oliktok Point. In 1999 and 2000, these flocks were in waters >10 m deep, but were found in the shallow (<10 m) and mid-depth zone in July 2001. King eiders were unique among species surveyed by occurring in higher densities in low (<31%) and moderate (31-60%) ice cover (Fischer and Larned, 2004).

Satellite telemetry was used to determine that most king eiders spent more than 2 weeks staging offshore in the Beaufort Sea prior to migrating to molt locations in the Bering Sea (Phillips, 2005; Powell et al., 2005). Female king eiders may need to remain in the Beaufort Sea longer than males to replenish fat stores depleted during egg laying and incubation (Powell et al., 2005). Prior to molt migration, king eiders in the Beaufort Sea usually were found about 13 km offshore; however, during migration to molting areas, king eiders occupied a wide area ranging from shoreline to >50 km offshore (Phillips, 2005).

Fischer and Larned (2004) concluded that because king eiders were concentrated in mid-depth water offshore of the Colville River Delta, they could be particularly vulnerable to oil spills because of their large flock sizes, distances from shore, and the presence of moderate ice-cover conditions. For example, in midsummer 2001, they found 75% of king eiders in areas of >20% ice cover, suggesting that inefficiency or failure to clean up an oil spill in broken-ice conditions could have significant impacts to this species. Impacts could be especially severe, if oil persisted in areas of high use throughout the peak migration period.

D.2.a(4) Common Eider. Common eiders were surveyed in marine waters within 100 km of the Beaufort Sea shoreline between Barrow and Demarcation Point by Fischer and Larned (2004) during the summers 1999-2001. In general, common eiders were concentrated in shallow waters (<10 m), with the highest densities occurring in segments between Oliktok point and Prudhoe Bay and between Tigvariak Island and Brownlow Point. Common eiders were most commonly associated with barrier islands in these segments, becoming less commonly observed up to 50 km seaward. Common eider densities were highest in areas of low ice cover.

Fischer and Larned (2004) concluded that because eider densities did not vary between summer months, the eiders they observed near barrier islands were local breeders rather than molt or fall migrants. This is consistent with Petersen and Flint (2002), who showed that satellite-tagged common eider hens remained in shallow waters close to their breeding sites through September.

Petersen and Flint (2002) suggested that common eider populations that breed on the Y-K Delta and the western Beaufort Sea coast should be managed separately because while females of either group may occasionally overlap on wintering areas, fidelity to breeding areas would expose each breeding population to different environmental variables. This geographic isolation likely has resulted in subsequent differences in survival and reproduction between breeding populations.

Our most recent information still indicates that beginning in late June, male common eiders begin moving out of the Beaufort Sea. Most males are out by late August or early September, and most females were gone by late October or early November. When traveling west along the Beaufort Sea coast, approximately 90% of the common eiders migrate within 48 km of the coast; 7% migrate 13-16 km from shore, roughly along the 17- to 20-m isobath (Johnson and Herter, 1989, citing Bartels, 1973).

Common eiders nest on barrier islands, most often in close association with driftwood windbreaks (Noel et al., 2005). Arctic climate change is believed to reduce ice coverage, which allows for large wind-driven storm events and changes in tidal action. These changes result in eroded coastal vegetation and redistributes or removes driftwood. The effect of changes in the distribution of driftwood on suitability of common eider nest sites is unknown (Dau and Larned, 2004, 2005).

D.2.a(5) Long-tailed Ducks. Long-tailed ducks are abundant in and near lagoons, where they feed on the abundant food resources (Flint et al., 2003). In late June and early July, most male and nonbreeding female long-tailed ducks assemble in massive flocks in lagoons along the Beaufort Sea to molt, while a smaller number molt on large, freshwater lakes. They are flightless for a 3- to 4-week period through July and August, but the majority of birds remain in or adjacent to the lagoons as opposed to pelagic waters. Along nearshore transects, the density of long-tailed ducks decreased significantly between 1990 and 2000.

Long-tailed ducks were surveyed in marine waters within 100 km of the Beaufort Sea shoreline between Barrow and Demarcation Point by Fischer and Larned (2004) during the summers 1999-2001. The long-tailed duck was the most abundant marine bird observed during the survey. Long-tailed duck densities were highest in shallow water (<10 m) during 1999 and 2000. In July, long-tailed ducks were most numerous in shallow-water areas between Tigvariak Island and Brownlow Point. Long-tailed duck density was highest in areas with low ice cover. Overall, nearshore waters close to the Colville River Delta were particularly important to long-tailed ducks (Fischer and Larned, 2004).

Aerial breeding pair surveys have been conducted on the Arctic Coastal Plain for the past 19 years. The long-tailed duck population index for 2004 was 101,091 and was 7.8% below the previous 18-year mean of 109,618. The 19-year trend for long-tailed ducks is significantly negative, attributed primarily to a decrease in the number of grouped ducks (Mallek, Platte, and Stehn, 2005).

D.2.a(6) Black Guillemot. Our most recent information still indicates that the breeding population in Alaska is relatively small; the Chukchi and Beaufort seas have a combined total of fewer than 2,000 birds. Black guillemots were surveyed in marine waters within 100 km of the Beaufort Sea shoreline between Barrow and Demarcation Point by Fischer and Larned (2004) during the summers 1999-2001. Black guillemots were the least numerous (n=3) of all the birds (27, 517 total) observed during the surveys (Fischer and Larned, 2004).

Black guillemots remain closely associated with sea ice throughout their lifetime where they feed extensively on arctic cod (*Boreogadus saida*). The largest breeding colony in the Beaufort Sea is on Cooper Island, where breeding occurs between late June and early September. These guillemots make frequent foraging trips to the ice edge to forage on arctic cod; therefore, in the Beaufort Sea they are common within their foraging range from Cooper Island. When the sea ice is beyond their foraging range, it appears that black guillemots switch prey to other fish species for themselves and their chicks (Friends of Cooper Island, 2005).

Horned puffins appear to be expanding their breeding range to include Cooper Island. Horned puffins displace black guillemots from nesting cavities and kill guillemot chicks. Impacts to recruitment, when coupled with anticipated northward migration of the sea-ice front away from Cooper Island, could be contributing to declines in black guillemot abundance (Friends of Cooper Island, 2005). In 2005, however, the sea ice had retreated; however, weather patterns during the nesting season pushed pack ice near the island, and both species experienced high nesting success.

D.2.a(7) Yellow-Billed Loon. Aerial breeding pair surveys have been conducted in late June on the Arctic Coastal Plain for the past 19 years (Mallek, Platte, and Stehn, 2005). The yellow-billed loon population index for 2004 was 2, 262 and was 22.5% below the previous 18-year average. The 19-year growth trend is flat.

Very low numbers of yellow-billed loons were found in marine waters within 100 km of the Beaufort Sea shoreline between Barrow and Demarcation Point by Fischer and Larned (2004) during the summers 1999-2001. Most of these were found in shallow (<10 m) waters of Harrison Bay, between Cape Halkett and the Colville River Delta.

Counts of yellow-billed loons in nearshore waters and along barrier islands of the Beaufort Sea shoreline between Barrow and Demarcation Point in late June 2004 were more than double than all but one of the previous 5 years (Dau and Larned, 2004). The same survey made the following year, however, found the lowest number of yellow-billed loons counted since 1999 (Dau and Larned, 2005). Sea ice condition may influence the abundance and distribution of yellow-billed loons observed during this annual survey, which is timed to coincide with egg laying and incubation of common eiders.

The Center for Biological Diversity (CBD) petitioned the USDOI, FWS to list the yellow-billed loon as an endangered or threatened species under the ESA on March 30, 2004 (Center for Biological Diversity, 2004). The petition identifies threats to the species as oil and gas development, human disturbance, increased predation, small population size and low productivity, marine health, incidental bycatch from fishing, hunting, and the inadequacy of existing regulatory mechanisms.

The petition stated that breeding habitat for the species is threatened from potential destruction, modification, and fragmentation from oil, gas, and other development. Oil exploration, drilling, and pipeline development potentially could affect a significant portion of an already small population. Oil spills in freshwater nesting and broodrearing lakes, on rivers or streams, or in the marine environment could directly kill or injure birds or contaminate habitats and prey items (Center for Biological Diversity, 2004). The yellow-billed loon is highly vulnerable to environmental change and disturbance and exhibits a lower annual productivity rate than most waterfowl. The species is little studied, and basic biological information (such as the seasonal distribution of immature and nonbreeding yellow-billed loons) is slowly being acquired.

The FWS has not issued a 90-day finding on the CBD petition, but has worked with local, State, and Federal resource agencies to draft a Conservation Agreement for the yellow-billed loon, available for public comment in April 2006 (71 *FR* 13155-13157). The goal of the draft Conservation Agreement was to "... protect YBLO and their breeding, brood-rearing, and migrating habitats in Alaska, such that current or potential threats in these areas are avoided, eliminated or reduced to the degree that the species will not become threatened or endangered from these threats within the foreseeable future."

D.2.a(8) Shorebirds. Powell et al. (2004) monitored the movements and tenure times of shorebirds at two interior breeding sites, three coastal sites, and five staging areas along the Arctic Coastal Plain. They found that breeding shorebirds moved to adjacent coastal areas to stage prior to migration, but there was limited movement between coastal sites during the staging period. Any given staging site was likely to host birds from a wide breeding area. Aerial surveys were conducted to identify coastal "hotspots" of bird abundance. This study may help identify nearshore coastal areas that are important to shorebirds for staging prior to migration.

There appear to be coastal sites where large numbers of shorebirds congregate. For example, the Colville River Delta hosts between 41,000 and 300,000 shorebirds between July 25 and September 5 (Andres 1994; USDOI, FWS, 2004). The range of these numbers depends on how long birds remain in the area before migrating (Andres, 1994; Powell et al., 2004; Taylor et al., 2006). Results on bird tenure times from the Taylor et al. (2006) project may help clarify the anticipated range of shorebirds using the delta. At the present time, it appears that large numbers of shorebirds could be affected during this important postbreeding period should they encounter oil on shorelines through oil exposure and subsequent hypothermia, or indirectly by birds eating contaminated prey or their invertebrate food sources dying (USDOI, FWS, 2004).

D.2.b. Species with Lower Potential for Substantial Effects. The tundra swan, red-throated loon, Pacific loon, brant, snow goose, bar-tailed godwit, buff-breasted sandpiper, and other shorebird and seabird species were considered to have a lower potential for substantial effects. The yellow-billed loon (see Section D.2.a(7)), bar-tailed godwit, buff-breasted sandpiper, and arctic tern are several Beaufort Sea species considered Birds of Conservation Concern by the Fish and Wildlife Service (USDOI, FWS, 2002b).

D.2.b(1) Tundra Swan. Aerial breeding pair surveys have been conducted on the Arctic Coastal Plain for the past 19 years. The tundra swan population index for 2004 was 8,745 and was 11.8% below the previous 18-year mean of 9,916. The 19-year trend for tundra swans was significantly positive, attributed primarily to large numbers of swans observed during the 1997-2000 surveys (Mallek, Platte, and Stehn, 2005).

D.2.b(2) Red-Throated Loon. The FWS conducts an annual eider breeding-population survey on the Arctic Coastal Plain in mid-June. Numbers of other breeding waterbird species are recorded during these surveys. Results from the 2005 survey include that the red-throated loon index remained well below average, maintaining a significantly negative long-term growth rate, but a relatively stable trend for the most recent 7 years (Larned, Stehn, and Platte, 2005).

Aerial breeding pair surveys have been conducted on the Arctic Coastal Plain for the past 19 years. The red-throated loon population index in 2004 was 4,155 and was 34.2% above the previous 18-year mean. The population index has historically been highly variable, but the overall growth trend is significantly positive (Mallek, Platte, and Stehn, 2005).

Fischer and Larned (2004) found very low numbers of red-throated loons in marine waters within 100 km of the Beaufort Sea shoreline between Barrow and Demarcation Point during the summers 1999-2001. Most were observed in shallow water between Oliktok Point and Brownlow Point.

D.2.b(3) Pacific Loon. The FWS conducts an annual eider breeding population survey on the Arctic Coastal Plain in mid-June. Numbers of other breeding waterbird species are recorded during these surveys. Results from the 2005 survey include that the Pacific loon index was about average, continuing a stable trend that started in 1999 (Larned, Stehn, and Platte, 2005).

Pacific loons were surveyed in marine waters within 100 km of the Beaufort Sea shoreline between Barrow and Demarcation Point by Fischer and Larned (2004) during the summers 1999-2001. Pacific loons were found most often as singles or in pairs across the survey area in relatively low densities compared to other species. Pacific loons were associated with shallow waters (<10 m) with low ice cover. Overall, nearshore waters close to the Colville River Delta were particularly important to Pacific loons (Fischer and Larned, 2004).

Aerial breeding pair surveys have been conducted on the Arctic Coastal Plain for the past 19 years. The pacific loon population index in 2004 was 22,948 and was 15.3% below the previous 18-year mean (Mallek, Platte, and Stehn, 2005). The 19-year growth trend is flat.

D.2.b(4) Black Brant. Aerial surveys conducted during early June 2005 resulted in a population index of 14,264, a 5% decrease from the 2004 index of 15,033 (Larned, Stehn, and Platte, 2005). There are certain limitations of the survey design (brant are primarily colonial nesters), but population indices suggest that the 7-year and 14-year growth rates are 1.287 and 1.134, respectively. These data, however, were not consistent with other data from surveys designed to survey North Slope black brant colonies (Ritchie et al., 2002).

Breeding pair surveys have been conducted on the Arctic Coastal Plain for the last 19 years. The population index for black brant in 2004 was 5,305, a decrease from the 2003 index of 12,932 and well below the 1986-2003 average of 9,927. The population index between 1986 and 2003 has ranged between 1,126 and 22,042 (Mallek, Platte, and Stehn, 2005).

Numbers of black brant have ranged between 1,319 and 3,836 during surveys of nearshore and barrier islands along the North Slope in late June 1999-2005 (Dau and Larned, 2005). Fischer and Larned (2004) reported observing small flocks of brant during nearshore surveys of the Arctic coast during June-July 1999-2001.

D.2.b(5) Snow Goose. Aerial surveys conducted in early June do not appear to adequately sample colonial-nesting snow geese, but data from Larned, Stehn, and Platte (2005) showed a long-term growth trend that was consistent with other data from surveys designed to survey North Slope snow geese colonies (Ritchie et al., 2002).

Relatively small numbers of snow geese were observed during surveys of nearshore and barrier islands along the North Slope in late June 1999-2005 (Dau and Larned, 2005). Breeding pair surveys have been conducted on the Arctic Coastal Plain for the last 19 years. The population index for snow geese in 2004 was 3,802, an increase from the 2003 index of 2,554 and greater than the 1986-2003 average of 2,444. The population index between 1986 and 2003 has ranged between 0 and 29,257 (Mallek, Platte, and Stehn, 2005). Fischer and Larned (2004) reported observing small flocks of snow geese during nearshore surveys of the Arctic Coast during June-July 1999-2001.

D.2.b(6) Bar-Tailed Godwit. The North American population of bar-tailed godwits (*Limosa lapponica baueri*) breeds in western and northern Alaska. Postbreeding bar-tailed godwits move to staging grounds along the Bering Sea coast and then apparently fly nonstop 11,000 km to New Zealand. Recent counts conducted at both breeding and nonbreeding sites provide evidence of a serious and rapid population decline (McCaffrey et al., 2006), but the cause of the decline is unknown. The abundance and distribution of bar-tailed godwits in northern Alaska and coastal areas of the Beaufort Sea are not well understood.

D.2.b(7) Shorebirds and Seabirds. Fischer and Larned (2004) observed small numbers of seabirds in deep, offshore waters, including Sabine's gulls (*Xema sabini*), black-legged kittiwakes (*Rissa tridactyla*), arctic terns (*Sterna paradisaea*), and unidentified auklets (*Aethia* spp.). Small groups of shearwaters (*Puffinus* spp.) were observed foraging 25-55 km from shore between Oliktok Point and Brownlow Point in August 2000, and jaegers (*Stercorarius* spp.) were noted up to 75 km offshore along the entire coastline.

D.3. Local Water Quality.

This section contains an update of information on local water quality that might be affected by proposed Beaufort Sea Sale 202. The section updates the information in the multiple-sale EIS, incorporating information from the 195 EA and recent research (USDOI, MMS, 2003, 2004).

Hydrocarbons in marine particulate matter and sediments were characteristic of immature bitumens, shales, or coals; the degree of anthropogenic influence on the polycyclic aromatic hydrocarbon load in the Mackenzie River delta was small; and a large amount of dissolved organic carbon was carried into the coastal Beaufort Sea during peak flows at the time of river breakup in early June (USDOI, MMS, 2004). These studies confirm the multiple-sale EIS conclusion that North Slope rivers carry hydrocarbons from peat, coal, and natural seeps into the coastal waters. The concentration of petroleum hydrocarbons in Beaufort Sea water and organisms was examined in three recent studies, one of which included samples from the Barrow subsistence-whaling area. The studies found traces of petroleum hydrocarbons, but the concentrations were relatively low in comparison with other coastal areas off Alaska, the Arctic, and the conterminous United States (Naidu et al., 2005; USDOI, MMS, 2004b, 2005b,c).

A general description of the Chukchi and Beaufort seas water quality follows; however, more detailed information about the Chukchi and Beaufort seas chemical oceanography, water quality, and sources of pollution can be found in USDOI, MMS (1998, 2002, 2003).

Water quality in the Arctic Ocean is determined by both physical properties and chemical composition, and it may be affected by both anthropogenic and natural sources. The principal sources of pollutants entering the marine environment in general include discharges from industrial activities (petroleum industry) and accidental spills or discharges of crude or refined petroleum and other substances. The broad arctic distribution of pollutants is described in the Arctic Monitoring and Assessment Program (AMAP, 1997) report *Arctic Pollution Issues: A State of the Arctic Environmental Report.*

Degradation to OCS water quality may occur from seasonal plankton blooms (a natural process); seasonal changes in water turbidity due to terrestrial runoff and shoreline erosion; and, water column stratification due to temperature differentials. Another natural source of altered water quality is sea-ice cover. As sea ice forms during the fall, particulates are removed from the water column by ice crystals as they form and are locked into the ice cover. The result is very low turbidity levels during the winter. Seasonal plankton blooms occur primarily during spring and fall, with the most active blooms during spring, as the ice cover melts and sunlight reaches the nutrient-rich surface waters.

D.4. Bowhead Whales, Polar Bear, Other Marine Mammals, Fishes, and Essential Fish Habitat.

D.4.a. Bowhead Whales. Endangered Section 3(15) of the ESA, as amended, states: "(T)he term "species" includes any subspecies of fish or wildlife or plants, and any distinct population segment of any vertebrate fish or wildlife which interbreeds when mature" (16 U.S.C. § 1532). Thus, under the ESA, distinct population segments and subspecies are included along with biological species in the definition of "species," and such entities can be listed separately from other subspecies and/or distinct population segments of the same biological species.

Based on the best available information, and on the guidance provided by the NMFS in their letter of September 30, 2005, there are three species of cetaceans that are listed as endangered under the ESA that can occur within or near the Beaufort Sea OCS Planning Area or that could potentially be affected secondarily by activities within this planning area. The common and scientific names of these species are:

Bowhead whales (*Balaena mysticetus*)
Fin whales (*Balaenoptera physalus*)
Humpback whales (*Megaptera novaeangliae*)

It is clear both from the aforementioned September 30, 2005, letter to MMS from NMFS and from our own review that the bowhead is the species most likely to be impacted by oil and gas activities in the Beaufort Sea Planning Area. A detailed discussion of the bowhead whale can be found in the *Biological Evaluation of the Potential Effects of Oil and Gas Leasing and Exploration in the Alaska OCS Beaufort Sea and Chukchi Sea Planning Areas on Endangered Bowhead Whales (Balaena mysticetus), Fin Whales (Balaenoptera physalus), and Humpback Whales (Megaptera novaeangliae)* on our web site at: (http://www.mms.gov/alaska/ref/EIS%20EA/DraftProgrammatic%20EA%20&%20Biological%20Eval/final_be_whales.pdf).

There is no designated critical habitat for any species for which NMFS has jurisdiction that potentially could be affected by the Proposed Action.

The Marine Mammal Protection Act (MMPA) mandates management of marine mammal population stocks. Under Section 3 of the MMPA, the "...term 'population stock' or 'stock' means a group of marine mammals of the same species, or smaller taxa in a common spatial arrangement, that interbreed when mature" (16 U.S.C. § 1362 (11)). "Population stock" (usually referred to simply as "stock") designations of many groups of marine mammals have changed over the past 2 decades, in large part due to focused efforts to define the stocks coupled with the availability of relatively new tools with which to examine patterns of genetic variability from the field of molecular genetics. Thus, because of new information, many species of marine mammals that were formerly treated as if comprised of only a single stock, now may be subdivided into multiple stocks, or there may be discussion of whether multiple stocks exist. In the cases of marine mammals for which separate stocks have been delineated, we focus our description and evaluation of potential effects on those stocks that may occur within or near the Beaufort Sea Planning Area. However, we bring in information on the biological species as a whole, if it enhances the understanding of the relevant stock(s) or aids in evaluation of the significance of any potential effects on the stock that occurs within or near these areas.

D.4.a(1) Summary of Information about Bowhead Whale Status, Abundance, Distribution, Habitat Use and Ecology Relevant to Assessing Effects of the Proposed Action. There is one ESA-listed marine mammal species, the bowhead whale, which regularly seasonally occurs within the Beaufort Sea OCS Planning Area and within areas of the Chukchi Sea that could be affected by actions within the Beaufort Sea. This population stock of bowheads is the most robust and viable of surviving bowhead populations and, thus, its viability is critical to the long-term future of the biological species as a whole. There is scientific uncertainty about the population structure of bowheads that use the Beaufort and Chukchi seas. Available new information does not indicate that there has been any significant negative or other change in the population status of the Bering-Chukchi-Beaufort Sea (BCB Seas) bowhead whale population since MMS consulted with NMFS in 2003 regarding Sale 195 (USDOI, MMS, 2004) or the Beaufort Sea multiple-sale EIS (USDOI, MMS, 2003a). Data indicate that what is currently referred to as the Western Arctic stock (by NMFS) or as the BCB Seas stock (by the International Whaling Commission [IWC]) of bowheads is increasing in abundance. All recent available information indicates that the population has continued to increase in abundance over the past decade and may have doubled in size since about 1978. The estimated current annual rate of increase is similar to the estimate for the 1978-1993 time series. There are scientific analyses indicating that BCB Seas bowheads may have reached or are approaching, the lower limit of their historic population size. There is discussion in the scientific and regulatory communities regarding the potential delisting of this population. The cause of the historic decline of this species was overharvesting by commercial whalers. The primary known current human-related cause of mortality is a regulated subsistence hunt by Alaskan Natives. Conservation concerns include: the introduction of noise and related disturbance from existing, but especially potential future, oil and gas activities, shipping, other vessel traffic, and hunting in calving, migration, and feeding areas; contamination of their habitat by pollutants from planned and potential future oil and gas activity and by other local and distant pollution sources; uncertain potential impacts of climate warming; vessel strikes; and entanglement. No data are available indicating that, other than historic commercial whaling, any previous human activity has had a significant adverse impact on the current status of BCB Seas bowheads or their recovery. The uncertainty of the stock structure adds some uncertainty to summaries of the status of bowheads that may be impacted by the proposed action. Currently available information indicates that bowheads that use the Alaskan Beaufort Sea and Chukchi Sea Planning Areas are resilient at least to the level of human-caused mortality and disturbance that currently exists, and has existed since the cessation of commercial whaling, within their range. Data indicate that at least some bowheads are extremely long-lived (100+ years or more), and this longevity can affect the potential for a given individual to be exposed to a high number of disturbance and pollution events in its lifetime.

Within or near areas where the Proposed Action could occur, geographic areas of particular importance to this stock include the areas of the spring lead system in both the Chukchi and Beaufort seas and areas that are used for feeding by large numbers of individuals in some years, but not in all years. However, the significance of feeding in particular areas to the overall food requirements of the population or segments of the population is not clear. Available information indicates that most or much of the total calving of the bowheads, which comprise most of the bowhead whales in the world, occurs during the spring migration in and adjacent to especially the eastern Chukchi Sea and also the Beaufort Sea spring lead systems.

Bowheads feed in the Alaskan Beaufort Sea, but the extent and location of that feeding varies widely among years and locations. Bowheads are extremely long lived, slow growing, slow to mature, and currently have high survival rates. These features affect their vulnerability to pollution and disturbance in their environment. They are also unique in their ecology and their obligate use of lead systems to transit to summering grounds. This reliance on spring leads, and the fact that they apparently calve during the spring northward migration, also are features of their ecology that heightens their vulnerability to disturbance and oil spills in some areas.

Available new information also does not indicate there has been any significant change in the distribution of this population during the autumn in the Beaufort Sea since NMFS wrote its Biological Opinion in 2001. Recent data on distribution, abundance, or habitat use in the Chukchi Sea Planning Area are not available, and there is little information about summer use in the Beaufort Sea. We have taken available information into account in the update of our analyses of potential effects on this population.

D.4.a(2) Introduction. This section provides, updates and, in some cases, summarizes information from the Beaufort Sea multiple-sale EIS, the Biological Evaluation (BE) for Sale 195, and the Sale 195 EA (USDOI, MMS, 2003, 2004, 2006) and supplements this information with more recent information on the Western Arctic stock of the bowhead whale. All available information is considered in our update of our analyses of the potential effects of the Proposed Action on bowhead whales. Additionally, we provide an update of information related to evaluating potential cumulative anthropogenic impacts on this population, as defined under NEPA. As noted in the beginning of this document, we incorporate by reference all information provided previously in the Beaufort Sea multiple-sale final EIS, which provided a detailed evaluation of the bowhead whale and its habitat, the potential effects of three lease sales in the Beaufort Sea Planning Area and related activities on this stock of whales, and an evaluation of cumulative effects on this population stock.

The following are some additional sources of information have been reviewed for this update of bowhead information. The NOAA and the North Slope Borough (NSB) convened the first Workshop on Bowhead Whale Stock Structure Studies in the Bering-Chukchi-Beaufort Seas: 2005-2006 (USDOC, NOAA and NSB, 2005). The second meeting of this group is scheduled for spring 2006. The Scientific Committee of the IWC reviewed and critically evaluated new information available on the bowhead whale at their 2003 and 2005 meetings (IWC, 2003a, 2005a,b) and conducted an in-depth status assessment of this population in 2004 (IWC, 2004a,b). The MMS published *Aerial Surveys of Endangered Whales in the Beaufort Sea, Fall 2002-2004* (Monnett and Treacy, 2005). The report described the yearly distance of bowhead whale sightings from the coast, and specifically calculated the statistical mean value and the 25th and 75 quartile range for the sightings in two survey Regions. The report concludes that mean values for both Regions in all 3 years were within the respective 25th – 75th quartile ranges for all years (1982-2001). The *Final 2003 Alaska Marine Mammal Stock Assessment* (Angliss and Lodge, 2003) for this stock remains the most recent finalized stock assessment available, as no stock assessment was finalized in 2004. There is a revised draft stock assessment for 2005 available for this population (Angliss and Outlaw, 2005). The NMFS published the *Notice of Determination - Endangered and Threatened Species; Final Determination on a Petition to Designate Critical Habitat for the Bering Sea Stock of Bowhead Whales* (67 *FR* 55767). Details on bowheads that might lie outside the scope of the material provided here, in our multiple-sale EIS, or in our Sale 195 EA may be provided in one or more of these documents. We have reviewed and considered information in these documents and other available information in our evaluation of potential environmental impacts.

D.4.a(2)(a) ESA Listing History, Current Status, and Possible Delisting of the Western Arctic Stock of Bowhead Whale. The bowhead whale was listed as endangered on June 2, 1970. No critical habitat has been designated for the species. The NMFS received a petition on February 22, 2000, requesting that portions of the U.S. Beaufort and Chukchi seas be designated as critical habitat for the Western Arctic stock (Bering Sea stock) of bowhead whales. On August 30, 2002, the NMFS made a determination not to designate critical habitat for this population of bowheads (67 *FR* 55767) because: (1) the population decline was due to overexploitation by commercial whaling, and habitat issues were not a factor in the decline; (2) the population is abundant and increasing; (3) there is no indication that habitat degradation is having any negative impact on the increasing population; and (4) existing laws and practices adequately protect the species and its habitat.

All available information (e.g., Shelden et al., 2001; IWC, 2004a,b, 2005a,b; NMFS, 2003a,b); indicates that the BCB Seas population of bowheads is increasing, resilient to the level of mortality and other adverse effects that are currently occurring due to the subsistence hunt or other causes, and may have reached the lower limit of the estimate of the population size that existed prior to intensive commercial whaling.

Shelden et al. (2001) proposed that the bowhead whale species should be listed under the ESA as five distinct population segments, based on the distinct population segment definition developed by the NMFS and FWS in 1996. The five separate stocks of bowhead whales are the Bering Sea stock (referred to in IWC documents as the BCB Seas bowhead and as the Western Arctic stock in the NMFS's Alaska Marine Mammal stock assessments), the Spitsbergen stock, the Davis Strait stock, the Hudson Bay stock, and the Okhotsk stock. Shelden et al. (2001) evaluated each proposed distinct population segment to determine whether one or more should be reclassified. The authors presented two models to evaluate the status of bowhead whale stocks, one that they developed based on World Conservation Union criterion D1 and E (World Conservation Union, 1996, as referenced in Shelden et al., 2001), and a model developed by Gerber and DeMaster (1999) for ESA classification of North Pacific humpback whales. Under each of these classification systems, the authors determined that the Bering Sea population of bowhead whales should be delisted, whereas the other four populations of bowheads should continue to be listed as endangered (see also criticism of this determination by Taylor, [2003], the response of Shelden et al. [2003] and discussion by the IWC's Scientific Committee [IWC, 2003a]).

D.4.a(2)(b) Bowhead Population Structure and Current Stock Definitions. The IWC currently recognizes five stocks of bowheads for management purposes (IWC, 1992), with one of them being the BCB Seas stock. The BCB Seas bowheads are the largest of all surviving bowhead populations and the only stock to inhabit U.S. waters. All of the stocks except for the BCB Seas bowhead stock are "comprised of only a few tens to a few hundreds of individuals" (Angliss and Outlaw, 2005:209). Thus, the BCB Seas bowheads are the most robust and viable of surviving bowhead populations. The viability of bowheads in the BCB Seas stock is critical to the long-term future of the biological species as a whole.

The Scientific Committee of the IWC previously concluded that the BCB Seas bowheads comprise a single stock (DeMaster et al., 2000, as cited in IWC, 2003a). However, after an in-depth evaluation of available data, the Scientific Committee (IWC, 2004a) concluded that there is temporal and spatial heterogeneity among these bowheads, but analyses do not necessarily imply the existence of subpopulations with limited interbreeding; it was premature to draw conclusions about the relative plausibility of any hypotheses about stock structure or to reject any of them. Subsequently, "The Bowhead Group" (USDOC, NOAA and NSB, 2005) created a set of five stock-structure hypotheses, modified this set, and currently recommends testing of the following hypotheses: (1) one stock of BCB Seas bowheads as described and previously accepted by the IWC (Rugh et al., 2003); (2) one stock with generational gene shift; (3) temporal migration—there are two stocks and two putative wintering area, with the two stocks migrating separately in the spring but together in the fall; (4) segregation of stocks; spatial segregation of stocks; and (5) Chukchi Circuit—one population migrates from the Bering Sea to the Beaufort Sea in spring and back again in the fall, whereas the second leaves the Bering Sea, heads northwest along the Chukotka coast, heads towards the Barrow Canyon and then back to the Bering Sea (see USDOC, NOAA and NSB, 2005 for detailed descriptions and discussions). After more recent information provided to the IWC Subcommittee on Bowhead, Right and Gray Whales (IWC, 2005b), the subcommittee agree that what is termed the "Oslo Bump" (a significant increase in genetic difference between pairs of whales sampled approximately 1 week apart at Barrow during the fall migration) appears to be a real pattern within the data that are available. However, additional data are needed to determine if these data actually typify the bowhead population, and there is no single hypothesis adequate to explain the pattern. Stock structure is unclear at the time of writing of this Biological Evaluation (see IWC, 2004b, 2005a,b; USDOC, NOAA and NSB, 2005 for detailed descriptions and discussions). The IWC will be conducting an Implementation Review focusing on the stock structure of the BCB Seas bowhead with the goal of completing this at the 2007 annual meeting (IWC, 2005a). Two related intersessional workshops, one that occurred in 2005 and one that will occur in spring 2006, are focusing on this topic (IWC, 2005a,b).

The uncertainty about the stock structure of bowheads that inhabit the Chukchi and Beaufort seas adds uncertainty to the analysis of potential effects. It is not currently clear whether one or more population stocks of bowheads potentially could be impacted by the proposed activities. If more than one population may be affected, it may be that the areas in which the two stocks are likely to be vulnerable to adverse effects varies. If there is more than one stock, it is not clear what the estimated population sizes of the potentially affected population stocks are.

D.4.a(2)(c) Bowhead Past and Current Population Abundance. Woody and Botkin (1993) estimated that the historic population abundance of bowheads in the Western Arctic stock was between 10,400 and 23,000 whales in 1848 before the advent of commercial whaling, which severely depleted bowhead whales. They estimated that between 1,000 and 3,000 animals remained in 1914 near the end of the commercial-whaling period.

Based on both survey data and the incorporation of acoustic data, the abundance of the Western Arctic stock of bowhead whales was estimated between 7,200 and 9,400 individuals in 1993 (Zeh, Raftery, and Schaffner, 1995), with 8,200 as the best population estimate. This estimate was recently revised by Zeh and Punt (2004) to 8,167 (CV= 0.017) and is the estimate used by the NMFS in their draft 2005 stock assessment (Angliss and Outlaw, 2005). An alternative method produced an estimate of 7,800 individuals, with a 95% confidence interval of 6,800-8,900 individuals. Data indicate that the Western Arctic stock increased at an estimated rate of about 3.1% (Raftery, Zeh, and Givens, 1995) to 3.2% (Zeh, Raftery, and Schaffner, 1995) per year from 1978-1993. The estimated increase in the estimated population size most likely is due to a combination of improved data and better censusing techniques, along with an actual increase in the population.

George et al. (2004) estimated abundance in 2001 to be 10,470 (SE = 1,351) with a 95% confidence interval of 8,100-13,500. This estimate indicates a substantial increase in population abundance since 1993 and suggests that population abundance may have reached the lower limits of the historical population estimate. Zeh and Punt (2004, cited in Angliss and Outlaw, 2005) provided a slightly revised population estimate of 10,545 CV(N) =0,128 to the IWC in 2004. George et al. (2004) estimated that the annual rate of increase (ROI) of the population from 1978-2001 was 3.4% (95% CI 1.7%-5%) and Brandon and Wade (2004) estimate an ROI of 3.5% (95% CI 2.2-4.9%). The number of calves (121) counted in 2001 was the highest ever recorded for this population and this fact, when coupled with the estimated rate of increase, suggests a steady recovery of this population (George et al., 2004). This steady recovery is likely due to low anthropogenic mortality, a relatively pristine habitat, and a well-managed subsistence hunt (George et al., 2004).

D.4.a(2)(d) Bowhead Reproduction, Survival and Non-Human Sources of Mortality. Information gained from the various approaches at aging BCB Seas bowhead whales and estimating survival rates all suggest that bowheads are slow-growing, late-maturing, long-lived animals with survival rates that are currently high (Zeh et al., 1993; see below). Female bowheads probably become sexually mature at an age exceeding 15 years, from their late teens to mid-20's (Koski et al., 1993) (Schell and Saupe, 1993: about 20 years). Their size at sexual maturity is about 12.5-14.0 meters (m) long, probably at an age exceeding 15 years (17-29 years: Lubetkin et al., 2004 cited in IWC, 2004b). Most males probably become sexually mature at about 17-27 years (Lubetkin et al., 2004 cited in IWC, 2004b). Schell and Saupe (1993) looked at baleen plates as a means to determine the age of bowhead whales and concluded that bowheads are slow-growing, taking about 20 years to reach breeding size. Based on population structure and dynamics, Zeh et al. (1993) also concluded that the bowhead is a late-maturing, long-lived animal (George et al., 1999) with fairly low mortality. Photographic recaptures by Koski et al. (1993) also suggested advanced age at sexual maturity of late teens to mid-twenties.

Mating may start as early as January and February, when most of the population is in the Bering Sea but has also been reported as late as September and early October (Koski et al., 1993). Mating probably peaks in March-April (IWC, 2004b). Gestation has been estimated to range between 13 and 14 months (Nerini et al., 1984, as reported in Reese et al., 2001; Reese et al., 2001) and between 12 and 16 months by Koski et al. (1993) (see also information and discussion in IWC, 2004b). Reese et al. (2001) developed a nonlinear model for fetal growth in bowhead whales to estimate the length of gestation, with the model indicating an average length of gestation of 13.9 months. Data indicate most calving occurs during the spring migration when whales are in the Chukchi Sea. Koski et al. (1993) reported that calving occurs from March to early August, with the peak probably occurring between early April and the end of May (Koski et al., 1993). The model by Reese et al. (2001) also indicated that conception likely occurs in early March to early April, suggesting that breeding occurs in the Bering Sea. The conception date and length of gestation suggests that calving is likely to occur in mid-May to mid-June, when whales are between the Bering Strait and Point Barrow (in the Chukchi Sea). Reese et al. (2001) said this is consistent with other observations in the region, including: (a) relatively few neonate-cow pairs reported by whalers at St. Lawrence Island; (b) many neonates seen during the whale census in late May; (c) relatively few term females taken at Barrow; (d) taken females with term pregnancies appeared close to parturition; and (e) most of the herd believed to have migrated past Barrow by late May. Females give birth to a single calf probably every 3-4 years.

Discussion during the in-depth assessment by the IWC (2004b) also indicated that differences in lipid content between females of the same length and size are attributable to pregnant versus nonpregnant females. This may imply a high biological cost of reproduction, a fact noteworthy in considering the potential impact of excluding females from feeding areas. George et al. (2004, cited in IWC, 2004b) estimated pregnancy rates of 0.333/year and an estimated interbirth interval of 3.0 years using data from postmortem examinations of whales landed at Barrow and Kaktovik in the winter.

There is little information regarding causes of natural mortality for BCB Seas bowhead whales. Bowhead whales have no known predators except, perhaps, killer whales and subsistence whalers. The frequency of attacks by killer whales probably is low (George et al., 1994). A relatively small number of whales likely die as a result of entrapment in ice (Philo et al., 1993). Little is known about the effects of microbial or viral agents on natural mortality.

The discovery of traditional whaling tools recovered from five bowheads landed since 1981 (George et al., 1995) and estimates of age using aspartic-acid racemization techniques (George et al., 1999) both suggest bowheads can live a very long time, in some instances more than 100 years. The oldest harvested females whose ages were estimated using corpora albicans accumulation to estimate female age were more than 100 years old (George et al., 2004, cited in IWC, 2004b). Discussion in the IWC (2004b) indicated that neither lifespan nor age at sexual maturity is certain. Lifespan may be greater than the largest estimates.

Using aerial photographs of naturally marked bowheads collected between 1981 and 1998, Zeh et al. (2002:832) estimated "the posterior mean for bowhead survival rate...is 0.984, and 95% of the posterior probability lies between 0.948 and 1." They noted that a high estimated survival rate is consistent with other bowhead life-history data.

D.4.a(2)(e) Migration, Distribution, and Habitat Use. As available information permits, we provide detailed summary and discussion about the migration, distribution, and habitat use of bowheads to provide insight into areas where bowheads might be exposed to oil- and gas-related activities, when they might be exposed, and what the significance of their exposure in certain geographic areas might be relative to that in other areas. We include information, as available, about female with calves. This aids our evaluation of potential effects and informs potential mitigations of effects.

The BCB Seas bowheads generally occur north of 60° N. and south of 75° N. (Angliss and Outlaw, 2005) in the Bering, Chukchi, and Beaufort seas. They have an affinity for ice and are associated with relatively heavy ice cover and shallow continental shelf waters for much of the year.

Winter and Other Use of the Bering Sea. Bowhead whales of the BCB Seas stock overwinter in the central and western Bering Sea. Most mating probably occurs in the Bering Sea. The amount of feeding in the Bering Sea in the winter is unknown as is the amount of feeding in the Bering Strait in the fall (Richardson and Thomson, 2002). In the Bering Sea, bowheads frequent the marginal ice zone, regardless of where the zone is, and polynyas. Important winter areas in the Bering Sea include polynyas along the northern Gulf of Anadyr, south of St. Matthew Island, and near St. Lawrence Island. Bowheads congregate in these polynyas before migrating (Moore and Reeves, 1993).

Observations by Mel'nikov, Zelensky, and Ainana (1997) from shore-based observations of waters adjacent to the Chukotka Peninsula in 1994-1995 indicate that bowheads winter in the Bering Sea along leads and polynyas adjacent to the Asian coastline. Mel'nikov, Zelensky, and Ainana (1997) summarized that in years when there is little winter ice, bowheads inhabit the Bering Strait and potentially inhabit southern portions of the Chukchi Sea.

During their southward migration in the autumn, bowheads pass through the Bering Strait in late October through early November on their way to overwintering areas in the Bering Sea. Large numbers of bowheads were taken in June and July during commercial whaling over large portions of the northwestern and northcentral Bering Sea (Figure 1b in Dahlheim et al., 1980, from Townsend, 1935).

Spring Migration. Some, or nearly all (see stock discussion above), of the bowheads that winter in the Bering Sea migrate northward through the Bering Strait to the Chukchi Sea and through the Alaskan Beaufort Sea to summer feeding grounds in the Canadian Beaufort Sea. The bowhead northward spring migration appears to coincide with ice breakup and probably begins most years in April (possibly late March depending on ice conditions) and early May. It is thought to occur after the peak of breeding, which is believed to occur in March-April (C. George, cited in IWC, 2004b).

Bowheads congregate in the polynyas before migrating (Moore and Reeves, 1993; Mel'nikov, Zelensky, and Ainana, 1997). Large numbers of bowheads were taken in June and July during commercial whaling over large portions of the northwestern and northcentral Bering Sea (Figure 1b in Dahlheim et al., 1980, from Townsend, 1935). Bowheads migrate up both the eastern and western sides of the Bering Strait in the spring (Mel'nikov, Zelensky, and Ainana, 1997; Mel'nikov et al., 2004). They pass through the Bering Strait and eastern Chukchi Sea from late March to mid-June through newly opened leads in the shear zone between the shorefast ice and the offshore pack ice. During spring aerial surveys in the late 1980's, bowheads were documented to be migrating in shorefast leads and polynyas up the coast of northwestern Alaska (see Figures 4 and 5 in Mel'nikov, Zelensky, and Ainana, 1997).

Based on shore-based surveys in 1999-2001, Mel'nikov et al. (2004) observed that the start of spring migration from the Gulf of Anadyr varies between cold and mild years by up to 30 days, but in both instances, continues at least until June 20. Mel'nikov et al. (2004) also reported that weather influenced migration, with migration seeming to stop when there were storms or high winds in the western Bering Strait or at the exit from the Gulf of Anadyr.

The migration past Barrow takes place in pulses in some years (e.g., in 2004) but not in others (e.g., 2003) (Koski et al., 2004, cited in IWC, 2004b). At Barrow, the first migratory pulse is typically dominated by juveniles. This pattern gradually reverses and by the end of the migration, there are almost no juveniles. Currently, the whales are first seen at Barrow around April 9-10. In later May (May 15-June), large whales and cow/calf pairs are seen (H. Brower, in USDOC, NOAA and NSB, 2005; IWC, 2004b). Koski et al. (2004b) found that females and calves constituted 31-68% of the total number of whales seen during the last few days of the migration. Their rate of spring migration was slower and more circuitous than other bowheads. Calves had shorter dive duration, surface duration, and blow interval than their mothers. Calf blow rate was nearly three times that of their mothers. Most calving probably occurs in the Chukchi Sea. Some individuals or subset of the population may summer in the Chukchi Sea.

Several studies of acoustical and visual comparisons of the bowhead's spring migration off Barrow indicate that bowheads also may migrate under ice within several kilometers of the leads. Data from several observers indicate that bowheads migrate underneath ice and can break through ice 14-18 centimeters [cm] (5.5-7 inches [in]) thick to breathe (George et al., 1989; Clark, Ellison, and Beeman, 1986). Bowheads may use cues from ambient light and echoes from their calls to navigate under ice and to distinguish thin ice from multiyear floes (thick ice). After passing through Barrow from April through mid-June, they move easterly through or near offshore leads. East of Point Barrow, the lead systems divide into many branches that vary in location and extent from year to year. The spring-migration route is offshore of the barrier islands in the central Alaskan Beaufort Sea.

Summer. Bowheads arrive on their summer feeding grounds near Banks Island from mid-May through June (July: IWC, 2005b) and remain in the Canadian Beaufort Sea and Amundsen Gulf until late August or early September (Moore and Reeves, 1993). Bowhead whales are seen also in the central Chukchi Sea and along the Chukotka coast in July and August. They may occupy the northeastern Chukchi Sea in late summer more regularly than commonly believed (Moore, 1992; USDOC, NOAA, and NSB, 2005), but it is unclear if these are "early-autumn" migrants or whales that have summered nearby (Moore et al., 1995) or elsewhere. Bowhead whales have been observed near Barrow in the mid-summer (e.g., Brower, as cited in USDOI, MMS, 1995). Eight bowheads were observed near Barrow on July 25, 1999, 2 at 71° 30' N., 155° 40'W. to 155° 54' W. from a helicopter during a search, and six at 71° 26' N., 156° 23' W. from the bridge of the icebreaker *Sir Wilfrid Laurier* (Moore and DeMaster, 2000). Moore and DeMaster (2000:61) noted that these observations are consistent with Russian scientist suggestions that "...Barrow Canyon is a focal feeding area for bowheads and that they 'move on' from there only when zooplankton concentrations disperse (Mel'nikov et al. 1998)" and consistent with the time frame of earlier observations summarized by Moore (1992.)

Some biologists conclude that almost the entire Bering Sea bowhead population migrates to the Beaufort Sea each spring and that few whales, if any, summer in the Chukchi Sea. Incidental sightings suggest that bowhead whales may occupy the Chukchi Sea in the summer more regularly than commonly believed. Moore (1992) summarized observations of bowheads in the northeastern Chukchi in late summer. Other scientists maintain that a few bowheads swim northwest along the Chukotka coast in late spring and summer in the Chukchi Sea. Observation by numerous Russian authors (cited in Mel'nikov, Zelensky, and Ainana [1997:8]) indicates that bowheads occur in waters of the Chukchi Sea off the coast of Chukotka in the summer.

Harry Brower, Jr. observed whales in the Barrow area in the middle of the summer, when hunters were hunting bearded seals on the ice edge (Brower, as cited in USDOI, MMS, 1995). The monitoring program conducted while towing the single steel drilling caisson to the McCovey location in 2002 recorded five bowhead whales off Point Barrow on July 21.

Recent systematic data about bowhead distribution and abundance in the Chukchi Sea OCS Planning Area are lacking. The MMS funded large-scale surveys in this area when there was oil and gas leasing and exploration, but while surveys in the Beaufort Sea have continued, the last surveys in the Chukchi Sea were about 15 years ago. These data were summarized by Mel'nikov, Zelensky, and Ainana (1997), Moore (1992), Moore and Clarke (1990), and Moore, DeMaster, and Dayton (2000). We have plotted counts of bowheads observed in the Chukchi Sea during those surveys (Figure 3), because they visually provide limited insight into areas where bowheads may be exposed to oil and gas activities should they occur in the Chukchi Sea Planning Area. However, we caution against over-interpretation of these data out of context of survey effort, because these data were collected between 1979 and 1991. They should not be interpreted as indicating current use of the Chukchi Sea by bowhead whales. However, they are the best data that are available.

Bowheads found in the Bering and Chukchi Seas in the summer may be part of the expanding Western Arctic stock (DeMaster et al., 2000, as referenced in Angliss, DeMaster, and Lopez, 2001).

Evidence indicates that the number of bowheads that inhabit the BCB Seas has increased substantially since the time of the surveys (Brandon and Wade, 2004, cited in IWC, 2004b). Temporal and spatial patterns of distribution also may be modified. Conversely, earlier information may have inferred less variability in distribution than actually existed.

Fall Habitat Use and Migration. Those bowheads that have been summer feeding in the Canadian Beaufort Sea begin moving westward into Alaskan waters in August and September. While few bowheads generally are seen in Alaskan waters until the major portion of the migration takes place (typically mid-September to mid-October), in some years bowheads are present in substantial numbers in early September (Greene and McLennan, 2001; Treacy, 1998). In 1997, Treacy (1998) reported sighting 170 bowheads, including 6 calves, between Cross Island and Kaktovik on September 3 during the first flight of the survey that year. In 1997, Treacy (1998) observed large numbers of bowheads between Barrow and Cape Halkett in mid-September. Large numbers were still present between Dease Inlet and Barrow in early October (although they may not have been the same individuals).

There is some indication that the fall migration, just as the spring migration, takes place in pulses or aggregations of whales (Moore and Reeves, 1993). Eskimo whalers report that smaller whales precede large adults and cow-calf pairs on the fall migration (Braham et al., 1984, as reported in Moore and Reeves, 1993). During the autumn migration Koski and Miller (2004, cited in IWC, 2004b) found decreasing proportions of small whales and increasing proportions of large whales as one moved offshore. "Mothers and calves tended to avoid water depths less than (<) 20 m." (Koski and Miller, cited in IWC, 2004b:14). These authors also found that in the Central Beaufort Sea in late August, the vast majority of the whales were subadults and this percentage declined throughout the autumn to about 35% by early October. They reported that mother/calf pairs "arrived in September and were common until early October" (Koski and Miller, 2004, cited in IWC, 2004b).

Inupiat whalers estimate that bowheads take about 2 days to travel from Kaktovik to Cross Island, reaching the Prudhoe Bay area in the central Beaufort Sea by late September, and 5 days to travel from Cross Island to Point Barrow (T. Napageak, 1996, as cited in NMFS, 1999).

Individual movements and average speeds (approximately 1.1-5.8 kilometers per hour [km/h]) vary widely (Wartzog et al., 1990; Mate, Krutzikowsky, and Winsor, 2000). Much faster speeds (e.g., up to 9.8 ± 4.0 km/h) were estimated for bowheads migrating out of the Gulf of Anadyr during the northward spring migration (Mel'nikov et al., 2004).

Wartzog et al. (1989) placed radio tags on bowheads and tracked the tagged whales in 1988. One tagged whale was tracked for 915 km as it migrated west at an average speed of 2.9 km/h in ice-free waters. It traveled at an average speed of 3.7 km/h in relatively ice-free waters and at an average speed of 2.7 km/h through eight-tenths ice cover and greater. Another whale traveled 1,291 km at an average speed of 5.13 km in ice-free waters but showed no directed migratory movement, staying within 81 km of the tagging site. Additional tagged whales in 1989 migrated 954-1,347 km at average speeds of 1.5-2.5 km/h (Wartzog et al., 1990). Mate, Krutzikowsky, and Winsor (2000) tagged 12 juvenile bowhead whales with satellite-monitored radio tags in the Canadian Beaufort Sea. The whale with the longest record traveled about 3,886 km from Canada across the Alaskan Beaufort Sea to the Chukchi Sea off Russia and averaged 5.0 km/h. This whale's speed was faster, though not significantly faster, in heavy ice than in open water.

Oceanographic conditions can vary during the fall migration from open water to more than nine-tenths ice coverage. The extent of ice cover may influence the timing or duration of the fall migration. Miller, Elliot, and Richardson (1996) observed that whales within the Northstar region (long. 147°-150° W.) migrate closer to shore in light and moderate ice years and farther offshore in heavy ice years, with median distances offshore of 30-40 km (19-25 miles [mi]) in both light and moderate ice years and 60-70 km (37-43 mi) in heavy ice years. Moore (2000) looked at bowhead distribution and habitat selection in heavy, moderate, and light ice conditions in data collected during the autumn from 1982-1991. This study concluded that bowhead whales select shallow inner-shelf waters during moderate and light ice conditions and deeper slope habitat in heavy ice conditions. During the summer, bowheads selected continental slope waters and moderate ice conditions (Moore, DeMaster, and Dayton, 2000). Interseasonal depth and ice-cover habitats were significantly different for bowhead whales. Ljungblad et al. (1987) observed during the years from 1979-1986 that the fall migration extended over a longer period, that higher whale densities were estimated, and that daily sighting rates were higher and peaked later in the season in light ice years as compared to heavy ice years.

Fall aerial surveys of bowhead whales in the Alaskan Beaufort Sea have been conducted since 1979 by the Bureau of Land Management and the MMS (Ljungblad et al., 1987; Treacy, 1988-1998, 2000). Over a 19-year period (1982-2000), there were 15 years with some level of offshore seismic exploration and/or drilling activity and 4 years (1994, 1995, 1999, and 2000) in which neither offshore activity took place during September or October. The parametric Tukey HSD test was applied to MMS fall aerial-transect data (1982-2000) to compare the distances of bowhead whales north of a normalized coastline in two analysis regions of the Alaskan Beaufort Sea from 140-156° W. longitude (see USDOI, MMS, 2003:Map 7). While the Tukey HSD indicates significant differences between individual years, it does not compare actual levels of human activity in those years nor does it test for potential effects of sea ice and other oceanographic conditions on bowhead migrations (Treacy, 2000). Treacy (2000) showed in a year-to-year comparison that the mean migration regionwide in fall 1998 was significantly closer to shore in both the East and West Regions than in 1999, a year with no offshore seismic or drilling activity during the fall season in the Alaskan Beaufort Sea.

While other factors may have dominating effects on site-specific distributions, such as prey concentrations, seismic activities, and localized vessel traffic, broad-area fall distributions of bowhead whale sightings in the central Alaskan Beaufort Sea may be driven by overall sea-ice severity (Treacy, 2001). Treacy (2002) concluded that:

> Bowhead whales occur farther offshore in heavy-ice years during fall migrations across the Central Alaskan Beaufort Sea (142° W to 155° W longitudes). Bowheads generally occupy nearshore waters in years of light sea-ice severity, somewhat more offshore waters in moderate ice years, and are even farther offshore in heavy ice years. While other factors...may have localized effects on site-specific distributions, broad-area distributions of bowhead whale sightings in the central Alaskan Beaufort Sea are related to overall sea-ice severity.

Further evidence that bowhead whales migrate at varying distances from shore in different years also is provided by site-specific studies monitoring whale distribution relative to local seismic exploration in nearshore waters of the central Beaufort Sea (Miller et al., 1997; Miller, Elliot, and Richardson, 1998; Miller et al., 1999). In 1996, bowhead sightings were fairly broadly distributed between the 10-m and 50-m depth contours. In 1997, bowhead sightings were fairly broadly distributed between the 10-m and 40-m depth contours, unusually close to shore. In 1998, the bowhead migration corridor generally was farther offshore than in either 1996 or 1997, between the 10-m and 100-m depth contours and approximately 10-60 km from shore.

Aerial surveys near the proposed Liberty development project in 1997 (BPXA, 1998) showed that the primary fall-migration route was offshore of the barrier islands, outside the proposed development area. However, a few bowheads were observed in lagoon entrances between the barrier islands and in the lagoons immediately inside the barrier islands, as shown in Figures 4-4 and 4-5 of the Environmental Report submitted by BPXA for the Liberty development project (BPXA, 1998). Because survey coverage in the nearshore areas was more intensive than in offshore areas, maps and tabulations of raw sightings overestimate the importance of nearshore areas relative to offshore areas. Transects generally did not extend south of the middle of Stefansson Sound. Nevertheless, these data provide information on the presence of bowhead whales near the then-proposed Liberty development area during the fall migration. Probably only a small number of bowheads, if any, came within 10 km (6 mi) of the area.

Some bowheads may swim inside the barrier islands during the fall migration. For example Frank Long, Jr. reported that whales are seen inside the barrier islands near Cross Island nearly every year and are sometimes seen between Seal Island and West Dock (U.S. Army Corps of Engineers, 1999). Crews from the commercial-whaling ships looked for the whales near the barrier islands in the Beaufort Sea and in the lagoons inside the barrier islands (Brower, 1980). Whales have been known to migrate south of Cross Island, Reindeer Island, and Argo Island during years when fall storms push ice against the barrier islands (Brower, 1980). Inupiat whaling crews from Nuiqsut also have noticed that the whale migration appears to be influenced by wind, with whales stopping when the winds are light and, when the wind starts blowing, the whales started moving through Captain Bay towards Cross Island (Tuckle, as cited in USDOI, MMS, 1986). Some bowhead whales have been observed swimming about 25 yards from the beach shoreline near Point Barrow during the fall migration (Rexford, as cited in USDOI, MMS, 1996). A comment received from the Alaska Eskimo Whaling Commission on the Liberty draft EIS indicated that Inupiat workers at Endicott have, on occasion, sighted bowheads on the north side of Tern Island. No specific information was provided regarding the location of the whale.

Data are limited on the bowhead fall migration through the Chukchi Sea before the whales move south into the Bering Sea. Bowhead whales commonly are seen from the coast to about 150 km (93 mi) offshore between Point Barrow and Icy Cape, suggesting that most bowheads disperse southwest after passing Point Barrow and cross the central Chukchi Sea near Herald Shoal to the northern coast of the Chukotka Peninsula. However, sightings north of 72° N. latitude suggest that at least some whales migrate across the Chukchi Sea farther to the north. Mel'nikov, Zelensky, and Ainana (1997) argued that data suggest that after rounding Point Barrow, some bowheads head for the northwestern coast of the Chukotka Peninsula and others proceed primarily in the direction of the Bering Strait and into the Bering Sea. Mel'nikov (in USDOC, NOAA, and NSB, 2005) reported that abundance increases along northern Chukotka in September as whales come from the north. More whales are seen along the Chukotka coast in October. J.C. George (cited in IWC, 2004b) noted that bowheads pass through the Bering Strait into the Bering Sea between October and November on their way to overwintering areas in the Bering Sea.

The timing, duration, and location of the fall migration along the Chukotka Peninsula are highly variable and are linked to the timing of freezeup (Mel'nikov, Zelensky, and Ainana, 1997). Whales migrate in "one short pulse over a month" in years with early freezeup, but when ice formation is late, whales migrate over a period of 1.5-2 months in 2 pulses (Mel'nikov, Zelensky, and Ainana, 1997:13.

Summary and Evaluation of Known Use of the Beaufort Sea by Bowheads. Bowhead whales may occur in the portions of the Beaufort Sea Planning Area from spring through late fall. Spatial distribution, length of residency, habitat use, and timing of use is variable among years. Currently, the whales are first seen at Barrow around April 9-10, and this early pulse is dominated by juveniles. The size/age composition of whales entering the Beaufort gradually switches so that by later in May (May 15-June) large whales and cow/calf pairs are seen. Most of the herd is believed to have migrated past Barrow by late May. After passing Barrow, whales travel in spring leads through heavy pack ice, generally in a northeasterly direction, eventually heading east toward the southeastern Beaufort Sea, reaching the Canadian Beaufort by July. The number of bowheads observed feeding in Canadian waters is variable as is the distribution and behavior of whale observed there. They range through the Beaufort Sea in the summer. Large numbers of whale have been observed in early September in western portions of the planning area. It is not clear whether these whales migrated west early or did not migrate into the eastern Beaufort. The extent and locations of feeding in portions of the Beaufort Sea Planning Area varies considerably among years. In late summer (typically early September, but sometimes beginning earlier), bowhead whales migrate west. Data indicate that bowheads occupy inner and outer shelf habitat in light and moderate ice years but occur in outer shelf and slope habitat in years of heavy ice.

Summary and Evaluation of Known Use of the Chukchi Sea by Bowhead Whales. The Chukchi Sea OCS Planning Area is an integral part of the total range of BCB Seas bowhead whales, and portions of this planning area are either part of or are primary calving ground during the spring for these whales. During the spring (widely bracketed as mid-March to approximately mid-June), bowheads migrate through leads on their way to summer feeding grounds. This lead system is an apparently obligate pathway for this population. Most calving apparently occurs during the spring migration between April and early June. In some years, parts of the spring lead system in the Chukchi Sea west, northwest, and southwest of Barrow are used as feeding areas over extended periods of time during the spring migration, but this use is inconsistent. Bowhead whales have been observed throughout the summer in waters along the northeastern Chukchi Peninsula of Russia (and along the southeastern portion of the Chukchi Peninsula in the Bering Sea). In the autumn, bowheads are in the Chukchi Sea as part of their autumn migration back to the Bering Sea from about mid-September through October, passing through Bering Strait to the Bering Sea between October and November. Some of the bowheads whales are very far north (e.g., 72° N. latitude) in the Chukchi. After passing Barrow, some of the whales head towards Wrangell Island and then follow the Asian coast southeast to the Bering Sea. Observations indicate bowheads feed along the Russian coast in the autumn. Lee et al. (2005) summarized that both bulk body tissue and baleen isotopic values indicate that the Bering and Chukchi sea regions are the predominant feeding areas for adults and subadults. Some of the feeding in the western Alaskan Beaufort Sea (e.g., west of Harrison Bay) is on prey advected from the Chukchi Sea.

Recent systematic data about bowhead seasonal patterns of distribution, abundance, and habitat use in the Chukchi Sea OCS Planning Area are lacking. The MMS funded large-scale surveys in this area when there was oil and gas leasing and exploration, but the last surveys were about 15 years ago. Since that period, data indicate that the bowhead population has increased substantially (about 3.3-3.4%/year), there have been significant reductions in sea-ice extent and a great decline in average sea-ice thickness ice (see the section on climate warming in the Baseline section). For these reasons, we acknowledge considerable uncertainty about the extent of current use of the Chukchi Sea by bowhead whales, especially during the summer months and the fall migration.

D.4.a(2)(f) Bowhead Feeding. The importance of the Alaskan Beaufort Sea as a feeding area for bowheads is an issue of great concern to Inupiat whalers and is a major issue in evaluating the potential significance of any effect that may occur as a result of oil and gas activities in the Beaufort Sea and Chukchi Sea Planning Areas. Both MMS and the NSB believe that, with regards to understanding bowhead feeding within the Alaskan Beaufort Sea, there are major questions that remain to be answered (Stang and George, 2003).

Because of the importance of this topic in past discussions and evaluations, we provide considerable detail about available information.

Bowheads are filter feeders, filtering prey from the water through baleen fibers in their mouth. They apparently feed throughout the water column, including bottomfeeding as well as surface skim feeding

(Würsig et al., 1989). Skim feeding can occur when animals are alone and conversely may occur in coordinated echelons of over a dozen animals (Würsig et al., 1989). Food items most commonly found in the stomachs of harvested bowheads include euphausiids, copepods, mysids, and amphipods. Euphausiids and copepods are thought to be their primary prey. Lowry, Sheffield, and George (2004) documented that other crustaceans and fish also were eaten but were minor components in samples consisting mostly of copepods or euphausiids.

Available data indicate that bowhead whales feed in both the Chukchi and Beaufort Sea Planning Areas and that this use varies in degree among years, among individuals, and among areas. It is likely that bowheads continue to feed opportunistically where food is available as they move through or about the Alaskan Beaufort Sea, similar to what they are thought to do during the spring migration.

Observations from the 1980's documented that some feeding occurs in the spring in the northeastern Chukchi Sea, but this feeding was not consistently seen (e.g., Ljungblad et al., 1987; Carroll et al., 1987). Stomach contents from bowheads harvested between St. Lawrence Island and Point Barrow during April into June also indicated it is likely that some whales feed during the spring migration (Carroll et al., 1987; Shelden and Rugh, 1995, 2002). Carroll et al. (1987) reported that the region west of Point Barrow seems to be of particular importance for feeding, at least in some years, but whales may feed opportunistically at other locations in the lead system where oceanographic conditions produce locally abundant food. Lowry (1993) reported that the stomachs of 13 out of 36 spring-migrating bowheads harvested near Point Barrow between 1979 through 1988 contained food. Lowry estimated total volumes of contents in stomachs ranged from less than 1 to 60 liters (L), with an average of 12.2 L in eight specimens. Shelden and Rugh (1995) concluded that "In years when oceanographic conditions are favorable, the lead system near Barrow may serve as an important feeding ground in the spring (Carroll et al., 1997)." Richardson and Thomson (2002) concluded that some, probably limited, feeding occurs in the spring.

It is known that bowhead whales feed in the Canadian Beaufort in the summer and early fall (e.g., Würsig et al, 1985), and in the Alaskan Beaufort in late summer/early fall (Lowry and Frost, 1984; Ljungblad et al., 1986; Schell and Saupe, 1993; Lowry, Sheffield, and George, 2004; summarized in Richardson and Thomson, 2002). Available information indicates it is likely there is considerable inter-annual variability in the locations where feeding occurs during the summer and fall in the Alaska Beaufort Sea, in the length of time individuals spend feeding, and in the number of individuals feeding in various areas in the Beaufort Sea.

In at least some years, some bowheads apparently take their time returning westward during the fall migration, sometimes barely moving at all, with some localities being used as staging areas due to abundant food resources or social reasons (Akootchook, 1995, as reported in NMFS, 2001). The Inupiat believe that whales follow the ocean currents carrying food organisms (e.g., Napageak, 1996, as reported in NMFS, 2001). Bowheads have been observed feeding not more than 1,500 feet (ft) offshore in about 15-20 ft of water (Rexford, 1979, as reported in NMFS, 2001). Nuiqsut Mayor Nukapigak testified at the Nuiqsut Public Hearing on March 19, 2001, that he and others saw a hundred or so bowhead whales and gray whales feeding near Northstar Island (USDOI, MMS, 2002). Some bowheads appear to feed east of Barter Island as they migrate westward (Thomson and Richardson, 1987).

Interannual variability in the use of areas of the Beaufort Sea by bowheads for feeding also has been observed during aerial surveys by MMS and others. Ljungblad et al. (1986) reported that feeding bowheads comprised approximately 25% of the total bowheads observed during aerial surveys conducted in the Beaufort Sea from 1979 through 1985. Miller, Elliott, and Richardson (1998) reported observing many aggregations of feeding whales in nearshore waters near or just offshore of the 10-m depth contour during late summer/autumn 1997. In some years (e.g., 1997) (Miller, Elliot, and Richardson, 1998; Treacy, 2002), many aggregations have been seen feeding (e.g., between Point Barrow and Smith Bay), whereas in other years very little feeding was observed. Bowheads occasionally have been observed feeding north of Flaxman Island.

Treacy (2002) summarized data regarding the frequency of feeding and milling of bowhead whales observed on transect during aerial surveys conducted by MMS in the Beaufort Sea between 1982 and 2001.

Because whales exhibiting milling behavior also may be feeding whales, whales with milling behavior were included with whales with apparent feeding behavior, even though some milling whales may have been engaged in other forms of social behavior. Feeding and milling whales observed per unit effort for each fall season (1982-2001) were mapped for visual comparison of relative occurrence of these behaviors in the Alaskan Beaufort Sea. Treacy (2002) summarized that a greater relative occurrence of feeding and/or milling behavior in bowhead whales was detected on transect near the mouth of Dease Inlet during aerial surveys of bowhead whales in the Beaufort Sea in 6 out of 20 years (1984, 1989, 1997, 1998, 1999, and 2000). In 4 of those years (1989, 1997, 1998, and 1999), Treacy also reported that a similar frequency of feeding and/or milling behavior was observed on transect near Cape Halkett, Alaska. During this 20-year period, there were 9 years when feeding and/or milling behaviors were noted on transect, but not in or near either Dease Inlet or Cape Halkett (1982, 1983, 1985, 1986, 1988, 1990, 1993, 1995, and 1996). In 1987, 1991, 1992, 1994, and 2001, Treacy (2002) reported that neither feeding nor milling behaviors were noted on transect at any location in the study area. Interannual and geographic variation in prey availability likely accounts for opportunistic feeding aggregations in particular years and locations (Treacy, 2002).

Of 245 whales observed during 2003 during MMS BWASP, 31% were classified as milling but none as feeding (Monnett and Treacy, 2005). Monnett and Treacy (2005) reported concentrations of milling whales nearshore north and northwest of Oliktok Point on September 20, 2003. In 2004, 29% of 253 bowheads observed were classified as feeding and 10% as milling. Locations of feeding whales included northeast of Barrow, in Smith Bay, and to the west of Kaktovik. Milling whales were in the far eastern portions of the study area.

Data from MMS's BWASP surveys (e.g., Treacy, 1998, 2000) shows high numbers of whales, many of which were feeding, in some areas over relatively long periods (e.g., weeks) of time in some years (e.g., 1997) in areas in the western Alaskan Beaufort) but not in others.

In the years that feeding whales are seen in a given area over a period of time, if the same individuals are staying in the areas and feeding, for these lengths of time, in those years they could be deriving a higher than typical percentage of their yearly energetic requirements from the Alaskan Beaufort Sea.

Based on stomach content data supplemented by behavioral evidence, far more than 10% of the bowheads that passes through the eastern Alaskan Beaufort Sea during late summer and autumn feed there. Based on examination of the stomach contents of whales harvested in the autumn between 1969-2000, Lowry, Sheffield, and George (2004) found that there were no significant difference in the percentages of bowheads that had been feeding between those harvested near Kaktovik (83%), Barrow (75%), or between subadults (78%) versus adults (73%). Twenty-four out of 32 whales taken during the fall at Kaktovik from 1979-2000 and included in this analysis were considered to have been feeding (Lowry and Sheffield, 2002). The status of three other whales was uncertain. Copepods were the dominant prey species by volume. Seventy-seven out of 106 whales harvested during the fall near Barrow from 1987-2000 and included in this analysis were considered to have been feeding. The status of two other whales was uncertain. There was no estimate of stomach contents for 61 whales. Of the 77 whales classified as feeding whales, there were estimates of stomach volume for 16 autumn-feeding whales. Euphausiids were the dominant prey species by volume.

Stomach volumes are reported for 34 of 90 whales harvested in the autumn at Kaktovik and Barrow. The stomach of the harvested whales contained highly variable amounts of food (range=2-150 L at Kaktovik, with 39% containing with >20 L and 11% containing >100 L; n=18) (range =1-189 L at Barrow, with 56% containing with >20 L and 31% containing >100 L; n=16) (Table 6 in Lowry, Sheffield, and George, 2004:219). Four out of five whales taken during the fall at Cross Island from 1987-2000 were considered to have been feeding (at least 10 items or 1 L of prey). Length-girth relationships show that subadult bowheads, and possibly adults, gain weight while in the Beaufort Sea in summer and lose weight while elsewhere. Lipid content of blubber, at least in subadults, is higher when they leave the Beaufort in fall than when they return in spring. This evidence suggests the importance of feeding in the Beaufort Sea during summer and early autumn. They do not show what fraction of the annual feeding occurs in the eastern and central Beaufort Sea. Lowry, Sheffield, and George (2004:221) concluded that:

...Bowhead whales feed regularly in the nearshore waters of the eastern, central and western Alaskan Beaufort Sea during September and October...this entire region should be considered an integral part of the summer-autumn feeding range of bowhead whales. Results of stomach contents analysis, aerial observations, and traditional knowledge suggest that reference to the passage of bowhead whales through this region as a 'westward autumn migration' is misleading...it is a very incomplete description of their activities in the region. Second, feeding near Barrow during the spring migration is not just occasional, but rather a relatively common event...However, the amount of food in the stomachs tends to be lower in spring than in autumn....

However, examination of stomach contents only showed whether or not bowhead whales had fed and what prey were eaten, and it does not directly address the relative significance of feeding in various regions...This unresolved issue remains important in the evaluation of possible cumulative effects of oil and gas development on bowhead whales.....

Because the standard for classifying a whale as feeding is set so low, but prey volumes are rarely reported, we find it difficult to critically evaluate these findings relative to the issue of assessing the importance of various areas as bowhead feeding area, either to the population as a whole or to segments of the population. As pointed out by Thomson, Koski, and Richardson (2002), there is a large difference between a stomach with a small amount of prey (10 prey items) and one that is full.

It is unclear how important this feeding is in terms of meeting the annual food needs of the population or to meeting the food needs of particular segments of the population (e.g., see discussion in Richardson and Thomson, 2002). Many assumptions, such as those about residence time and approximations, influence current conclusions. Because marked individuals have not been studied, it is unclear how much variability also exists among classes of individuals or individuals within a class in habitat residency times, or what factors influence residency times.

Richardson and Thomson (2002) pointed out that bowhead activity throughout the year needs to be considered when evaluating the importance of feeding in the eastern Alaskan Beaufort Sea in late summer and autumn.

Although numerous observations have been made of bowheads feeding during both the spring migration north to the Beaufort Sea and the fall migration west across the Alaskan Beaufort Sea, quantitative data showing how food consumed in the Alaskan Beaufort Sea contributes to the bowhead whale population's overall annual energy needs is fairly limited.

A study by Richardson (1987) concluded that food consumed in the eastern Beaufort Sea contributed little to the bowhead whale population's annual energy needs, although the area may be important to some individual whales. The study area for this 1985-1986 study extended from eastern Camden Bay to the Alaska/Canada border from shore to the 200-m depth contour for the intensive study area, and beyond this contour only for aerial survey data (Richardson and Thomson, 2002). The conclusion was controversial. The NSB's Science Advisory Committee (1987) believed the study was too short in duration (two field seasons, one of which was limited by ice cover), suboptimal sampling designs, and difficulties in estimating food availability and consumption. The Committee did not accept the conclusion that the study area is unimportant as a feeding area for bowhead whales.

Richardson and Thomson (2002) finalized the report from the MMS-funded feeding study entitled *Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information*, which compiled and integrated existing traditional and scientific knowledge about the importance of the eastern Alaskan Beaufort Sea for feeding by bowhead whales. The project was an extension, with additional fieldwork (mainly in September of 1998, 1999, and 2000), of the previous study conducted in 1985 and 1985. The primary study area for this study extended the westward boundary about 1° longitude from that of the 1985-1986 study. Thus the boundary for the latter study was near the middle of Camden Bay (145° W. longitude). With the concurrence of the NSB Scientific Review Board, efforts in deep offshore areas were de-emphasized in this latter study so as to concentrate efforts in shallow areas of particular concern to Kaktovik hunters and, potentially, to oil industry. Boat-based zooplankton sampling in 1998-2000 was limited to areas seaward of the 50-m contour. Aerial surveys extended to the 200-m contour, and MMS surveys extended further.

Griffiths (1999) noted that the average zooplankton biomass in the study area was higher in 1986 than in 1998. Habitat suitable for feeding appears to have been less common in the eastern Alaskan Beaufort Sea in 1998 than it was in 1986. In 1998, the principal feeding area within the eastern study area appeared to have been near Kaktovik. Griffiths, Thomson, and Bradstreet (2002) discussed zooplankton biomass samples collected in the Canadian Beaufort Sea during the 1980's and in the Alaskan Beaufort Sea in 1986, 1998, and 1999, where bowhead whales were either observed feeding or where whales had been observed feeding the previous day. Bowhead whales feed in areas with a higher than average concentration of zooplankton. The distribution of biomass values at locations with feeding bowheads indicates that the feeding threshold for bowheads may be a wet biomass of ~800 milligrams per cubic meter (mg/m^3).

Most whales observed where zooplankton were sampled were subadults. "Adult bowheads tend to feed where large copepods predominate" (Richardson and Thomson, 2002:xxv.

Koski (2000) summarized that the most common activity of bowheads in the eastern Alaskan Beaufort Sea during late summer and autumn was feeding. Bowhead use of the eastern Alaskan Beaufort Sea during late summer and autumn can be highly variable from year to year, with substantial differences in the numbers, size classes, residence times, and distributions of bowheads recorded there during 1985, 1986, 1998, and 1999.

Although various types of evidence (with the exception of isotope ratios) (see below) indicate that the eastern Beaufort Sea as a whole, including the Canadian Beaufort, is important to bowhead whales for feeding, the eastern Alaskan Beaufort Sea is only a small fraction of that area (Richardson and Thomson, 2002.

Similarly, data indicate that the amount of time bowheads spend feeding in the fall in the eastern Alaskan Beaufort Sea is highly variable among years. Available evidence indicates that in many years, the average bowhead does not spend much time in the eastern Alaskan Beaufort Sea and, thus, does not feed there extensively. Bowhead whales moved quickly through the area in 1998 and did not stop to feed for any great period of time. In contrast, during 1986, subadult whales stopped to feed in the study area for periods of at least several days. In 1999, adult whales stopped to feed in the Flaxman-to-Herschel zone for extended periods (Koski et al., 2002). In 1999, the main bowhead feeding areas were 20-60 km offshore in waters 40-100 m deep in the central part of the study area east and northeast of Kaktovik, between Kaktovik and Demarcation Bay (Koski, Miller, and Gazey, 2000). In 1999, one bowhead remained in the study area for at least 9 days, and 10 others remained for 1-6 days. Their mean rate of movement was about one-eighth of the rate observed in 1998.

Koski et al. (2002) used six calculation methods to estimate residence time for whales in the eastern Alaskan Beaufort Sea area, from Flaxman Island to Herschel Island. The annual residence time varied from 2.1-8.3 days and averaged 5.1 days. Of the individual bowheads that traveled through this portion of the Alaskan Beaufort Sea, some spent at least 7 days.

Miller et al. (2002) pointed out that it is difficult to recognize feeding behavior during typical aerial surveys. More focused observations are usually needed to obtain evidence of feeding below the surface.

Baleen from bowhead whales provides a multiyear record of isotope ratios in prey species consumed during different seasons, including information about the occurrence of feeding in the Bering Sea and Chukchi Sea system. The isotopic composition of the whale is compared with the isotope ratios of its prey from various geographic locations to make estimates of the importance of the habitat as a feeding area.

Carbon-isotope analysis of bowhead baleen has indicated that a significant amount of feeding may occur in wintering areas (Schell, Saupe, and Haubenstock, 1987).

Carbon-isotope analysis of zooplankton, bowhead tissues, and bowhead baleen indicates that a significant amount of feeding may occur in areas west of the eastern Alaskan Beaufort Sea, at least by subadult whales (Schell, Saupe, and Haubenstock, 1987). Subadult whales show marked changes in the carbon isotope over the seasons, indicating that carbon in the body tissues is replaced to a large extent from feeding in summer and feeding in the autumn-winter months. In contrast, adult animals sampled show very little seasonal change in the carbon isotope and have an isotopic composition best matched by prey from the western and southern regions of their range, implying that little feeding occurs in summer (Schell and Saupe, 1983).

The importance of the Alaskan Beaufort Sea as a bowhead feeding area also may have changed, or be changing, due to changes in prey availability elsewhere in their range. Isotope data indicate that primary productivity in the Bering and southern Chukchi seas is declining. Schell (1999a) looked at baleen from 35 bowheads that were archived, in addition to whales from the recent harvest, and constructed an isotopic record that extends from 1947-1997. He inferred from this record that seasonal primary productivity in the North Pacific was higher over the period from 1947-1966, and then began a decline that continues to the most recent samples from 1997. Isotope ratios in 1997 are the lowest in 50 years and indicate a decline in the Bering Sea productivity of 35-40% from the carrying capacity that existed 30 years ago. If the decline in productivity continues, the relative importance of the eastern Beaufort Sea to feeding bowheads may increase (Schell, 1999b).

Lee and Schell (2002) analyzed carbon isotope ratios in bowhead whale muscle, baleen, and fat, and in bowhead food organisms. They found that the isotopic signatures in zooplankton from Bering and Chukchi waters, which sometimes extend into the western Beaufort Sea, are similar and cannot be differentiated from one another. Zooplankton from the eastern Beaufort Sea (summer and early autumn range) has an isotopic signature that is distinct from that in Bering/Chukchi zooplankton. Lee and Schell compared these isotopic signatures in zooplankton to isotopic signatures in bowhead tissues.

Lee and Schell (2002) found that carbon isotopes in the muscle sampled in the fall were not significantly different from those in muscle sampled in the spring. Carbon isotopes in the muscle during both seasons closely matched the isotope ratios of zooplankton from the Bering and Chukchi waters, indicating most of the annual food requirements of adults and subadults are met from that portion of their range. Based on the comparison of carbon isotopes in the zooplankton and in bowhead tissues, they estimate that 10-26% of the annual bowhead feeding activity was in the eastern and central Beaufort Sea waters, roughly east of Prudhoe Bay.

Isotope data from baleen showed different feeding strategies by adult and subadult whales. Subadults acquired sufficient food in the eastern Beaufort Sea to alter the carbon isotope ratios in baleen relative to baleen representing feeding in Bering and Chukchi waters. Baleen plates from subadults showed a wider range in isotope ratios than those from adults, suggesting active feeding over all parts of their range.

Much of the isotopic evidence seems to indicate that especially adult bowhead whales feed primarily on prey from the Bering and/or Chukchi Sea (Schell, Saupe, and Haubenstock, 1987; Schell and Saupe, 1993; Lee and Schell, 2002). Hoekstra et al. (2002) found seasonal values were consistent for all age classes of bowhead whales and suggested that the Bering and Beaufort seas are both important regions for feeding.

In contrast, Hoekstra et al. (2002) concluded that seasonal fluctuations in carbon isotope values was consistent for all age classes of bowhead whales and suggests that the Bering and Beaufort seas are both important regions for feeding. Hoekstra et al. (2002) included data on isotope ratios in tissue subsamples from some of the same individual bowheads from Kaktovik and Barrow that were analyzed by Lee and Schell. There was an apparent discrepancy in the data from these two studies and somewhat different conclusions. The source of the discrepancy related to differences in the results from the Kaktovik whale-muscle samples. Hoekstra et al. (2002) suggest the percentage of annual feeding activity in the eastern Beaufort Sea could be on the order of 37-45% (compared to 10-26%). This discrepancy was considered critical in assessing the importance of feeding in the eastern Beaufort Sea. Lee and Schell subsequently repeated their isotopic analyses on additional subsamples from the same Kaktovik whales and obtained the same results they obtained initially (Lee and Schell, 2002). These re-analyses confirm the accuracy of the measurements reported by Lee and Schell in their draft report. Hoekstra et al. have not repeated their isotopic analyses at this time; therefore, the reason for the discrepancy between the two sets of data remains uncertain.

Recently, Lee at al. (2005) published data from isotope ratio analyses of bowhead baleen from whales all of whom except one had been harvested in the autumn of 1997-1999 (Barrow: n=4; Kaktovik: n=10) and muscle (Barrow: n=14; Kaktovik: n=10). Results of these samples were compared to data from baleen collected in past studies from both spring (predominantly) and autumn whales in 1986-1988 (see Table 1 in Lee et al., 2005:274). Lee et al. (2005:285) concluded that the new data continue to indicate that the BCB Seas "bowhead whale population acquires the bulk of its annual food intake from the Bering-Chukchi system.... Our data indicate that they acquire only a minority of their annual diet from the eastern and central Beaufort Sea...although subadult bowheads apparently feed there somewhat more often than do adults."

Thomson, Koski, and Richardson (2002) tried to reconcile the low estimates of summer feeding, as indicated by the isotope data of Lee and Schell, with other data: behavioral observations showing frequent feeding in the eastern Beaufort Sea during the summer and early autumn; zooplankton sampling near bowheads feeding in those areas shows that whales concentrate their feeding at locations with much higher than average biomasses of zooplankton; frequent occurrence of food in the stomachs of bowheads harvested in the Alaskan Beaufort Sea during late summer and autumn; and length-girth relationships show that subadult bowheads, and possibly adults, gain weight while in the Beaufort Sea in summer and lose weight while elsewhere; and lipid content of blubber, at least in subadults, is higher when they leave the Beaufort in fall than when they return in spring. Although some of this evidence suggests the importance of feeding in the Beaufort Sea during summer and early autumn, those types of data on summer and early fall feeding in the Beaufort Sea do not specifically show what fraction of the annual feeding occurs in the eastern and central Beaufort Sea. No comparable data on feeding, girth, or energy content have been obtained during and after the whales feed in the Chukchi sea in mid- to late fall.

They concluded that bowheads fed for an average of 47% of their time in the eastern Alaskan Beaufort Sea during late summer and autumn. A substantial minority of the feeding occurred during travel. Among traveling whales, feeding as well as travel was occurring during a substantial percentage of the time, on the order of 43%.

Assumptions about residence times influence these energetics-related estimates. As noted, available data indicate there is variability in habitat use among years. Because marked individuals have not been studied, it is unclear how much variability also exists among individuals in habitat residency times or what factors influence residency times.

Estimated food consumption by bowheads in the eastern Alaskan study area (Flaxman Island to the Alaska/Canada border) was expressed as a percentage of total annual consumption by the population (Thomson, Koski, and Richardson, 2002). This was done separately for each year of the study and averaged for the 5 years of the study.

The amount of feeding in the Chukchi Sea and Bering Strait in the fall is unknown as is the amount of feeding in the Bering Sea in the winter (Richardson and Thomson, 2002). Richardson and Thomson (2002:xxxviii) concluded that: "...behavioral, aerial-survey, and stomach-content data, as well as certain energetics data...show that bowheads also feed widely across the eastern and central Beaufort Sea in summer and fall."

They also concluded (Richardson and Thomson, 2002:xliii) that:

> In an average year, the population of bowhead whales derives an estimated 2.4% of annual energetic requirements" in the eastern part of the Alaskan Beaufort Sea studied.
>
> In 1 of 5 years of study, the population may have derived 7.5% or more of annual energetic requirements from the area. Utilization of the study area varies widely in time and space depending on zooplankton availability and other factors. In 4 of 5 study years, the bowhead

population was estimated to consume <2% of its annual requirements within the eastern Alaskan Beaufort Sea during late summer and autumn....

Sensitivity analysis indicated that the upper bound of the 95% confidence interval was below 5% in four of the years. This upper bound was 16.5% in 1999, when the best estimate was 7.5%. Richardson and Thomson (2002) stated that they suspected the whale-days figure for 1999 was overestimated, and that the 16.5% upper bound on that confidence interval was unrealistically high. Richardson and Thomson (2002:xliv) concluded that: "It is implausible that the population would consume more than a few percent of its annual food requirements in the study year in an average year."

One source of uncertainty that affected the analyses related to bowhead energetics is that the amount of feeding in the Chukchi Sea and Bering Strait in the fall is unknown as is the amount of feeding in the Bering Sea in the winter (Richardson and Thomson (2002). In mid to late fall, at least some bowheads feed in the southwest Chukchi. Detailed feeding studies have not been conducted in the Bering Sea in the winter.

Thomson, Koski, and Richardson (2002) offered a feeding scenario, parts of which are speculative, that might be consistent with all these data. In this scenario, feeding occurs commonly in the Beaufort Sea in summer and early autumn, and bowheads gain energy stores while feeding there. However, zooplankton availability is not as high in the Beaufort Sea during summer as in the Chukchi and northern Bering seas during autumn. Also, feeding in the western Beaufort in autumn effectively may be on Chukchi prey advected to that area. Thus, bowheads might acquire more energy from Bering/Chukchi prey in autumn than from eastern and central Beaufort prey in summer/early autumn. Given this, plus an assumed low turnover rate of body components, the overall body composition of bowheads may be dominated by components from the Bering/Chukchi system, even at the end of the summer when leaving the Beaufort. Energy gained in the Beaufort and Chukchi seas during summer and fall presumably is used during winter when food availability is low, resulting in reduced girth and energy stores when returning to the Beaufort Sea in spring than when leaving in autumn.

Richardson and Thomson (2002) pointed out that the isotopic and behavioral and stomach content data might not be in conflict, if prey availability in the Chukchi and/or Bering Sea were "notably better" than in the eastern Beaufort Sea. However, they also point out that: "...it is difficult to understand why bowheads would migrate from the Bering-Chukchi area to the Beaufort Sea if feeding in the Beaufort Sea were unimportant."

Richardson and Thomson (2002) note that while the study has provided many new data about bowhead feeding ecology and related biology, "...there are still numerous approximations, assumptions, data gaps, and variations of opinion regarding the interpretation of data. This is inevitable.... The authors do not claim that the project has resolved all uncertainty about the importance of the eastern Alaskan Beaufort Sea for feeding by bowhead whales...."

Thus, the aforementioned study acknowledges certain limitations and the results of this study confirmed that the eastern Alaskan Beaufort Sea is used by bowhead whales for feeding (Stang and George, 2003). Richardson and Thomson (2002) summarized that this use varies widely in degree among years and individuals.

Another recent summary of bowhead whale information is available on the MMS website (http://www.mms.gov/alaska/ref/EIS%20EA/DraftProgrammatic%20EA%20&%20Biological%20Eval/PEA_1.pdf). It is entitled Draft Programmatic Environmental Assessment – Arctic Ocean Outer Continental Shelf Seismic Surveys – 2006.

D.4.b. Polar Bear. This section contains an update of information on polar bears that might be affected by proposed Beaufort Sea Sale 202. The section updates the information in the multiple-sale EIS and the 195 EA by incorporating information from the PEA for seismic operation and recent research. Section IV.B.2.d(2) of this EA contains a one-page summary of the updated information. Because of the current uncertainty regarding the future status of the polar bear (see below), a more thorough review of the species' ecology, incorporating previously published material, is provided as well.

According to the FWS, the status of polar bears worldwide is declining as a result of climate changes, loss of ice habitat, and unregulated hunting pressures (USDOI, FWS, 2005).

On February 16, 2005, the Centers for Biological Diversity (CBD) petitioned the FWS to list the polar bear as a threatened species under the Endangered Species Act due to global warming and the melting of their sea ice habitat (CBD, 2005). In June, 2005 the IUCN/SSG (World Conservation Union/Species Survival Commission) Polar Bear Specialist Group (PBSG) concluded that the IUCN Red List classification of the polar bear should be upgraded from Least Concern to Vulnerable based on the likelihood of an overall decline in the size of the total world polar bear population by more than 30% within the next 35-50 years. The principal reason for this projected decline is "climatic warming and its consequent negative effects on the sea ice habitat of polar bears" (IUCN/PBSG press release, 2005). On February 7, 2006, the 90-day finding by the FWS determined that the CBD petition contained sufficient information indicating that listing polar bears as threatened may be warranted. Therefore, the FWS is currently conducting a 12-month status review of the species to determine whether listing is warranted; if that finding is positive, the FWS will publish a proposed rule to list the species.

Polar bears are the apical predators of the arctic marine ecosystem (Amstrup, 2003) and are specialized predators of phocid seals in ice-covered waters (Derocher, Lunn, and Stirling, 2004). Polar bears have a circumpolar distribution throughout the Northern Hemisphere, and the global population was last estimated at 21,500-25,000 (Lunn et al., 2002). There are two polar bear stocks recognized in Alaska: the southern Beaufort Sea stock (SBS) and the Chukchi/Bering Seas stock (CBS), although there is considerable overlap between the two in the western Beaufort /eastern Chukchi seas (Amstrup et al., 2005). The SBS population ranges from the Baillie Islands, Canada west to Point Hope, Alaska and is subject to harvest from both countries. The CBS population ranges from Point Barrow, Alaska west to the Eastern Siberian Sea. These two populations overlap between Point Hope and Point Barrow, Alaska, centered near Point Lay (Amstrup, 1995).

Polar bears are a classic *K*-selected species, meaning they have delayed maturation, small litter sizes, and high adult survival rates (Bunnell and Tait, 1981). Because polar bears exist in relatively small populations and have low reproductive rates, populations may be detrimentally impacted by even small reductions in their populations (Amstrup, 2000). Their low reproductive rate requires that there must be a high rate of survival to maintain population levels (Amstrup, 2003). Mating occurs from March to May, followed by a delayed implantation in the autumn (Ramsay and Stirling, 1988). Females give birth the following December or January to one to three cubs, which remain with their mother until they are at least 2 years of age (Harington, 1968; Jefferson, Leatherwood, and Webber, 1993). Females will not rebreed until they separate from their cubs. In the Beaufort Sea, female polar bears usually do not breed for the first time until they are 5 years of age (Lentfer and Hensel, 1980), which means that they give birth for the first time at age 6. The maximum reproductive age for polar bears is unknown but likely is well into their 20's (Amstrup, 2003). The average reproductive interval for a polar bear is 3-4 years. A female may produce 8-10 cubs in her lifetime, of which only 50-60% will survive (Amstrup, 2003). A complete reproductive cycle is energetically expensive for female polar bears. When nutritionally stressed, female polar bears can forgo reproduction rather than risk their own survival (Amstrup, 2003). This is possible because implantation of the fertilized egg is delayed till autumn; hence a malnourished female unable to sustain a pregnancy can terminate the process by aborting or resorbing the fetus (Amstrup, 2003).

In northern Alaska, pregnant females enter maternity dens by late November. These dens typically are located in snow drifts in coastal areas, stable parts of the offshore pack ice, or on landfast ice (Amstrup and Garner, 1994). Newborn polar bears are among the most undeveloped of placental mammals; therefore, undisturbed maternal dens are critical in protecting them from the rigors of the arctic winter for the first 2 months of their life (Amstrup, 2000). The highest density of land dens in Alaska occurs along the coastal barrier islands of the eastern Beaufort Sea and within the Arctic National Wildlife Refuge (Amstrup and Garner, 1994). Protecting these core maternity denning areas is of critical importance to the long-term conservation of polar bears.

Polar bears usually forage in areas where there are high concentrations of ringed seals, their primary prey (Stirling and McEwan, 1975; Larsen, 1985), although bearded seals, walruses, and beluga whales also are taken opportunistically (Amstrup and DeMaster, 1988). Polar bears are almost completely carnivorous, although they will feed opportunistically on a variety of foods, including carrion, bird eggs, and vegetation (Smith, 1985; Smith and Hill, 1996; Derocher, Wiig, and Bangjord, 2000). Polar bears prefer shallow-water areas, perhaps reflecting similar preferences by their primary prey, ringed seals, as well as the higher productivity in these areas (Durner et al., 2004). In spring, polar bears in the Beaufort Sea overwhelmingly prefer regions with ice concentrations >90% and composed of icefloes 2-10 km in diameter (Durner et al., 2004). In summer, bears in the Beaufort Sea select habitats with a high proportion of old ice, which takes them far from the coast as the ice melts. In fact, 75% of bear locations in the summer occurs on sea ice in waters >350 m deep, which places them outside the areas of greatest prey abundance. This is because ringed seals tend to aggregate in open-water areas in late summer and early fall, where primary productivity is thought to be high (Harwood and Stirling, 1992), placing them well out of reach of polar bears summering on the pack ice. The distribution of seals and the habitat-selection pattern by bears in the Beaufort Sea suggest that most polar bears do not feed extensively during summer (Durner et al., 2004), which is supported by reports of the seasonal activity levels of polar bears. Amstrup et al. (2000) showed that polar bears in the Beaufort Sea have their lowest level of movements in September, which correlates with the period when the sea ice has carried polar bears beyond the preferred habitat of seals. Conversely, 75% of bear observations in winter occurred in waters <130 m deep. During winter, polar bears prefer the lead system at the shear zone between the shorefast ice and the active offshore ice. This narrow zone of moving ice parallels the coastline and creates openings that are used by seals. Thus, polar bears in winter use a relatively small area of the Beaufort Sea where prey is most abundant and accessible (Durner et al., 2004). Consequently, changes in the extent and type of this ice cover are expected to affect the distributions and foraging success of polar bears (Tynan and DeMaster, 1997).

Polynas, or areas of open water surrounded by ice, are another habitat type that is extremely important to polar bears (Stirling, 1997). Polynas are areas of increased productivity at all trophic levels in arctic waters, particularly where they occur over continental shelves, and often are the sites of marine mammal and bird conentrations. The increased biological productivity around polynas is likely the key factor in their ecological significance. Polynas vary in size and shape and may be caused by wind, tidal fluctuations, currents, upwellings, or a combination of these factors (Stirling, 1997).

The preferred habitat of polar bears is the annual ice over the continental shelf and interisland archipelagos that encircle the polar basin (Derocher, Lunn, and Stirling, 2004). Recent research has indicated that the total sea-ice extent has declined over the last few decades, particularly in both nearshore areas and in the amount of multiyear ice in the polar basin (Parkinson and Cavalieri, 2002; Comiso, 2002a,b). Polar bears and ringed seals depend on sea ice for their life functions, and reductions in the extent and persistence of ice in the Beaufort and Chukchi seas almost certainly will have negative effects on their populations (USDOI, FWS, 1995). Climate change already has affected polar bears in Western Hudson Bay in Canada, where they hunt ringed seals on the sea ice from November to July and spend the open-water season fasting on shore. In a long-term study, Stirling, Lunn, and Iacozza (1999) correlated decreased body condition and reproductive performance in bears with a trend toward earlier breakup of sea ice in recent years. The earlier breakup shortens the bears' feeding season and increases the length of their fasting season. Because ringed seals often give birth to and care for their pups on stable shorefast ice, changes in the extent and stability of shorefast ice and/or the timing of breakup could reduce their productivity. Due to the close predator-prey relationship between polar bears and ringed seals, decreases in ringed seal abundance can be expected to cause declines in polar bear populations (Stirling and Oritsland, 1995). In fact, a new analysis of the Western Hudson Bay polar bear subpopulation confirms that it has declined by almost 20% in the last 30 years (IUCN/PBSG press release, 2005), and this decline is linked to significant reductions in the apparent survival of ringed seal pups coincident with earlier sea-ice breakup.

Climate change also may help explain why coastal communities in Western Hudson Bay have experienced increased bear-human conflicts prior to freezeup each fall. With earlier sea ice breakup, polar bears are forced ashore earlier, in poorer nutritional condition, and remain without access to seals for a longer time. As they exhaust their fat reserves towards the end of the ice-free period, they are more likely to encroach upon human settlements in search of alternative food sources and come into conflict with humans. Thus, the increase in polar bear-human interactions in Western Hudson Bay probably reflects an increase in nutritionally stressed bears searching for food (Amstrup et al., 2006). Similar effects may be expected to occur in Alaska, if climate change continues.

The reduction in the summer ice cover in the Beaufort Sea might affect polar bears in several ways. For example, the 195 EA explained that reductions in sea-ice coverage would adversely affect the availability of pinnipeds as prey for polar bears (USDOI, MMS, 2004:Appendix I, Sec. I.2.e(1)). Also, summer sea-ice reduction would affect the severity of storm events along the coast of Alaska, with consequent effects on polar bears. When the ice cover is reduced, particularly during late summer, the available open-water surface increases, and waves are able to grow in height. For example, rough weather prevented scouting about one-third of the time that whaling crews were on Cross Island during 2001 (Galginaitis and Funk, 2004:24) and about half of the time during 2003 (Galginaitis and Funk, 2005:18). The unusually rough water that restricted scouting for whales might have been related to changes in the summer sea-ice cover during recent years. As explained in Section IV.A.1.a, the analysis of long-term data sets indicates substantial reductions in both the extent and thickness of the arctic sea-ice cover during the past 20-40 years, with record minimum extent in 2002 and again in 2005, and extreme minima in 2003 and 2004 (Stroeve et al., 2005; NASA, 2005). Wave heights in the Beaufort Sea typically range from 1.5 m during summer to 2.5 m during fall, although maximum wave heights of 7-7.5 m are expected (Brower et al., 1988). In fact, a late-summer storm in the Beaufort in September 2000 developed waves 6-7 m high at Point Barrow (Lynch et al., 2003). Such large waves undoubtedly would induce energetic stress, or worse, in any swimming bears unfortunate enough to be caught in them.

Polar bears are excellent swimmers and swim while actively hunting, while moving between hunting areas, and while moving between sea ice and terrestrial habitats. In June, 2005, USGS researchers identified a female polar bear which apparently swam for more than 557 km, from Norton Sound back to the retreating pack ice in the Beaufort Sea northwest of Wainwright (Amstrup et al., 2006).

Swimming is believed to be more energetically costly than walking, which helps explain why bears often will abandon the melting sea ice in favor of land when ice concentrations drop below 50% (Derocher, Lunn, and Stirling, 2004). Polar bears also may become energetically stressed when the pack ice retreats and carries them to deeper waters beyond the productive continental shelf zone. These bears eventually may choose to swim for shore, where annual food resources, such as carcasses of whales killed by Alaskan Natives, can be found along the coast. Despite being strong swimmers, energetically stressed bears are susceptible to misfortune on such long-distance swims. For example, Monnett and Gleason (2006) reported unprecedented polar bear mortalities following a severe storm event in the Beaufort Sea in fall 2004. They estimated that at least 27 bears may have died as a result of this one storm; they attributed this phenomenon to longer open-water periods and reduced sea-ice cover. If such events are recurrent, they easily could rise to the level of a significant impact on polar bear populations, especially considering that current human removals of the SBS population are believed to be at or near maximum sustainable levels. It could take polar bears in the SBS 4-7 years or longer to recover from such mass mortalities (USDOI, FWS, pers. commun.).

Additionally, polar bear use of coastal areas during the fall open water period has increased in recent years in the Beaufort Sea (Schliebe et al., 2005). In fact, nearshore densities of polar bears are two to five times greater in autumn than in summer (Durner and Amstrup, 2000). Aerial surveys flown in September and October from 2000-2005 have revealed that 53% of the bears observed along the coast have been females with cubs, and that 71% of all bears observed were within a 30-km radius of the village of Kaktovik on the edge of the Arctic National Wildlife Refuge (USDOI, FWS, pers. commun.). Congregations of more than 60 polar bears and as many as 12 brown bears have been observed feeding on whale carcasses near Kaktovik in recent years during the fall open-water period (Miller, Schliebe, and Proffitt, 2006). These observed changes in polar bear distribution have been correlated with the distance to the pack ice at that time of year. The farther from shore the leading edge of the pack ice is, the more bears are observed onshore in the fall (Schliebe et al., 2005).

Sport hunting for polar bears has been banned in Alaska since 1972, although bears are still taken for subsistence, recreation, and handicrafts by Alaskan Natives. In 1988, the Inuvialuit Game Council from Canada and the North Slope Borough from Alaska implemented the Polar Bear Management Agreement for the Southern Beaufort Sea, a voluntary agreement that limited the total harvest from the SBS population to within sustainable levels (Brower et al., 2002). The stipulations contained in this voluntary agreement actually are more stringent than those contained in the Marine Mammal Protection Act (MMPA). Sustainable quotas under the agreement are set at 80 bears per year of which, no more than 27 may be female. This quota is believed to be at or near sustainable levels. Recent harvest levels (2000-2005) from the SBS stock averaged 37 individuals in the U.S. and 25 individuals in Canada, for an average harvest of 62 bears per year, well within the agreement's quotas (USDOI, FWS, unpublished data). For the same period, reported U.S. harvest levels of the CBS stock averaged 41 bears, while average Russian harvests of the CBS stock are believed to be much higher (USDOI, FWS, 2003).

A reliable estimate for the CBS stock of polar bears, which ranges into the southern Beaufort Sea, does not exist, and its current status is in question. In 2002, the IUCN/SSG Polar Bear Specialist Group estimated the size of the CBS population at 2,000+ bears, although the certainty of this estimate was considered poor (Lunn et al., 2002). Russia prohibited polar bear hunting in 1956 in response to perceived population declines; however, both sport and subsistence harvest continued in Alaska until 1972. During the 1960's, hunters took an average of 189 bears per year from the CBS population, an unsustainable rate of harvest that likely caused significant population declines. With the passage of the MMPA in 1972, which prohibited sport hunting of marine mammals, the average annual Alaska harvest in the Chukchi Sea dropped to 67 bears per year. However, with the collapse of the Soviet empire in 1991, levels of illegal harvest dramatically increased in Chukotka in the Russian Far East. While the magnitude of the Russian harvest from the CBS is not precisely known, some estimates place it as high as 400 bears per year, although the figure is more likely between 100 and 250 bears per year. Models run by the FWS indicate that this level of harvest of the CBS population most likely is unsustainable, and that an average annual harvest of 180 bears (4.5% of the starting population) potentially could reduce the population by 50% within 18 years (USDOI, FWS, 2003). This simulated harvest level is similar to the estimated U.S./Russia annual harvest for the period 1992-2006, as well as to the unsustainable harvest levels experienced in Alaska in the 1960's, indicating that the CBS stock of polar bears well may be in decline due to overharvesting. The FWS calculations were based on a starting population of 4,000 bears, which is believed to fairly characterize a healthy CBS population.

In 2001 the SBS population was estimated at ~1,800 individuals and was thought to be increasing (Lunn et al., 2002). The most recent population growth rate for the SBS population was estimated at 2.4% annually, based on data from 1982 through 1992, although the population growth rate is believed to have slowed or stabilized since 1992. However, recent information suggests that the SBS polar bear population may be smaller than previously estimated. Researchers from the U.S. Geological Survey state that:

> High recapture rates during capture/recapture studies in 2005 and 2006 suggest that the number of polar bears in the Beaufort Sea region may be smaller than previously estimated. Final analyses of these new population data will not be completed until early in 2007, but preliminary evaluations of ongoing data collection suggest that conservative management is warranted until final estimates are calculated (S. C. Amstrup and E. V. Regehr, pers. comm.).

Neither the SBS nor CBS stock is listed as "depleted" under the MMPA. The SBS is assumed to be within optimum sustainable population levels, although this new information puts this assumption in question (USDOI, FWS: http://alaska.fws.gov/fisheries/mmm/polarbear/reports.htm). The SBS currently is designated a "non-strategic stock" by the FWS. Due to the lack of information concerning the CBS population, the FWS has designated it as "uncertain" at this time.

D.4.c. Other Marine Mammals. This section contains an update of information on other marine mammals that might be affected by proposed Beaufort Sea Sale 202. The section updates the information in the multiple-sale EIS and the 195 EA, incorporating information from the PEA for seismic operation and recent research. Section IV.B.2.d(3) contains a one-page summary of the updated information.

As explained in the multiple-sale EIS, there are several species of non-ESA-listed marine mammals aside from polar bear that occur in or near the Beaufort Sea lease area; they are:

Pinnipeds:

Ringed seal (*Phoca hispida*)
Spotted seal (*Phoca largha*)
Bearded seal (*Erignathus barbatus*)
Pacific walrus (*Odobenus rosmarus divergens*)

Cetaceans

Beluga whale *(Delphinapterus leucas)*
Gray whale *(Eschrichtius robusta)*

The 195 EA concluded that ringed seals and other ice-dependent pinnipeds were resources of primary concern, partly because of climate change (USDOI, MMS, 2004:Appendix I, Sec. I.2.e(1)). For that reason, special attention has been focused on them.

D.4.c(1) Pinnipeds.

D.4.c(1)(a) Ringed Seal. No reliable estimate for the size of the Alaska ringed seal stock currently is available (Angliss and Outlaw, 2005), although past estimates ranged from 1.0 million to 3.6 million (Frost et al., 1988). Due to the absence of a reliable estimate, we summarize some background information in the following.

Ringed seals have a circumpolar distribution from approximately 35° N. latitude to the North Pole and occur in all seas of the Arctic Ocean (King, 1983). Ringed seals are year-round residents in the Chukchi and Beaufort seas. They are closely associated with ice. They have the unique ability to maintain breathing holes in thick ice and, therefore, are able to exploit the ice-covered parts of the Arctic during winter, when most other marine mammals have migrated south (Rosing-Asvid, 2006). In winter and spring, the highest densities of ringed seals are found on stable, shorefast ice. In summer, ringed seals often occur along the receding ice edges or farther north in the pack ice. Ringed seals seem to prefer large icefloes> 48 m in diameter and often are found in the interior pack ice, where sea-ice concentrations exceed 90% (Simpkins et al. 2003). Ringed seal densities in the Beaufort Sea are greatest in water with >80% ice cover (Stirling, Kingsley, and Calvert, 1981) and depths between 5 and 35 m (Frost et al., 2004). Densities also are highest on relatively flat ice and near the fast-ice edge, declining both shoreward and seaward of that edge (Frost et al., 2004). Ringed seal densities historically have been substantially lower in the western than the eastern part of the Beaufort Sea (Burns and Kelly, 1982; Kelly, 1988). The lower densities to the west appear to be related to very shallow water depths in much of the area between the shore and barrier islands. Surveys flown from 1996-1999 indicate that the highest density of seals along the central Beaufort Sea coast in Alaska occurred from approximately Kaktovik west to Brownlow Point (Frost et al., 2004). This may be due to the fact that relative productivity, as measured by zooplankton biomass, is approximately four times greater there than the average biomass in other areas of the eastern Beaufort Sea (Frost et al., 2004). Ringed seals are found throughout the Beaufort, Chukchi, and Bering seas (Angliss and Outlaw, 2005) and are the most common and widespread seal species in the area.

As stated, no reliable estimate for the size of the Alaska ringed seal stock is available (Angliss and Outlaw, 2005), although past estimates ranged from 1.0 million to 3.6 million (Frost et al., 1988). Ringed seal numbers are considerably higher in the Bering and Chukchi seas, particularly during winter and early spring (71 *FR* 9783). Recent work by Bengtson et al. (2005) reported an estimated abundance of as many as 252, 488 ringed seals in the eastern Chukchi Sea. Frost and Lowry (1981) estimated 80,000 ringed seals in the Beaufort Sea during summer and 40,000 during winter, although some authors (Amstrup, 1995) estimated the Beaufort Sea population at four times these numbers. Few, if any, seals inhabit ice-covered waters shallower than 3 m due to water freezing to the bottom and/or poor prey availability caused by the limited amount of ice-free water (71 *FR* 9785). Frost et al. (2002) reported that population-trend analyses in the central Beaufort Sea suggested a substantial decline of 31% in observed ringed seal densities from 1980-1987 to 1996-1999. However, this apparent decline may have been due to a difference in the timing of surveys rather than an actual decline in abundance (Frost et al., 2002). Spatial and temporal comparisons typically rest on the assumption that the proportion of animals visible is constant from survey to survey. However, Frost et al. (2004) cautioned against comparing survey results because of the marked between-year variation in density estimates common for ringed seal surveys. This likely is due to the timing of the surveys relative to ice conditions and the progress of the seals' annual molt (Frost et al., 2004). In fact, Kelly (2005) found that aerial surveys can underestimate ringed seal densities by factors of >13, because the proportion of seals visible during survey periods can change rapidly from day to day. Therefore, comparisons of ringed seal densities between regions and between years based on aerial surveys should account for the proportion of the population visible during each survey (i.e. appropriate correction factors should be used) (Kelly, 2005). Ringed seals are not listed as "depleted" under the MMPA, and the Alaska stock of ringed seals is not classified as a strategic stock by the NMFS.

In early summer, the highest densities of ringed seals in the Chukchi Sea are found in nearshore fast and pack ice (Bengston et al., 2005). This also appears to be true in the Beaufort Sea, based on incidental sightings of seals during aerials surveys for bowhead whales (USDOI, MMS, 2004). 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). In late summer and early fall, ringed seals often aggregate in open-water areas where primary productivity is thought to be high (Harwood and Stirling, 1992).

Ringed seals give birth from mid-March through April to a single pup, which they nurse for 5-8 weeks (Hammil et al., 1991; Lydersen and Hammill, 1993). Pupping and nursing occur in subnivean lairs constructed on either landfast or drifting pack ice, during which time they are hunted by polar bears (Stirling and Archibald, 1977; Smith, 1980). Mating occurs shortly after pupping (~ 4 weeks), and the female delays implantation of the embryo until later in the summer (July-August). Ringed seals feed on a variety of fish and invertebrates. Diet depends on the prey availability, depth of water, and distance from shore. In Alaskan waters, the primary prey of ringed seals is arctic cod, saffron cod, shrimps, amphipods, and euphausiids (Kelly, 1988; Reeves, Stewart, and Leatherwood, 1992).

Ringed seals are an important subsistence species for Alaskan Native hunters. The number of seals taken annually varies considerably between years due to ice and wind conditions, which impact hunter access to seals. The Alaska Department of Fish and Game (ADF&G) maintains a subsistence harvest database and, as of August 2000, the mean estimate of ringed seals taken annually is 9,567 (ADF&G, 2000).

D.4.c(1)(b) Spotted Seal. No reliable estimate for the size of the Alaska spotted seal stock currently is available (Angliss and Outlaw, 2005); therefore, some background information is summarized here. Spotted seals are distributed along the continental shelf of the Beaufort, Chukchi, Bering, and Okhotsk seas, and south to the northern Yellow Sea and western Sea of Japan (Shaughnessy and Fay, 1977). They are common in the coastal Alaskan waters in ice-free seasons. They migrate south from the Chukchi Sea and into the Bering Sea in October-November (Lowry et al., 1998). Spotted seals overwinter in the Bering Sea and inhabit the southern margin of the ice during spring, moving to coastal habitats after the retreat of the sea ice (Shaughnessy and Fay, 1977; Simpkins et al., 2003). Spotted seals are not known to use the Beaufort Sea in winter. Spotted seals are closely related to, and often mistaken for, Pacific harbor seals (*Phoca vitulina richardsi*). The two species often are seen together and are partially sympatric in the southern Bering Sea (Quakenbush, 1988).

As stated, no reliable estimate for the size of the Alaska spotted seal stock currently is available (Angliss and Outlaw, 2005). An early estimate of the size of the world population of spotted seals was 370,000-420,000, and the size of the Bering Sea population, including animals in Russian waters, was estimated to be 200,000-250,000 animals (Bigg, 1981). Using telemetry data, the ADF&G corrected 1992 survey results producing a rough estimate of 59,214 animals (Rugh et al., 1993) for western Alaska and the Bering Sea. Spotted seals are not listed as "depleted" under the MMPA. The Alaska stock of spotted seals is not classified by NMFS as a strategic stock.

During spring when pupping, breeding, and molting occur, spotted seals inhabit the southern margin of the sea ice in the Bering Sea (Quakenbush, 1988; Rugh, Shelden, and Withrow, 1997). Of eight known breeding areas, three occur in the Bering Sea (Angliss and Outlaw, 2005). Pupping occurs on ice in April-May, and pups are weaned within 3-4 weeks. Adult spotted seals often are seen on the ice in female-pup or male-female pairs, or in male-female-pup triads. Mating occurs around the time the pups are weaned, and mating pairs are monogamous for the breeding season. During the summer and fall, spotted seals are found primarily in the Bering and Chukchi seas, but some range into the Beaufort Sea (Rugh, Shelden, and Withrow, 1997; Lowry et al., 1998) from July until September. In total, there probably are only a few dozen spotted seals along the coast of the central Beaufort Sea during summer and early fall (Richardson, 2000). 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 seen commonly in bays, lagoons, and estuaries, but they also range far offshore to 72° N. latitude (Shaughnessy and Fay, 1977). Spotted seals are rarely seen on the pack ice during summer, except when the ice is very near shore.

Principal foods of adult spotted seals are schooling fishes, although the total array of foods is quite varied. In the Arctic, their diet is similar to that of ringed seals, including a variety of fishes such as arctic and saffron cod, and also shrimp and euphausiids (Kato, 1982; Quakenbush, 1988; Reeves, Stewart, and Leatherwood, 1992). Within their geographic range they are known to eat sand lance, sculpins, flatfishes, and cephalapods (mainly octopus). The juvenile diet is primarily crustaceans (shrimp).

Spotted seals are an important subsistence species for Alaskan Native hunters, primarily in the Bering Strait and Yukon-Kuskokwim regions (Lowry, 1984). The number of seals taken annually varies considerably between years due to ice and wind conditions, which impact hunter access to seals. Between 1966 and 1976, an average of about 2,400 spotted seals was taken annually (Lowry, 1984). The ADF&G maintains a subsistence-harvest database, which indicates that at least 5,265 spotted seals are taken annually for subsistence use (ADF&G, 2000).

D.4.c(1)(c) Bearded Seal. No reliable estimate currently is available for the size of the Alaska stock of bearded seals (Angliss and Outlaw, 2005); therefore, some background information is summarized in the following. Bearded seals are the largest of the northern phocids and have a circumpolar distribution ranging from the Arctic Ocean down into the western Pacific (Burns, 1981). In Alaskan waters, bearded seals occur over the continental shelves of the Bering, Chukchi, and Beaufort seas (Burns, 1981). Bearded seals predominantly are benthic feeders (Burns, 1981), feeding on a variety of invertebrates (crabs, shrimp, clams, and snails) and other food organisms, including arctic and saffron cod, flounders, sculpins, and octopuses (Kelly, 1988; Reeves, Stewart, and Leatherwood, 1992). Bearded seals also feed on ice-associated organisms when they are present, allowing the seals to live in areas with water considerably deeper than 200 m. In some areas, bearded seals are associated with the ice year-round; however, they usually move shoreward into open-water areas when pack ice retreats. During the open-water period, bearded seals occur mainly in relatively shallow areas, preferring areas no deeper than 200 m (Harwood et al., 2005; USDOI, MMS, 2004).

As stated, no reliable estimate for the size of the Alaska bearded seal stock is available (Angliss and Outlaw, 2005). Bengtson et al. (2005) conducted surveys in the eastern Chukchi Sea but could not estimate abundance from their data. Early estimates of the Bering-Chukchi seas population range from 250,000-300,000 (Burns, 1981). Bearded seals are not listed as "depleted" under the MMPA. The Alaska stock of bearded seals is not classified by NMFS as a strategic stock.

Seasonal movements of bearded seals are related directly to the advance and retreat of sea ice and to water depth (Kelly, 1988). During winter, most bearded seals in Alaskan waters are found in the Bering Sea. From mid-April to June as the ice recedes, some of the bearded seals that overwintered in the Bering Sea migrate northward through the Bering Strait. During summer, the most favorable bearded seal habitat is found in the central and northern Chukchi Sea, where they are found near the widely fragmented margin of the pack ice; they also are found in nearshore areas of the central and western Beaufort Sea during summer. Suitable habitat is more limited in the Beaufort Sea where the continental shelf is narrower and the pack-ice edge frequently occurs seaward of the shelf and over water too deep for benthic feeding. In the Beaufort

Sea, bearded seals rarely use coastal haulouts. Females pup in April-May, bearing a single pup. Breeding occurs within a few weeks after the pup is weaned, and implantation is delayed until July.

Bearded seals are an important subsistence species for Alaskan Native hunters. The number of seals taken annually varies considerably between years due to ice and wind conditions, which impact hunter access to seals. The ADF&G maintains a database, and the mean estimate of bearded seals taken annually is 6,788 (ADF&G, 2000).

D.4.c(1)(d) Pacific Walrus. No reliable estimate currently is available for the size of the Alaskan stock of Pacific walrus (Angliss and Outlaw, 2005); therefore, some background information is summarized in the following. Pacific walruses range throughout the shallow continental shelf waters of the Bering and Chukchi seas, where their distribution is closely linked with the seasonal distribution of the pack ice. Walruses are migratory, moving south with the advancing ice in autumn and north as the ice recedes in spring (Fay, 1981). Walrus specialize in feeding on benthic macro-invertebrates (Fay, 1982); as such, they generally prefer waters <200 m deep along the pack-ice margin where ice concentrations are <80% (Fay, 1982; Fay and Burns, 1988). The juxtaposition of broken ice over relatively shallow continental shelf waters is important to them for feeding, particularly for females with dependent young that may not be capable of deep diving or long-term exposure to the frigid water. Considering this, the recent observations of nine motherless calves stranded on ice floes in deep waters off of northwest Alaska are troubling (Cooper et al., 2006). Recent trends in seasonal sea-ice breakup have resulted in seasonal sea-ice retreating off the continental shelves and over deep Arctic Ocean waters. This trend poses adaptive challenges for the walrus population (Tynan and DeMaster, 1997). Females with calves are not normally observed in deep Arctic basin waters due to the depth of the water and resultant inaccessibility of food there. Considering that walrus calves are dependent on maternal care for 2 years or more before they are able to forage for themselves, the observation of motherless calves stranded on ice floes in deep waters may have implications for the Pacific walrus population (Cooper et al., 2006). These calves may have been abandoned by their mothers due to lack of food, and the authors speculate that much higher numbers than the nine observed may have been present in their study area.

Walruses are extremely social and gregarious animals, and spend approximately one-third of their time hauled out onto land or ice, usually in close physical contact with one another. Walruses rely on sea ice as a substrate for resting and giving birth (Angliss and Outlaw, 2005) and generally require ice thicknesses of 50 centimeters (cm) or more to support their weight (USDOI, FWS, pers. commun.). Pacific walruses are segregated by gender for much of the year as they migrate over vast areas of the Bering and Chukchi seas (Fay, 1982). During the summer months, the majority of the subadults, females, and calves move into the Chukchi Sea. In contrast, adult males generally abandon the sea ice in spring for coastal haulouts in Bristol Bay and the Gulf of Anadyr (Jay and Hills, 2005). The Chukchi Sea west of Barrow is the northeastern extent of the main summer range of the walrus; few are seen farther east in the Beaufort Sea (e.g., Harwood et al., 2005). Those observed in the Beaufort Sea typically are lone individuals.

Walruses are long-lived animals with low rates of reproduction. Females reach sexual maturity at 4-9 years of age, and give birth to one calf every 2 or more years. Although males become fertile at 5-7 years of age, they do not reach full competitive maturity until age 15-16. Some walruses may live to age 35-40, and they remain fertile until relatively late in life. As stated, no reliable estimate for the size of the Alaska Pacific walrus stock is available (Angliss and Outlaw, 2005), although the FWS is launching a substantial effort to produce a more precise abundance estimate of Pacific walruses. Results from these survey efforts should be available in 2007 (USDOI, FWS, 2006). Estimates of the Pacific walrus population suggest a minimum of 200,000 animals were necessary to withstand the levels of commercial harvests, which occurred in the 18th and 19th centuries (Fay, 1982). The population size has never been known with certainty; however, although the most recent survey estimate was approximately 201,039 animals (Gilbert et al., 1992). Pacific walruses are not listed as "depleted" under the MMPA. The Alaska stock of Pacific walrus is not classified by NMFS as a strategic stock.

In winter, pacific walrus inhabit the pack ice of the Bering Sea. Breeding occurs between January and March, and implantation is delayed until June-July. Gestation lasts 11 months, and calving occurs on the sea ice in April-May, approximately 15 months after mating. Calves are not weaned for 2 years or more after birth (Fay, 1982). By May, as the pack ice loosens, adult females and dependent young move northward into the Chukchi Sea.

In summer, walruses tend to concentrate in areas of unconsolidated pack ice within 100 km of the leading edge of the pack ice in the Chukchi Sea. By July, large groups of up to several thousand walruses can be found along the edge of the pack ice between Icy Cape and Point Barrow. When suitable pack ice is not available, walruses will haul out to rest on land, preferring sites sheltered from wind and surf. Traditional haulout sites in the eastern Chukchi Sea include Cape Thompson, Cape Lisburne, and Icy Cape. In recent years, Cape Lisburne has seen regular walrus use in the late summer (USDOI, FWS, pers. commun.). By August, depending on the retreat of the pack ice, walruses are found farther offshore, with principal concentrations to the northwest of Barrow. By September, the edge of the pack ice generally retreats to about 71° N. latitude, although it may retreat as far as 76° N. latitude in some years. In October, as the pack ice advances, large herds begin moving back down to the Bering Sea.

Walruses are benthic feeders, and prefer areas <80 m deep (Fay, 1982). In a recent study, 98% of satellite locations of tagged walruses in Bristol Bay were in water depths of 60 m or less (Jay and Hills, 2005). Walruses most commonly feed on bivalve mollusks (clams), but they also will feed on other benthic invertebrates (e.g., snails, shrimp, crabs, worms). Some walruses have been reported to prey on marine birds and small seals.

The Pacific walrus is an important subsistence species for Alaskan Native hunters. The number of walruses taken annually has varied over the years, with recent harvest levels much lower than historic highs. Based on harvest data from Alaska and Chukotka in the years 2001-2005, mean harvest mortality levels are estimated at 5,458 animals per year (USDOI, FWS, 2006).

D.4.c(2) Cetaceans.

D.4.c(2)(a) Beluga Whale. Beluga whales are found throughout arctic and subarctic waters of the Northern Hemisphere. They inhabit seasonally ice-covered waters and are closely associated with open leads and polynyas in ice-covered regions (Hazard, 1988). In summer months, they migrate to warmer coastal estuaries, bays, and rivers (Finley, 1982). In Alaska, there are five recognized stocks: (1) Eastern Chukchi Sea; (2) Beaufort Sea; (3) Cook Inlet; (4) Bristol Bay; and (5) Eastern Bering Sea (O'Corry-Crowe et al., 1997). Within the Proposed Action area, only the Beaufort Sea stock and eastern Chukchi Sea stocks are present.

The NMFS has set the minimum population estimate for the Beaufort Sea beluga whale stock at 32, 453 and the total corrected abundance estimate for the eastern Chukchi Sea stock at 3,710 (Angliss and Outlaw, 2005). Of the five beluga whale stocks, only the Cook Inlet stock is listed as "depleted" under the MMPA (65 *FR* 34590). Neither the Beaufort Sea nor the eastern Chukchi Sea stocks are listed as "depleted" or classified as a strategic stock under the MMPA.

Beluga whales of both stocks winter in the Bering Sea and summer in the Beaufort and Chukchi seas, migrating around western and northern Alaska (Angliss and Outlaw, 2005). The majority of belugas in the Beaufort stock migrate into the Beaufort Sea in April or May, although some whales may pass Point Barrow as early as late March and as late as July (Braham et al., 1984; Ljungblad et al., 1984; Richardson et al., 1995). Belugas of the eastern Chukchi stock satellite tagged in the eastern Chukchi Sea 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.

Belugas are rarely seen in the central Alaskan Beaufort Sea during the summer. They are strongly associated with the ice (Burns, Shapiro, and Fay, 1981), and prefer areas with moderate to high ice cover (54-66%) (Moore and DeMaster, 1997). Belugas are known to forage at ice edges and ice cracks (Bradstreet, 1982; Crawford and Jorgenson, 1990), and feeding aggregations occur primarily in nearshore areas, where dense schools of arctic cod concentrate in late summer. These coastal feeding aggregations may occur in open water as well as beneath or near ice. During late summer and autumn, most belugas migrate far offshore near the pack ice front (Frost et al., 1988; Hazard, 1988; Clarke, Moore, and Johnson, 1993; Miller et al., 1998). Moore (2000) and Moore et al. (2000) suggest that beluga whales select deeper slope water independent of ice cover. The main fall migration corridor of beluga whales is ~100+ km north of the coast; however, small numbers of belugas are sometimes seen near the north coast of Alaska during the westward migration in late summer and autumn (Johnson, 1979). Belugas can be found in large groups exceeding 500 animals (National Marine Mammal Lab, 1998). Pod structure in beluga groups appears to be along matrilineal lines, with males forming separate aggregations. Small groups often are observed traveling or resting together. Females calve in May-July, when herds are in their summer areas. Calves typically are weaned at 2 years of age. Mating occurs in March-April.

Winter food habits of belugas are largely unknown; however, during summer they eat a wide variety of prey (USDOI, MMS, 2004). In summer, they feed on a variety of schooling and anadromous fishes that are sequentially abundant in coastal zones. Principal species eaten include herring, capelin, smelt, arctic and saffron cods, salmon, flatfishes, and sculpins. Octopus, squid, shrimps, crabs, and clams are eaten occasionally. Most feeding is done over the continental shelf and in nearshore estuaries and river mouths. In the shallow waters of Alaska, most feeding dives probably are to depths of 20-100 feet (6-30 m) and last 2-5 minutes.

Beluga whales from both stocks are an important subsistence resource for Alaskan Native hunters. For the eastern Chukchi Sea stock, annual subsistence take averaged 65 animals from 1999-2003. Annual subsistence take for the Beaufort Sea stock averaged 53 animals for the same period (Angliss and Outlaw, 2005).

D.4.c(2)(b) Gray Whale. Recently, gray whale calls were recorded each month from October 2003 through May 2004 northeast of Barrow, indicating that some whales did not migrate to California as expected (Moore et al., 2004). Because of this new information, some background information is summarized in the following. Gray whales formerly inhabited both the North Atlantic and North Pacific oceans; however, they are believed to have become extinct in the Atlantic by the early 1700's. There are two stocks recognized in the North Pacific: the eastern north Pacific stock, which lives along the west coast of North America, and the western north Pacific stock, which lives along the coast of eastern Asia (Angliss and Lodge, 2005).

The latest abundance estimate for the eastern north Pacific stock is 18,178 individuals (Rugh et al., In press, as cited in Angliss and Outlaw, 2005). The NMFS has provided a minimum population estimate of 17,752 (Angliss and Outlaw, 2005). Federal protection under the ESA was removed in 1994, and further evaluation determined that the stock was neither in danger of extinction nor likely to become endangered in the foreseeable future (Rugh et al., 1999). The eastern North Pacific stock is not designated as depleted under the MMPA nor considered a strategic stock by NMFS.

During the summer months, eastern north Pacific gray whales and their calves feed in the northern Bering and Chukchi seas (Tomilin, 1957; Rice and Wolman, 1971; Braham, 1984; Nerini, 1984), particularly north of St. Lawerence Island and in the Chirikov Basin (Moore et al., 2000). Gray whales prefer areas of little or no ice cover (<5%) (Moore and DeMaster, 1997). They are a coastal species, spending most of their time in waters <60 m deep. In mid-October, the whales begin their migration to the west coast of Baja California and the east coast of the Gulf of California to breed and calve (Swartz and Jones, 1981; Jones and Swartz, 1984). The northbound migration starts in mid-February and continues through May (Rice, 1984).

Gray whales are bottom feeders, sucking sediment from the seafloor. Their primary prey is amphipods, although other food items are ingested. Although gray whales probably feed opportunistically throughout their range, they return annually to primary feeding areas in the northern Bering Sea and Chukchi Sea (e.g., Nerini, 1984; Moore, Clarke, and Ljungblad, 1986; Weller et al., 1999). During 1982-1991 aerial surveys in the Alaskan Chukchi and Beaufort seas, gray whales were associated with virtually the same habitat throughout the summer and the autumn (38-m depth and <7% ice cover) (Moore and DeMaster, 1997). It is likely that shallow coastal and offshore shoal areas provide habitat rich in gray whale prey, and their association and congregation in larger numbers with offshore shoals in the northern Chukchi Sea may indicate that these are important feeding areas for the expanding population (Moore and DeMaster, 1997).

As the population expands, it also is believed that gray whales are expanding their feeding areas in arctic Alaska.

Only a small number of gray whales enter the Beaufort Sea east of Point Barrow although in recent years, ice conditions around Barrow have become lighter, and gray whales may have become more common there. In fact, Moore et al. (2006) reported that Native hunters have noticed increasing numbers of gray whales near Barrow in the late summer and autumn, which may indicate a northward shift in the distribution of this species. Gray whale calls also were recorded each month from October 2003 through May 2004 northeast of Barrow, indicating that some whales did not migrate to California as expected (Moore et al., 2004). This extended occurrence of gray whales in the Beaufort Sea complements observations of feeding whales moving north from the Bering Sea to the Chukchi Sea in summer (Moore et al., 2003), and may be indicative of marine ecosystem changes occurring in the North Pacific. For example, Moore, Grebmeier, and Davis (2003) suggested that gray whale use of the Chirikov Basin has decreased, likely as a result of the combined effects of changing currents and a downturn in amphipod productivity. The northeasternmost recurring known gray whale feeding area is in the Chukchi Sea southwest of Barrow (Clarke, Moore, and Ljungblad, 1989).

Gray whales are taken by both Alaskan and Russian subsistence hunters; however, most of the harvest is done by the Russians. The only reported takes in Alaska in the last decade occurred in 1995, when Alaskan Natives harvested two animals (IWC, 1997). In 1997, the IWC implemented an annual cap of 140 gray whales to be taken by Russia and the U.S. (Makah Indian Tribe in Washington State). Annual subsistence take averaged 122 whales from 1999-2003 (Angliss and Lodge, 2005). The Makah Indian Tribe in Washington State is authorized to take four gray whales from this stock each year, but the last reported harvest was one animal in 1999 (IWC, 2001).

D.4.d. Fish/Fishery Resources and Essential Fish Habitat. This section contains an update of information on fishes and Essential Fish Habitat (EFH) that might be affected by proposed Beaufort Sea Sale 202. The section updates the information in the multiple-sale EIS and 195 EA (USDOI, MMS, 2003, 2004). As summarized in the EIS, the marine coastal environment of the Beaufort Sea consists of inlets, lagoons, bars, and numerous mudflats. During the open-water season, the nearshore zone of this area is dominated by a band of relatively warm, brackish water that extends across the entire Beaufort Sea coast. The summer distribution and abundance of coastal fishes (marine and migratory species) is strongly affected by this band of brackish water. The band typically extends 1-6 mi offshore and contains more abundant food resources than waters farther offshore. It is formed after breakup by freshwater input from rivers such as the Ikpikpuk, the Colville, the Sagavanirktok, and the Canning.

The information in the multiple-sale EIS and 195 EA is augmented by a summary in the Arctic seismic PEA (USDOI, MMS, 2006a). Only two parts of the updated PEA summary will be repeated here, because the entire PEA is available on the MMS website (http://www.mms.gov/alaska/ref/EIS%20EA/DraftProgrammatic%20EA%20&%20Biological%20Eval/PEA_1.pdf). The updated parts are about recent evidence of the effect of climate change on arctic fish, and about the few commercial fisheries in the Alaskan Beaufort Sea and, therefore, the few species covered by fishery-management plans in these waters.

D.4.d(1) The Effect of Climate Change on Fish Resources. The climate of the Arctic is changing and affecting fish distributions. Evidence of such change is discussed in the Arctic Climate Impact Assessment (ACIA, 2005). Trends in instrumental records over the past 50 years indicate a reasonably coherent picture of recent environmental change in northern high latitudes (ACIA, 2005). It is probable that the past decade was warmer than any other in the period of the instrumental record. The observed warming in the Arctic appears to be without precedent since the early Holocene.

Climate change is altering the distribution and abundance of marine life in the Arctic. For example, Berge et al. (2005) report the fist observations of settled blue mussels, *Mytilus edulis,* in the high Arctic Archipelago of Svaalbard for the first time since the Viking Age. A scattered population was discovered at a single site at the mouth of Isfjorden in August 2004. Their data indicate that most mussels settled there as spat in 2002, and that larvae were transported by the currents northwards from the Norwegian coast to

Svaalbard the same year. This extension of the blue mussels' distribution range was made possible by the unusually high northward mass transport of warm Atlantic water resulting in elevated sea-surface temperatures in the North Atlantic and along the west coast of Svaalbard. Numerous other examples are being realized in the North Atlantic, where temperate and subtropical fishes are being caught and documented for the first time off the United Kingdom and the Scandinavian countries.

While climatic warming is not distributed evenly across the Arctic, the Bering, Chukchi, and Beaufort seas clearly are experiencing a warming trend (ACIA, 2005). Over the last 50 years, annual average temperatures have risen by about 2-3 °C (Celsius) in Alaska and the Canadian Yukon, and by about 0.5 °C over the Bering Sea and most of Chukotka (ACIA, 2004). The largest changes have been during winter, when near-surface air temperatures increased by about 3-5 °C over Alaska, the Canadian Yukon, and the Bering Sea, while winters in Chukotka got 1-2 °C colder.

Climate change can affect fish production (e.g., individuals and/or populations) through a variety of means (Loeng, 2005). Direct effects of temperature on the metabolism, growth, and distribution of fishes occur. Food-web effects also occur through changes in lower trophic-level production or in the abundance of predators, but such effects are difficult to predict. Fish-recruitment patterns are strongly influenced by oceanographic processes such as local wind patterns and mixing and by prey availability during early lifestages. Recruitment success sometimes is affected by changes in the time of spawning, fecundity rates, survival rate of larvae, and food availability.

For example, a climate shift occurred in the Bering Sea in 1977, abruptly changing from a cool to a warm period—perhaps a reflection of the Pacific Decadal Oscillation (ACIA, 2004, 2005). The warming brought about ecosystem shifts that favored herring stocks and enhanced productivity for Pacific cod, skates, flatfishes, and noncrustacean invertebrates. The species composition of seafloor organisms changed from being crab dominated to a more diverse assemblage of echinoderms, sponges, and other sea life. Historically high commercial catches of Pacific salmon occurred. The walleye pollock catch, which was at low levels in the 1960's and 1970's (2-6 million tonnes), has increased to levels >10 million tonnes for most years since 1980. Additional recent climate-related impacts observed in the Bering Sea large marine ecosystem include significant reductions in certain seabird and marine mammal populations, unusual algal blooms, abnormally high water temperatures, and low harvests of salmon on their return to spawning areas. While the Bering Sea fishery has become one of the world's largest, numbers of salmon have been far below expected levels, fish have been smaller than average, and their traditional migratory patterns appear to have been altered.

We know that better known fish resources (e.g., abundant species) can exhibit very large interannual fluctuations in distribution, abundance, and biomass (e.g., capelin, arctic cod, Bering flounder, Pacific sand lance). Climate change experienced in the past and apparently accelerating in arctic Alaska likely is altering the distribution and abundance of their respective populations from what was known from past surveys.

The Arctic Climate Impact Assessment (ACIA, 2004, 2005) concluded (in part) that:

(1) The southern limit of distribution for colder water species (e.g., Arctic cod) are anticipated to move northward. The distribution of more southerly species (e.g., from the Bering Sea) are anticipated to move northward. Timing and location of spawning and feeding migrations are anticipated to alter;
(2) Wind-driven advection patterns of larvae may be critical as well as a match/mismatch in the timing of zooplankton production and fish-larval production, thereby influencing productivity (e.g., population abundance and demography);
(3) Species composition and diversity will change: Pacific cod, herring, walleye pollock, and some flatfish are likely to move northward and become more abundant, while capelin, Arctic cod, and Greenland halibut will have a restricted range and decline in abundance.

D.4.d(2) Commercial Fish Species and Essential Fish Habitat. Presently, Pacific salmon are the only managed species with EFH designated in the Alaskan Beaufort and Chukchi seas. All five species of

Pacific salmon occur in the Alaskan Beaufort and Chukchi seas (Craig and Halderson, 1986; NMFS, 2005); they are the pink (humpback), chum (dog), sockeye (red) salmon, chinook (king) salmon, and coho (silver) salmon. Pacific salmon in the Alaskan Beaufort and Chukchi seas are considered "rare" species in terms of abundance and range.

A significant body of information exists on the life histories and general distribution of salmon in Alaska (NMFS, 2005). Life history, general distribution, fisheries background, relevant trophic information, habitat, and biological associations are described for Pacific salmon in Appendix F.5 of NMFS (2005) and incorporated herein by reference. More information regarding the biology, ecology, and behavior of Pacific salmon is described in Augerot (2005), Quinn (2005), and the ADF&G Fish Distribution Database-Fish Profiles (http://www.sf.adfg.state.ak.us/SARR/FishDistrib/FDD_fishprofiles.cfm).

Salmon numbers decrease north of the Bering Strait, and they are relatively rare in the Beaufort Sea (Craig and Halderson, 1986). Spawning runs in arctic streams are minor compared to those of commercially important populations farther south (Craig and Halderson, 1986). Rivers south of Point Hope support comparatively large runs of chum and pink salmon, and have been basically the northern distributional limits for chinook, coho, and sockeye salmon (Craig and Halderson, 1986), although this appears no longer so. Craig and Halderson (1986) noted that only pink salmon and, to a lesser degree, chum salmon, occur with any regularity in arctic waters north of Point Hope and presumably maintain small populations in several of the northern drainages; most occurring in streams west of Barrow.

In general, information on Pacific Salmon and their EFH is limited with respect to current distribution and abundance estimates and associated trends, local and regional movements; and specifics about life history habitats.

D.4.d(2)(a) Chinook, Sockeye, and Coho Salmon. There are no known stocks of chinook, sockeye, or coho salmon in arctic waters north of Point Hope (Craig and Halderson, 1986). All three species are considered extremely rare in the Beaufort Sea, representing no more than isolated migrants (vagrants) from populations in southern Alaska or Russia (Fechhelm and Griffiths, 2001). Records of these species usually consist of single specimens. Climate change in arctic Alaska (i.e., warming) may facilitate the range expansion of chinook, sockeye, and coho salmon (e.g., Babaluk et al., 2000).

The northernmost known spawning population of chinook salmon is believed to be in Kotzebue Sound (Healy, 1991). Small numbers of chinook salmon reportedly are taken each year in the Barrow domestic fishery, which operates in Elson Lagoon (Fechhelm and Griffiths, 2001, citing George, pers. commun.). Strays have been captured in the Kuk and Colville rivers (Craig and Halderson, 1986). There also are indications of a small run of chinook salmon in the Kugrua River southwest of Point Barrow at Peard Bay in the Chukchi Sea (Fechhelm and Griffiths, 2001, citing George, pers. comm.).

Sockeye salmon have their northernmost known spawning population in Kotzebue Sound (Stephenson, 2006, citing Burgner, 1991). The northernmost known population of spawning coho salmon is near Point Hope, although coho salmon occasionally have been captured in marine waters farther east, near Prudhoe Bay (Craig and Halderson, 1986).

D.4.d(2)(b) Pink Salmon. Pink salmon are widely distributed over the northern Pacific Ocean and Bering Sea; they also occur to a lesser degree in arctic waters (Augerot, 2005). Pink salmon are the most abundant salmon species in the Beaufort Sea, although their abundance is greatly reduced compared to waters in western and southern Alaska (Craig and Halderson, 1986; Fechhelm and Griffiths, 2001). Their abundance generally increases from east to west along the Alaskan Beaufort Sea coast. Fechhelm and Griffiths (2001) state that reports of pink salmon in Canada are rare, with the last reported occurrence being that of Dymond (1940). However, Babaluk et al. (2000) report the two most recent records of range extensions of pink salmon in the Canadian Arctic: pink salmon caught in August 1993 in the Sachs River estuary subsistence fishery (Banks Island, Northwest Territories), and another caught in September 1992 in the West Channel of the Mackenzie River near Aklavik, Northwest Territories. Augerot (2005) depicts pink salmon of limited spawning distribution in the Alaskan Arctic.

Craig and Halderson (1986) note that available data suggest that pink salmon are more abundant in even-numbered years (e.g., 1978, 1982) than in odd-numbered years (e.g., 1975, 1983), as is the general pattern for this species in western Alaska (Craig and Halderson, 1986, citing Heard, 1986). This perceived pattern may be a manifestation of the distinctive 2-year life cycle of the pink salmon. Unlike other anadromous fish species in arctic Alaska, the pink salmon is a short-lived species that places all its reproductive effort into a single spawning event, and then dies. With its rigid 2-year life cycle, there is virtually no reproductive overlap between generations; therefore, every spawning event must be successful for the continued survival of the stock (Craig and Halderson, 1986).

Small runs of pink salmon sometimes occur in nine drainages north of Point Hope (Craig and Halderson, 1986; Fechhelm and Griffiths, 2001). Small spawning runs of pink salmon occur in the Sagavanirktok and Colville rivers, although not predictably from year to year. Among the few pink salmon collected in the Sagavanirktok River and delta were several spawned-out adults. Bendock (1979) noted pink salmon spawning near the Itkillik River and at Umiat. Two male spawners were caught near Ocean Point just north of Nuiqsut (Fechhelm and Griffiths, 2001, citing McElderry and Craig, 1981). In recent years, "substantial numbers" of pink salmon have been taken near the Itkillik River as part of a fall subsistence fishery (Fechhelm and Griffiths, 2001, citing George, pers. commun.). Pink salmon also are taken in the subsistence fisheries operating in the Chipp River and Elson Lagoon just to the east of Point Barrow (Fechhelm and Griffiths, 2001, citing George, pers. commun.). Craig and Halderson (1986) proposed that pink salmon spawn successfully and maintain small but viable populations in at least some arctic drainages; continued occurrences of pink salmon in arctic drainages indicates their suggestion is credible.

Run timings are rather inexact. Along the northeastern Chukchi Sea coast, run times in spawning streams may occur in mid-July; while along the western Beaufort coast, run times appear to commence in late July until the end of August (Craig and Halderson, 1986). Occurrence of adult salmon in spawning streams in mid- to late July indicates their presence in marine waters along the arctic coast in advance of the runs. How early salmon move into marine waters of the region is unknown, but is hypothesized to precede runs in spawning streams by as much as several weeks.

Schmidt, McMillan, and Gallaway (1983) describe the life cycle of pink salmon:

> Eggs are laid in redds [nests] dug in gravel. The eggs hatch during the winter however the alevins remain in the gravel, until the yolk sac is absorbed, emerging later in spring. After emerging from the gravel, the fry begin moving downstream. They remain in the estuary for up to a month prior to moving offshore. Little is known of the movements undertaken during the 18 months the salmon spend at sea. It is likely the North Slope populations move westerly towards the Chukchi Sea and upon maturing at the age of 2 years, the salmon then return to their natal streams to spawn in the fall.

Generally, early marine schools of pink salmon fry, often in large, dense aggregations, tend to follow shorelines and, during the first weeks at sea, spend much of their time in shallow water only a few centimeters deep (NMFS, 2005:Appendix F). It has been suggested that this onshore period involves a distinct ecological life-history stage in both pink and chum salmon. In many areas throughout their ranges, pink salmon and chum salmon fry of similar age and size comingle in both large and small schools during early life in the marine environment.

Diet studies show that pink salmon are both opportunistic and generalized feeders and, on occasion, they specialize in specific prey items (NMFS 2005:Appendix F). Young-of-the-year probably do not feed significantly during the short period spent in natal streams but feed on copepods and other zooplankton in the estuary (Schmidt, McMillan, and Gallaway, 1983). As the fish grow, larger prey species become important, including amphipods, euphausiids, and fishes (Schmidt, McMillan, and Gallaway, 1983, citing Morrow, 1980 and Scott and Crossman, 1973). Craig and Halderson (1986) state that most (adult) pink salmon caught in Simpson Lagoon had not fed recently (88% empty stomachs, n=17). The only available information on marine feeding is from Kasegaluk Lagoon, where stomachs of 17 captured adult salmon contained mostly fish (chiefly arctic cod), with some amphipods and mysids (Craig and Halderson, 1986, citing Craig and Schmidt, 1985). Studies indicate that juvenile pink salmon primarily are diurnal feeders (NMFS 2005:Appendix F).

D.4.d(2)(c) **Chum Salmon.** Chum salmon are widely distributed in arctic waters but are relatively less common than pink salmon (Craig and Halderson, 1986; Babaluk et al., 2000; Fechhelm and Griffiths, 2001). Only populations relatively small in number spawn north and east of the Noatak River, which enters the Chukchi Sea at Kotzebue, Alaska (NMFS 2005:Appendix F). In general, chum salmon spawn in the lower reaches of coastal streams <100 mi upstream from the ocean (NMFS 2005:Appendix F). Chum salmon are the Pacific salmon most frequently caught by fishermen in the lower Mackenzie River area of Canada (Babaluk et al., 2000, citing Hunter, 1974). Their long migration up the Mackenzie River (about 2,000 km) is nearly as impressive as that of chum salmon in the Yukon River (3,200 km [Craig and Halderson, 1986, citing Hart, 1973]). Despite the presence of these spawning stocks, few studies conducted in Canadian waters report catching chum salmon (Fechhelm and Griffiths, 2001).

The Pitmigea, Kukpowruk, Kuk, and Kugrua rivers along the northeastern Chukchi Sea coast are reported to support small populations of chum salmon. Individual salmon have been collected in the Kukpuk, Kokolik, and Utukok rivers; Kuchiak Creek; Kaegaluk Lagoon; and along the Wainwright Coast; however, these salmon are treated as strays (Craig and Halderson, 1986; Fechhelm and Griffiths, 2001).

Small spawning runs of chum salmon occur in the Colville River from mid-August to mid-September (Bendock, 1979). In recent years, smolts have been caught in the lower delta (Fechhelm and Griffiths, 2001, citing Moulton, 1999, 2001). Chum salmon are taken in the fall subsistence fishery but comprise a minor portion of the total catch (Fechhelm and Griffiths, 2001). Substantial numbers (undefined) of chum salmon are taken in the Chipp River and in Elson Lagoon, including adults in spawning condition, although such harvests are variable from year to year (Fechhelm and Griffiths, 2001, citing George, pers. commun.). Despite the presence of these runs, Fechhelm and Griffiths (2001) regard chum salmon as rare in Beaufort Sea coastal waters, particularly east of the Colville River.

Generally, chum salmon return to spawn as 2-7-year olds (NMFS 2005:Appendix F). Two-year-old chum are rare in North America and occur primarily in the southern part of their range (e.g., Oregon). Seven-year-old chum also are rare and occur mostly in the northern areas (e.g., Arctic). In general, chum salmon get older from south to north. Slow to rapid growth in the ocean can modify the age at maturity. Slower growth during the second year at sea causes some chum salmon to mature 1 or 2 years later.

Chum salmon fry, like pink salmon, do not overwinter in streams but migrate (mostly at night) out of streams directly to sea shortly after emergence. The timing of outmigration in the Arctic is unknown, but in more southern waters it occurs between February and June (chiefly during April and May). Chum salmon tend to linger and forage in intertidal areas at the head of bays. Estuaries are very important for chum salmon rearing during summer.

Once in coastal waters, chum salmon juveniles probably migrate southward toward the Bering Sea, thereby avoiding the cold waters of the arctic marine environment in winter. There apparently is some evidence from a few tag recoveries that chum salmon from arctic rivers may migrate as far south as the Gulf of Alaska (Craig and Halderson, 1986, citing Neave, 1964).

Juvenile chum salmon use a wide variety of prey species, including mostly invertebrates (including insects), and gelatinous organisms (NMFS, 2005:Appendix F). Chum salmon eat a variety of foods during their ocean life, e.g., amphipods, euphausiids, pteropods, copepods, fish, and squid larvae. Chum salmon also use gelatinous zooplankton for food more often than other species of salmon.

Chum salmon are subject to the same habitat concerns as other species of salmon, e.g., habitat destruction, pollution (NMFS, 2005:Appendix F). Additionally, chum salmon have two habitat requirements that are essential in their life history that make them very vulnerable: (1) reliance on upwelling ground water for spawning and incubation and (2) reliance on estuaries/tidal wetlands for juvenile rearing after migrating out of spawning streams. In the Noatak River, an arctic drainage just south of Point Hope, chum salmon spawn in areas where intragravel temperatures are 3-5 °C higher than in the mainstem (Craig and Halderson, 1986, citing Merritt and Raymond, 1983). These warmer spawning habitats provide about 1,130 temperature units (centigrade-degree days) between spawning and emergence, compared to only 215 temperature units available elsewhere in the drainage during the same period (Craig and Halderson, 1986). The hydrology of upwelling ground water into stream gravel is highly complex and poorly understood (NMFS, 2005:Appendix F).

D.4.d(3) Distribution and Abundance Trends of Pacific Salmon in the Alaskan Beaufort Sea. The literature largely treats the Beaufort Sea as a population sink for Pacific salmon, in some cases suggesting that none of the salmon species have established sustained populations in waters east of Point Barrow (Bendock and Burr, 1984). Many reports describe salmon as "straying" into the Beaufort Sea (Craig and Halderson, 1986) or comprising only a few isolated spawning stocks of pink and chum salmon (Craig and Halderson, 1986; Fechhelm and Griffiths, 2001). The occurrence of pink and chum salmon in arctic waters probably is due to their relative tolerance of cold water temperatures and their predominantly marine life cycle (Craig and Halderson, 1986, citing Salonius, 1973). The expansion of chinook, sockeye, and coho salmon into the Arctic appears restricted by cold water temperatures, particularly in freshwater environments (Craig and Halderson, 1986). However, the recent range extensions of pink, sockeye, and chum salmon in the Canadian Arctic, as described by Babaluk et al. (2000), indicate that some Pacific salmon may be expanding their distribution in arctic waters, and possibly also their abundance. Babaluk et al. (2000) also note that significant temperature increases in arctic areas as a result of climate warming may result in greater numbers of Pacific salmon in the area.

Because Pacific salmon appear to be expanding their range eastward and northward in the Canadian Beaufort Sea, it is reasonable to expect that Pacific salmon are expanding their distribution in the Chukchi Sea and that their populations may be increasing in both the northeastern Chukchi Sea and western Beaufort Sea.

Data Deficiencies. Information of current distribution and abundance (e.g., density per square kilometer) estimates, age structure, population trends, or habitat use areas are not available or are outdated for fish populations in the western Beaufort seas. For example, it is not known if the findings of Frost and Lowry (1983) still accurately portray the diversity and abundance of demersal fishes in the Alaskan Beaufort Sea. Another important data gap is the lack of information concerning discrete populations for arctic fishes using modern scientific methods. In addition, Pacific salmon occur in the region; however, studies directed at investigating their population dynamics, migration, and habitat use are nonexistent.

D.5. Environmental Justice.

Alaskan Inupiat Natives, a recognized minority, are the predominant residents of the North Slope Borough (NSB), the area potentially most affected by the Beaufort Sea multiple sales and Sale 202 in particular. Effects on Inupiat Natives could occur because of their reliance on subsistence foods, and exploration and development may affect subsistence resources and harvest practices.

Environmental justice is an initiative that culminated with President Clinton's February 11, 1994, Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, and an accompanying Presidential memorandum. The Executive Order requires each Federal Agency to make the consideration of environmental justice part of its mission. Its intent is to promote fair treatment of people of all races, so no person or group of people shoulders a disproportionate share of the negative environmental effects from this country's domestic and foreign programs.

The Executive Order focuses on minority and low-income people, but the Environmental Protection Agency (USEPA) defines environmental justice as the "equal treatment of all individuals, groups or communities regardless of race, ethnicity, or economic status from environmental hazards" (U.S. Department of Energy, 1997; USEPA, 2006). Specifically, the Executive Order requires an evaluation in an EIS or EA as to whether the proposed project would have "disproportionately high adverse human health and environmental effects...on minority populations and low income populations." The Environmental Justice Executive Order also includes consideration of potential effects to Native subsistence activities and, to this end, MMS continues to maintain a dialogue on Environmental Justice with local communities in this region.

The MMS public process for Environmental Justice outreach and for gathering and addressing Environmental Justice concerns and issues is described in detail in the Beaufort Sea multiple-sale final EIS (USDOI, MMS, 2003). Since 1999, all MMS public meetings have been conducted under the auspices of Environmental Justice. Environmental Justice-related concerns are taken back to MMS management and incorporated into environmental study planning and design, environmental impact evaluation, and the development of new mitigating measures that are incorporated into the EIS or EA.

Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments*, requires Federal agencies to consult with tribal governments on Federal matters that significantly or uniquely affect their communities. In January 2001, a USDOI Alaska Regional Government-to-Government policy was signed by all the USDOI Alaska Regional Directors, including the MMS. In acknowledgement of the importance of consultation, the MMS invites tribal governments to participate in its environmental assessment processes.

The Inupiat People of the North Slope and the Northwest Arctic boroughs have made MMS aware of the potential burden of participating in too many planning and public meetings. Therefore, MMS has taken measures to more carefully plan the number and timing of meetings with regional tribal groups and local governments.

On October 28, 2005, MMS published a notice in the *Federal Register* requesting information for proposed Beaufort Sea Lease Sale 202 and providing a Notice of Intent to prepare an Environmental Assessment for the proposed sale. The *Federal Register* notice stated that the "environmental analysis and the [Consistency Determination] for Sale 202 will focus primarily on new issues that may have arisen since the completion of the EIS for Sales 186, 195, and 202 (February 2003) and on any changes that may have occurred in the State's coastal management plan." Many of these issues were discussed in government-to-government consultation with ICAS and Barrow, Nuiqsut, and Kaktovik tribal governments in a North Slopewide teleconference on March 9, 2006, and the tribal governments of Barrow on March 6, 2006; Nuiqsut on March 8, 2006; and Kaktovik on March 7, 2006. Public meetings with the NSB were held on December 13, 2004; February 1, 2006; and March 6, 2006. Meetings with the Alaska Eskimo Whaling Commission (AEWC) occurred on December 13, 2004, and March 6, 2006. Meetings were held with the city governments of Nuiqsut on March 8, 2006 and Kaktovik May 17, 2005, and March 9, 2006. A Memorandum of Understanding between MMS and the Native Village of Kaktovik formalizing the protocols of consultation and information exchange was signed on March 7, 2006.

Ongoing and new stakeholder issues raised since the completion of the multiple-Sale EIS and the Sale 195 EA include:

- the oil industry's continuing inability to clean up an oil spill in broken ice;
- the need to stage cleanup equipment in local communities to make spill response more timely and to give more local people response training;
- the need for improved monitoring of drilling muds disposal and flaring activities at Northstar;
- the leasing of nearshore areas by the State of Alaska off the Arctic National Wildlife Refuge 1002 area;
- present deferral areas are too small; the need for larger "Quiet Zone" deferral areas in the vicinity of Barrow, Cross Island, and Kaktovik that protect the bowhead whale-migration route from seismic-sound disturbance; that protect subsistence staging, pursuit, and butchering areas; and that protect critical whale feeding and calving areas;
- the need to reinstate a Cross Island deferral area;
- the need for impact funds to local communities;
- bowhead whales may be deflected from traditional hunting areas due to increased seismic activity in the Chukchi and Beaufort Seas;
- the effects of seismic noise on seals and fish;

- the need to employ monitors and observers from local communities on seismic vessels;
- bowhead whale migration may be deflected from noise caused by small vessels; the noise effects of onshore barge traffic and Canadian shipping on bowhead whales;
- the need to expand conflict avoidance agreements to other resources not considered by the AEWC, such as fishes, bearded seals, walruses, and beluga whales;
- the need for MMS to coordinate with and include the BLM, NMFS, the Coast Guard, and the State of Alaska in its public outreach process—the need for a multiagency working group or coordination team;
- the need for MMS, BLM, and the State of Alaska to coordinate their projects to recognize the linkage of onshore and offshore impacts and cumulative impacts;
- that multiple industrial operations may have a cumulative adverse impact on bowhead whale migration;
- that increased industrial noise levels in the Beaufort Sea will force hunters to travel farther to find whales, and that this may lead to reduced success and an increased struck-and-lost rate for hunters that in turn may cause the IWC to reduce the bowhead whale quota because of potential reduced hunting efficiency;
- the need to reevaluate the oil-spill-risk analysis;
- the need for MMS to revise its significance thresholds for subsistence and sociocultural systems and bring them in line with the MMPA's "no unmitigable adverse impact" definition;
- further analysis of effects on offshore bowhead whale-feeding areas;
- the need to pursue a Memorandum of Understanding with the NSB to ensure that their "Seven Points" concerns are addressed by MMS;
- the need for MMS to deal with potential impacts by instituting stronger mitigation measures and adopting bigger deferral areas;
- include a cumulative effects analysis that addresses the recommendations of the 2003 National Research Council (NRC) Report *Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope*;
- the need to reconsider the multiple-sale concept—because of a quickly changing arctic environment and increasing oil and gas activity—and instead prepare a Supplemental EIS instead of an EA for each lease sale;
- the "disconnect" between MMS and the residents of the North Slope on how lease-sale decisions are made;
- the need for an Barrow-based MMS/BLM office;
- the effects of toxins and contaminants in the arctic environment on subsistence foods;
- the effects of global climate change on ice conditions, subsistence resources, and subsistence-harvesting practices in the Alaskan Arctic;
- the increasing distance needed to travel to hunt as the ice edge retreats;
- the need for a Presidential withdrawal on lease sales in the Beaufort and Chukchi seas until controversial issues are satisfactorily addressed.

These issues are addressed in Section IV.C.1.f, Updated Effects on Environmental Justice, of this EA.

D.6. Land Use Plans and Coastal Zone Management.

D.6.a. Land Use Plans. Revisions were made during 2005 to the documents addressing land use in the NSB, including the NSB Comprehensive Plan (NSBCP), the NSB Land Management Regulations (NSBLMR), and the NSB Coastal Management Program (NSBCMP). The revisions simplified the regulatory process but did not alter the basic premise of the comprehensive plan, which is to preserve and protect the land and water habitat essential to the subsistence character of Inupiat life.

The NSBCP and NSBLMR are intended to guide decisions affecting land use, transportation, fire protection, public facilities, and the economy, as explained in the multiple-sale EIS (USDOI, MMS, 2003:Sec. III.C.5). The major goal is to support development of the villages and natural resources in a way that preserves the Inupiat way of life. Offshore policies are specifically limited to development and uses in the portion of the Beaufort and Chukchi seas that are within the boundary of the NSB. Activities on the OCS would not be subject to the NSBCP or NSBLMR.

D.6.b. Coastal Zone Management. The Federal Coastal Zone Management Act (CZMA) and the Alaska Coastal Management Act were enacted in 1972 and 1977, respectively. Through these acts, development and land use in coastal areas are managed to provide a balance between the use of and the need to protect valuable coastal resources and other uses of the coastal area. The Federal rules governing implementation of the CZMA recently were revised, effective February 2006. The revised rules provide greater transparency and predictability in implementing Federal consistency and fully maintain the authority and ability of coastal States to review proposed Federal actions that would have a reasonably foreseeable effect on any land or water use or natural resource of a State's coastal zone, as provided for in the CZMA.

D.6.c. Alaska Coastal Management Program. The State of Alaska recently amended its ACMP program and adopted new regulations under Title 11, Alaska Administrative Code (AAC), Chapters 110, 112, and 114. The state regulations became effective on October 29, 2004. On December 29, 2005, the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management (OCRM), completed its review and approved the amendments to the ACMP, finding that the amended ACMP meets all requirements of the CZMA.

Under the amended ACMP, all coastal districts including the NSB must revise their local plans to conform to the new Statewide standards. A district's existing coastal management program, including its enforceable policies, remains in effect until March 1, 2007, unless the Alaska Department of Natural Resources (ADNR) disapproves or modifies all or part of the district's program before March 1, 2007. However, any existing district enforceable policy that duplicates, restates, or incorporates by reference a statute or regulation of a Federal or State agency or addresses any matter regulated by the Alaska Department of Environmental Conservation are repealed and declared null and void under State law.

The Statewide standards that may be relevant to hypothesized sale activities are summarized in the following paragraphs under two headings: uses and activities, and resources and habitats.

D.6.c(a) Uses and Activities. Under the uses and activities category, the policies that may be relevant include: (1) coastal development; (2) natural hazard areas; (3) coastal access; (4) energy facilities; (5) utility routes and facilities; (6) sand and gravel extraction; (7) subsistence; and (8) transportation routes and facilities.

The coastal development standard gives priority to development that is water dependent or water related and uses that may be neither of these but for which there is no feasible or prudent inland alternative to meet the public need for the use or activity. The intent of the policy is to ensure that onshore development and activities that could be placed inland do not displace activities dependent upon coastal locations.

Natural hazards are defined under 11 AAC 112.990(15) as natural processes or adverse conditions that present a threat to life or property in the coastal areas from flooding, earthquakes, active faults, tsunamis, landslides, volcanoes, storm surges, ice formations, snow avalanches, erosion, and beach processes. Natural hazards also may include other natural processes or adverse conditions designated by the ADNR or by a district in a district plan. Natural hazards would be considered during review of individual projects when site-specific information is available. Development plans would need to describe natural hazards in the area, identify site-specific factors that might increase risks, and propose appropriate measures to reduce those risks.

The coastal access standard would require appropriate protection to help maintain the continued desirability of public access to, from, and along coastal waters. Minimizing conflicts between subsistence users and oil and gas activities would be a significant factor for maintaining access and use of the coastal area.

The Statewide energy-facilities standard would require that decisions on the siting and approval of energy-related facilities be based, to the extent practicable, on 16 criteria. Practicable as defined in 11 AAC 112.990(18) means feasible in light of overall project purposes after considering cost, existing technology, and logistics of compliance with the standard. The standard also recognizes that the facilities and activities authorized by the issuance of oil and gas leases in a Federal lease sale are uses of State concern.

Utility routes and facilities, unless water dependent or water related, would need to be sited inland to comply with the utility-route and -facilities standard. Utility routes and facilities along the coast would need to avoid, minimize, or mitigate: (1) alterations in surface- and groundwater drainage patterns; (2) disruption in known or reasonably foreseeable wildlife transit; and (3) blockage of existing or traditional access.

Under the Statewide standard, sand and gravel could be extracted from coastal waters, intertidal areas, barrier islands, and spits when no feasible and prudent noncoastal alternative is available to meet the public need. Approval to extract sand and gravel from these areas would require a permit from the U.S. Army Corps of Engineers.

The subsistence policy requires the designation of areas in which subsistence is an important use of coastal resources. A Federal OCS project affecting a designated subsistence-use area would need to avoid or minimize impacts to subsistence uses. An analysis or evaluation of reasonably foreseeable adverse impacts of the project on subsistence use also would be required.

Transportation routes and facilities would need to avoid, minimize, or mitigate: (1) alterations in surface and ground water drainage patterns; (2) disruption in known or reasonably foreseeable wildlife transit; and (3) blockage of existing or traditional access.

D.6.c(b) Resources and Habitats. Three ACMP policies come under the heading of resources and habitats: (1) habitats; (2) air, land, and water quality; and (3) historic, prehistoric, and archaeological resources.

Nine coastal habitats are identified in the habitat standards: (1) offshore areas; (2) estuaries; (3) wetlands; (4) tidelands; (5) rocky islands and sea cliffs; (6) barrier islands and lagoons; (7) exposed high-energy coasts; (8) rivers, streams, and lakes; and (9) important uplands. Each habitat must be managed to protect the physical characteristics, use, or resource for which the habitat is identified. Mitigation under the habitat standard involves a sequencing process:

- first, to avoid adverse impacts to the maximum extent practicable;
- second, when avoidance is not practicable, to minimize adverse impacts to the maximum extent practicable; and
- third, if neither avoidance nor minimization is practicable, to conduct mitigation to the extent appropriate and practicable.

The ACMP defers to the mandates and expertise of the Alaska, Department of Environmental Conservation (ADEC) to protect air, land, and water quality. The standards incorporate ADEC's statutes, regulations, and procedures. The ADEC standards include, but are not limited to:

- prevention, control and abatement of any water, land, subsurface land, and air pollution, and other sources or potential sources of pollution of the environment;
- prevention and control of public health nuisances;
- safeguard standards for petroleum and natural gas-pipeline construction, operation, modification, or alteration;
- protection of public water supplies by establishing minimum drinking water standards, and standards for the construction, improvement, and maintenance of public water-supply systems;
- collection and disposal of sewage and industrial waste;
- collection and disposal of garbage, refuse, and other discarded solid materials from industrial, commercial, agricultural, and community activities or operations;
- control of pesticides; and
- handling, transportation, treatment, storage, and disposal of hazardous wastes.

The policy addressing historic, prehistoric, and archaeological resources requires the designation of areas of the coastal zone that are important to the study, understanding, or illustration of national, State, or local history or prehistory, including natural processes. A project with a properly designated area would need to comply with the applicable requirements of AS 41.35.010 – 41.35.240 and 11 AAC 16.010 – 11 AAC 16.900.

Conclusion. No conflicts with the Statewide standards of the ACMP or with the enforceable policies of the NSBCMP are anticipated. A summary of this analysis is included in Section IV.B.2.f; but, otherwise, land use plans and coastal zone management are not analyzed further in this EA

APPENDIX E

THREATENED AND ENDANGERED SPECIES CONSULTATION

This appendix contains copies of or a reference to the following documents:

MMS letter to NOAA NMFS, dated August 12, 2005
NOAA NMFS letter to MMS, dated September 30, 2005
MMS memorandum to USFWS, dated December 13, 2005
FWS memorandum to MMS, dated January 5, 200(6)
MMS memorandum to FWS, dated April 18, 2006
FWS memorandum to MMS, dated May 23, 2006
NOAA, NMFS Biological Opinion, dated June 16, 2006

Biological Evaluation to NMFS and Biological Opinion from NMFS.

The document is entitled *Biological Evaluation of the Potential Effects of Oil and Gas Leasing and Exploration in the Alaska OCS Beaufort Sea and Chukchi Sea Planning Areas on Endangered Bowhead Whales (Balaena mysticetus), Fin Whales (Balaenoptera physalus), and Humpback Whales (Megaptera novaeangliae),* prepared in accordance with Section 7 of the Endangered Species Act. The Biological Evaluation is dated March 3, 2006. A copy of the Biological Evaluation is available on the MMS website at:
(http://www.mms.gov/alaska/ref/EIS%20EA/DraftProgrammatic%20EA%20&%20Biological%20Eval/final_be_whales.pdf).

The Biological Opinion is entitled *Endangered Species Act – Section 7 Consultation, Biological Opinion.* The Biological Opinion was sent to MMS on June 16, 2006; it is available at the bottom of the following MMS website: http://www.mms.gov/alaska/ref/pea_be.htm

United States Department of the Interior

MINERALS MANAGEMENT SERVICE
Alaska Outer Continental Shelf Region
3801 Centerpoint Drive, Suite 500
Anchorage, Alaska 99503-5823

AUG 12 2005

James W. Balsiger, Ph.D.
Regional Administrator, Alaska Region
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

Dear Dr. Balsiger:

The Minerals Management Service (MMS) proposes to reinitiate consultation under Section 7 of the Endangered Species Act (ESA) on oil and gas leasing and exploration activities on two Outer Continental Shelf (OCS) Planning Areas in the arctic. Specifically, we propose to reinitiate following the Arctic Regional Biological Opinion (ARBO) approach used in the past, so that the geographic area considered in the consultation is expanded to again include potential activities that could occur within the entire Beaufort Sea Planning Area and within the Chukchi Sea OCS Program Area, as delineated in the Attachment which is reproduced from the Final EIS for our current 5-Year OCS Leasing Program. Note that the current 5-Year Leasing Program excludes the nearshore Polynya area from leasing consideration in the Chukchi Sea. Below we briefly summarize relevant background.

In November 1988, the National Marine Fisheries Service (NMFS) prepared the Arctic Regional Biological Opinion (ARBO) which concerned leasing and exploration activities in the Arctic Region (Beaufort Sea, Chukchi Sea, and Hope Basin OCS Planning Areas). Because of the removal of the gray whale from the list of threatened and endangered species, the availability of new information on the potential impacts of oil and gas-related noise on bowhead whales, the use of new seismic survey technology in the Arctic, and trends in OCS activities in the Arctic Region, MMS proposed to reinitiate consultation with NMFS on November 2, 1999. Because of lack of industry interest in the Chukchi Sea and Hope Basin Planning Areas at that time, MMS proposed, and NMFS agreed, to limit the reinitiated consultation to leasing and exploration activities only in the Beaufort Sea Planning Area. Thus, in the resultant, and most current, Biological Opinion of May 25, 2001, NMFS concluded that

> "Present and foreseeable future oil and gas exploration activities on the Alaskan OCS are likely to occur only in the Beaufort Sea."

Because of this assumption, which was based on the best information available at the time, the action area for the May 2001 biological opinion was defined as the Alaskan Beaufort Sea OCS Planning Area, extending from the Canadian border to the Barrow area.

Due to industry response to our recent Beaufort Sea lease sales and call for information and nominations in the Chukchi Sea, and based on discussions with industry, the aforementioned assumption is no longer valid. Therefore, we would like to reinitiate consultation with your agency on leasing and exploration activities in areas of both the Beaufort Sea and the Chukchi Sea, as specified above.

In accordance with the Endangered Species Act Section 7 regulations governing interagency cooperation, MMS intends to prepare a biological evaluation in which we describe the actions and specific areas being considered in the consultation, describe the listed species and critical habitats that may be affected by those actions, evaluate potential effects and cumulative effects on listed species and critical habitats, and provide other relevant information necessary for NMFS to prepare their biological opinion.

By this letter, we are notifying you of the listed species and critical habitat that we, with your concurrence, expect to include in our biological evaluation. Based on previous correspondence with NMFS on this issue and based on our review of available information, MMS is aware of only one listed species, the endangered bowhead whale, that commonly occurs in these two planning areas. However, based on NMFS' November 1988 Biological Opinion, and, in some cases, other information suggesting the possible occurrence of other listed species in areas within or near these two planning areas, MMS currently intends to review and consider the following listed species in our biological evaluation:

Common Name	Scientific Name	ESA Status
Bowhead whale	*Balaena mysticetus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
Right whale	*Eubalaena glacialis*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered

We have included right and sei whales on this species list because, in your biological opinion of November 1988 (page 3), NMFS stated that these species were among "...six species of endangered whales that inhabit Arctic Region waters of Alaska." On page 4 of the 1988 ARBO, NMFS stated that "The right and sei whales are rare in Arctic waters. They are represented by isolated records in the Chukchi Sea, probably of stray individuals well outside the normal ranges of their populations." We believe that information available since that opinion supports this conclusion.

MMS is not aware of any designated or proposed critical habitat for any species that is under the jurisdiction of NMFS and that occurs within, near, or that could potentially be affected by leasing or exploration activities within, the Beaufort Sea or Chukchi Sea.

Please notify us of your concurrence with, or necessary revisions to, the above list of species and add any critical habitats which you believe need to be considered in our biological evaluation. In addition, we ask that you specify whether we should include Eastern North Pacific gray whales (*Eschrichtius robustus*) in our evaluation. While this population of gray whales was removed from the list of threatened and endangered species in 1994, NMFS's Biological Opinion on Oil and Gas Lease Sales 191 and 199 in the Cook Inlet OCS Planning Area included a "...general assessment of the effects of the action on gray whales as part of NMFS' continuing responsibility to monitor the status of the species." Lastly, we ask that you reaffirm NMFS's conclusion in recent consultations (e.g., the consultation on the Beaufort Sea Lease Sales 186, 195, and 202) that MMS does not need to consult on species along the transportation corridor from Valdez to ports along the Pacific coast and to the Far East.

To facilitate consideration of our request for concurrence, we are sending copies of this letter to your Anchorage Field Office. Upon receipt of your reply within 30 days, we will begin preparation of our biological evaluation reviewing potential effects of Federal oil and gas leasing and exploration by MMS within the Alaskan Beaufort Sea and the Chukchi Sea.

If you have any questions on the issues raised in this letter or require additional information, please contact Dr. Lisa Rotterman, Minerals Management Service, Mail Stop 8303, 3801 Centerpoint Drive, Suite 500, Anchorage Alaska 99503-5823 (commercial and FTS telephone: 907-334-5245)

Sincerely,

John Goll
Regional Director

Enclosure

cc: (w/enclosure)

Mr. Brad Smith
Anchorage Field Office
National Marine Fisheries Service
Federal Building
22 West 7th Avenue, Box 43
Anchorage Alaska 99513-7577

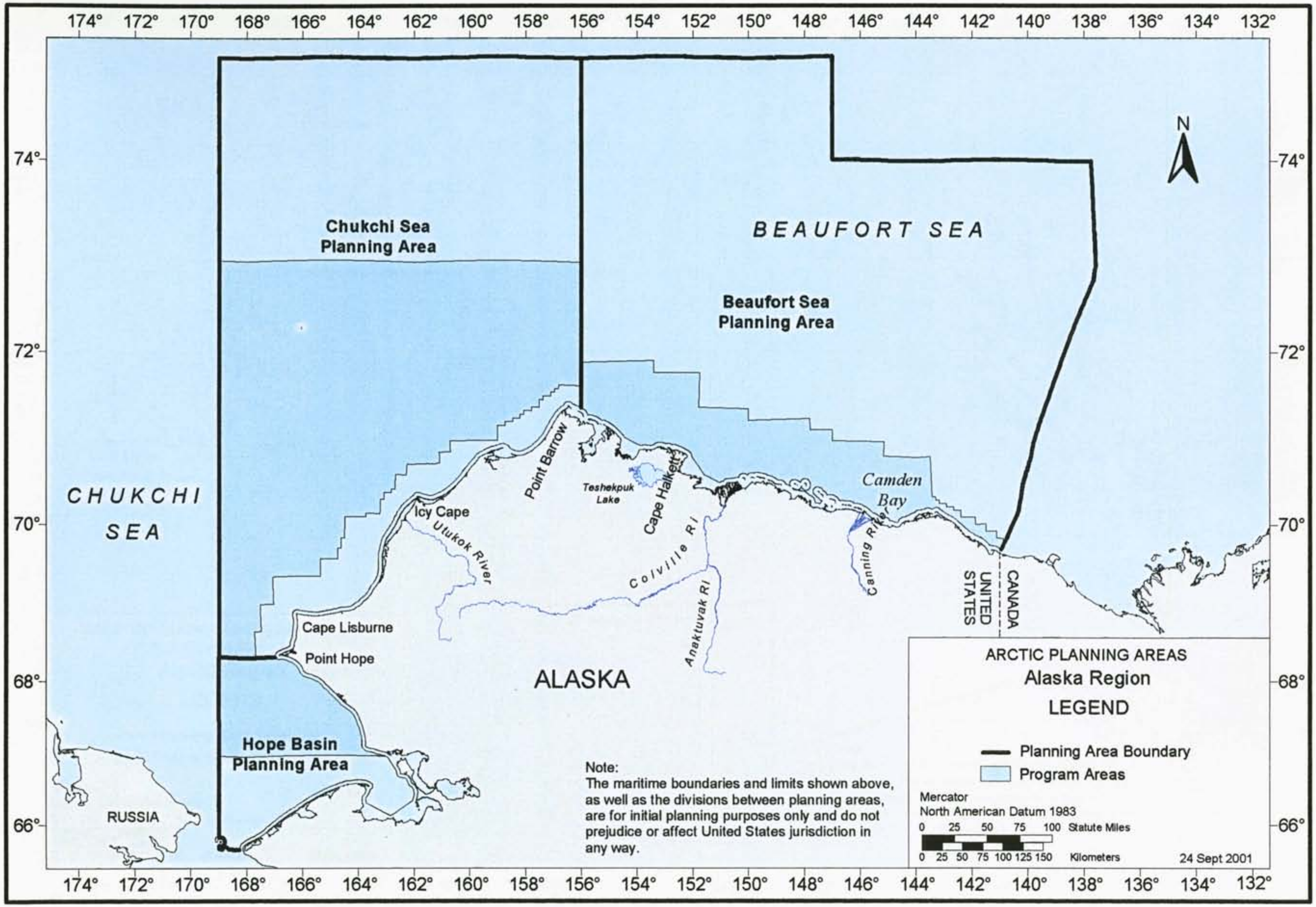


Figure 2-3. Beaufort Sea, Chukchi Sea, and Hope Basin Planning Areas - Alaska Region

UNITED STATES DEPARTMENT OF COMMERC
National Oceanic and Atmospheric Administratio
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

September 30, 2005

John Goll
Regional Director
Minerals Management Service
Alaska Outer Continental Shelf Region
3801 Centerpoint Drive, Suite 500
Anchorage, AK. 99503-5823

Dear Mr. Goll:

The National Marine Fisheries Service (NMFS) has received your letter requesting information on the presence of threatened or endangered species and their designated critical habitat which occur in the Alaska Beaufort Sea and Chukchi Sea planning areas.

The following species is listed under the Federal Endangered Species Act and is found in these areas:

Bowhead Whale (Balaena mysticetus)........................Endangered

Critical habitat has not been designated for the bowhead whale.

Additionally, the endangered humpback (Megaptera novaeangliae) and fin whale (Balaenoptera physalus) are found in waters of the Chukchi Sea and Bering Sea outside of the subject planning areas. These animals could be impacted secondarily by OCS activities. NMFS recommends their inclusion in your evaluation. NMFS also recommends the evaluation provide a comprehensive assessment of OCS activities on threatened and endangered species, and, to accomplish this, include all deferrals within these planning areas.

We hope this information will be useful in your section 7 determinations. Please direct any questions to Brad Smith in our Anchorage office, (907) 271-3023.

Sincerely,

Kaja Brix

Kaja Brix
Assistant Regional Administrator
for Protected Resources

United States Department of the Interior

MINERALS MANAGEMENT SERVICE
Alaska Outer Continental Shelf Region
3801 Centerpoint Drive, Suite 500
Anchorage, Alaska 99503-5823

DEC 13 2005

Memorandum

To: Regional Director, Region 7, U.S. Fish and Wildlife Service

From: Regional Director

Subject: Endangered Species Act, Section 7 Consultation Chukchi Sea and Beaufort Sea OCS Planning Areas

The Minerals Management Service (MMS) is undertaking assessment of potential environmental effects related to potential oil and gas leasing and exploration activities that may occur in the Beaufort Sea and Chukchi Sea Outer Continental Shelf (OCS) Planning Areas. We have delineated these two areas in the attachment which reflects the areas as shown in the Final Environmental Impact Study (EIS) for our current (2002-2007) 5-Year OCS Leasing Program. The proposed activities include 1) seismic surveys that could begin in June 2006 in the Chukchi Sea and in the Beaufort Sea later in the 2006 open water season; 2) proposed Beaufort Sea Oil and Gas Lease Sale 202 (currently scheduled for March 2007) and related exploration; and 3) proposed Chukchi Sea Oil and Gas Lease Sale 193 (potentially to be held in November 2007 if approved by the Secretary to be included in the 2007-2012 5-Year OCS Leasing Program) and related exploration (www.mms.gov/alaska/). As required under Section 7 of the Endangered Species Act (ESA), MMS will be evaluating potential effects of these actions to species listed, and habitat designated as critical, under the ESA and consulting with the U.S. Fish and Wildlife Service (FWS) regarding the aforementioned actions.

The MMS has recently consulted with FWS regarding leasing and exploration activities in the Beaufort Sea Planning Area. The FWS prepared a Biological Opinion for Sale 186, 195 and 202, dated October 23, 2002. That opinion, which included reasonable and prudent measures and conservation recommendations, concluded with a statement of "no jeopardy." In this Biological Opinion, the FWS stated that: "The MMS requested programmatic Section 7 consultation for proposed Beaufort Sea lease sales from 2003 through 2007 identified as Lease Sales 186, 195, and 202...Based upon the information contained in any future EA or supplemental EIS, the MMS will reinitiate programmatic consultation on Lease Sales 195 and/or 202 at later dates if new information comes to light that would trigger the need for reinitiation." The FWS upheld the no jeopardy statement for Sale 195 in a memorandum dated January 1, 2004. At this point, we have not yet completed our review of information that has become available since late 2003 to determine whether we will need to formally reinitiate consultation with you on actions that may occur within the Beaufort Sea Planning Area. We expect this review and related analyses to be completed very early in 2006 and will contact you then.

The MMS has not consulted with FWS on oil and gas activities in the Chukchi Sea Planning area since 1990, at which time the consultation was focused only on potential effects to the Arctic peregrine falcon (*Falco peregrinus tundrius*), a species which has subsequently been removed from the list of threatened and endangered species.

In accordance with the ESA's Section 7 regulations governing interagency cooperation, MMS intends to prepare at least two biological evaluations in the near future: the first focused on potential effects of seismic survey activities in the Chukchi Sea (which may occur as early as next summer) and the second in which we will look at a broader range of activities that might be associated with the proposed Chukchi Sea OCS Oil and Gas Lease Sale 193. In these evaluations, we will describe the actions and specific areas being considered in the consultation, describe the listed species and critical habitats that may be affected by those actions, evaluate potential effects and cumulative effects on listed species and critical habitats, and provide other relevant information necessary for FWS to prepare biological opinions.

By this letter, we request that the FWS specify what ESA listed, proposed, or candidate species, as well as designated critical habitat, may be in or near the Beaufort Sea Planning Area and/or in or near the Chukchi Sea Planning Area. We will use this list to prepare our evaluation of potential effects to ESA-listed species from the aforementioned actions. At present, based on your October 2002 Biological Opinion, your January 2004 memorandum, and our review of other available information, we are aware of the following species with status under the ESA for which FWS has management authority that may be in or near the Beaufort Sea Planning Area or the Chukchi Sea Planning Area and that may potentially be affected by proposed MMS actions in one or both of those areas:

Common Name	Scientific Name	ESA Status	Present in Beaufort Sea	Present in Chukchi Sea
Spectacled eiders	(*Somateria fischeri*)	threatened	yes	yes
Steller's eiders	(*Polysticta stelleri*)	threatened	yes	yes
Kittlitz's murrelets	(*Brachyramphus brevirostris*)	candidate	no	yes

We are aware that there is designated critical habitat for spectacled eiders within and adjacent to Ledyard Bay in the eastern Chukchi Sea. We are not aware of any other designated critical habitat within the Chukchi Sea or of any designated critical habitat for any species within or adjacent to the Beaufort Sea Planning Area.

We are also aware that the FWS has received petitions to list polar bears (*Ursus maritimus*) (petition in February 2005) and the yellow-billed loon (*Gavia adamsii*) (petition in March 2004) under the ESA. We request that you inform us as to whether you foresee that either, or both, of these two species is likely to be listed, or designated as candidate species for listing, under the ESA within the next two years.

Please notify us of your concurrence with, or necessary revisions to, the above list of species and add any critical habitats which you believe would need to be considered in any biological evaluations related to MMS proposed actions in each of these two planning areas.

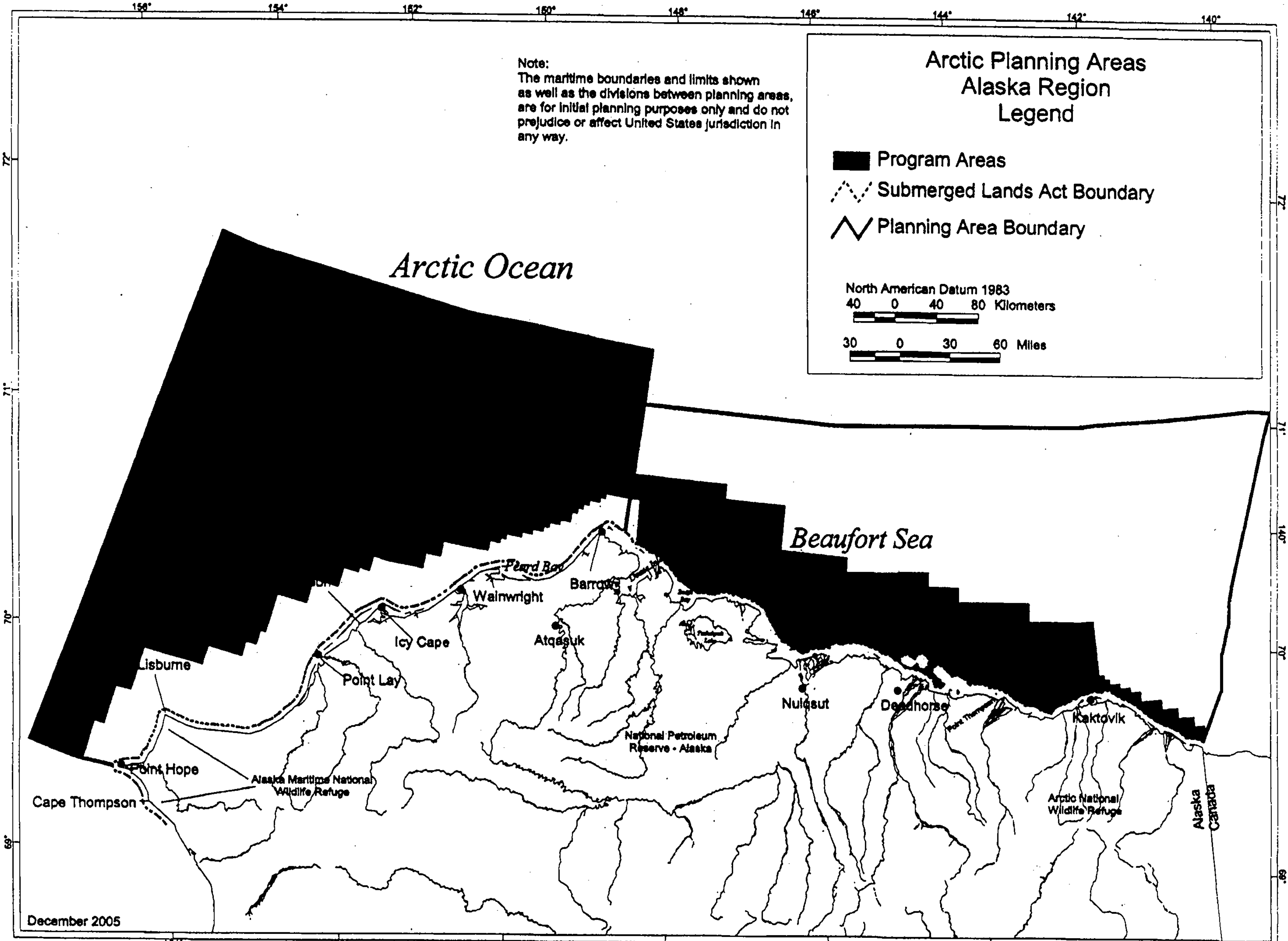
Lastly, we ask that you reaffirm FWS's conclusion in recent consultations (e.g., the consultation on the Beaufort Sea Lease Sales 186, 195, and 202) that MMS does not need to consult on species along the transportation corridor from Valdez to ports along the Pacific coast and to the Far East.

We request that you respond to this memorandum in as timely a manner as possible. Upon receipt of your reply within 30 days, we will begin preparation of our biological evaluations, reviewing potential effects of Federal oil and gas leasing and exploration by MMS within the Alaskan Beaufort Sea and the Chukchi Sea. To facilitate consideration of our request for concurrence, we are sending copies of this letter to the Northern Alaska Ecological Services' Office in Fairbanks.

If you have any questions on this consultation request or require additional information, please contact Dr. Lisa Rotterman, Minerals Management Service, 3801 Centerpoint Drive, Suite 500, Anchorage, Alaska 99503-5823 (commercial and FTS telephone: 907-334-5245) (lisa.rotterman@mms.gov) or Ms. Jill Lewandowski, Minerals Management Service, Mail Stop 4042, 381 Elden Street, Herndon, Virginia 20170-4817 (commercial and FTS telephone: 703-787-1703).

Attachment

cc: Mr. Steve Lewis, FWS
Judy Wilson, Chief ECU (MS 4042)
Jill Lewandowski, ENVD-EAB



Note:
The maritime boundaries and limits shown as well as the divisions between planning areas, are for initial planning purposes only and do not prejudice or affect United States jurisdiction in any way.
Arctic Planning Areas
Alaska Region
Legend
Program Areas
Submerged Lands Act Boundary
Planning Area Boundary
North American Datum 1983
40 0 40 80 Kilometers
30 0 30 60 Miles
Arctic Ocean
Beaufort Sea
Peard Bay
Barrow
Wainwright
Icy Cape
Atqasuk
Lisburne
Point Lay
Nuiqsut
Deadhorse
Kaktovik
National Petroleum Reserve - Alaska
Point Hope
Cape Thompson
Alaska Maritime National Wildlife Refuge
Arctic National Wildlife Refuge
Alaska
Canada
December 2005

United States Department of the Interior
U.S. FISH AND WILDLIFE SERVICE
Fairbanks Fish and Wildlife Field Office
101 12th Avenue, Room 110
Fairbanks, Alaska 99701
January 5, 2005

Memorandum

To: Regional Director, Alaska OCS Region, Minerals Management Service

From: Endangered Species Branch Chief Ted Swem

Subject: Section 7 Consultation- Chukchi Sea and Beaufort Sea OCS Planning Areas

This responds to your December 13, 2005 request for a list of endangered, threatened and candidate species and critical habitats pursuant to section 7 of the Endangered Species Act of 1973, as amended (Act). The following information is being provided for the Minerals Management Service's potential oil and gas activities that may occur in the Beaufort and Chukchi Sea Outer Continental Shelf (OCS) Planning Areas. The information below addresses the species and critical habitats present within those areas, which include the arctic coastal region from Point Hope eastward to the Canadian border. The following listed species are present in all or some portion of the planning areas:

Common Name	Scientific Name	Status	Present in Beaufort Sea	Present in Chukchi Sea
Steller's eider	*Polysticta stelleri*	threatened	yes	yes
Spectacled eider	*Somateria fischeri*	threatened	yes	yes
Kittlitz's murrelet	*Brachyramphus brevirostris*	candidate	likely	yes

Both planning areas provide marine habitat for the threatened spectacled eider and the threatened Alaska-breeding population of the Steller's eider. The Kittlitz's murrelet, a candidate species, discontinuously inhabits coastal waters of the Chukchi Sea to Barrow, so occurs within the Chukchi Sea Planning Area. Given that the species has been recorded near Barrow several times, it seems likely that it also occurs occasionally in the western Beaufort Sea, but to our knowledge no records yet exist to verify this.

Critical habitat for spectacled eiders exists in the southwest portion of the MMS Chukchi Sea Planning Area. The Ledyard Bay Unit of spectacled eider critical habitat includes marine waters within about 74 km (40 nm) from shore, from Cape Lisburne to Icy Cape, excluding waters less than 1.85 km (1nm) from shore. We assume that you have maps of these areas; please notify us if this is not the case. You are correct that no other designated critical habitat occurs within either the Chukchi or Beaufort Sea Planning Areas.

You asked whether we foresee that either the polar bear (*Ursus maritimus*) or yellow-billed loon (*Gavia adamsii)* will be listed under the Act within the next two years. As you know, we have been petitioned to list both species, and the petitions set in motion a process that will ultimately culminate in a decision as to whether listing is warranted. In order to list either species, we would have to first make a positive 90-day finding (which would state, in effect, that listing *may* be warranted) and then conduct a much more thorough 12-month evaluation of all available information that results in a determination that listing *is* warranted. As 90-day findings have not been finalized, the status of both species is pre-decisional. Thus, we have no basis for speculating on the outcome of decisions yet to be made or 12-month evaluations yet to be conducted.

Finally, you also asked for confirmation that you need not consult on potential impacts of transporting oil from Valdez to ports along the Pacific coast and to the Far East. There has been no change in the Service's approach, so we concur that MMS does not need to include the transportation of oil in this consultation.

This species list applies only to endangered and threatened species under the jurisdiction of the U.S. Fish and Wildlife Service. Please contact the National Oceanic and Atmospheric Administration - Fisheries for information on the status of listed and proposed species under their jurisdiction in the shoreline and off-shore action areas.

Thank you for your cooperation in meeting our joint responsibilities under the Act. If you have any questions on this consultation or require further information, please contact Dr. Jewel Bennett with the Fairbanks Fish and Wildlife Field Office at (907) 456-0239.

cc: Dr. Lisa Rotterman

United States Department of the Interior

MINERALS MANAGEMENT SERVICE
Alaska Outer Continental Shelf Region
3801 Centerpoint Drive, Suite 500
Anchorage, Alaska 99503-5823

APR 18 2006

Memorandum

To: Regional Director, Fish and Wildlife Service, Alaska

From: Regional Director

Subject: Proposed Beaufort Sea Lease Sale 202: Endangered Species Act, Section 7 Consultation

The Minerals Management Service (MMS) is beginning to update the assessment for the proposed Beaufort Sea Oil and Gas Lease Sale 202 (scheduled for March 2007). The final environmental impact statement (EIS) for the Beaufort Sea Planning Area Oil and Gas Lease Sales 186, 195, and 202, released in February 2003 (OCS EIS/EA MMS 2003-001), contains information on the anticipated activities and potential effects of proposed Lease Sale 202. The draft of this document, and information exchanged at meetings and in communications between MMS and the Fish and Wildlife Service (FWS) preceding its publication, served as the MMS's Biological Evaluation for the proposed action under Section 7 of the Endangered Species Act (ESA) and satisfied the information requirements specified in 50 CFR 402.12 and 402.14.

On October 23, 2002, and after formal consultation under Section 7 of the ESA of 1973, as amended, MMS received FWS's Final Biological Opinion for the Proposed Beaufort Sea Natural Gas and Oil Lease Sale 186. This was a "no jeopardy" opinion. In this Biological Opinion, FWS stated that:

> The MMS requested programmatic Section 7 consultation for proposed Beaufort Sea lease sales from 2003 through 2007 identified as Lease Sales 186, 195, and 202. The May 2002 Draft Alaska Outer Continental Shelf (OCS) Environmental Impact Statement (EIS) states that.... Based upon the information contained in any future EA or Supplemental EIS, the MMS will reinitiate programmatic consultation on Lease Sales 195 and/or 202 at later dates if new information comes to light that would trigger the need for reinitiation.

Page 27 of the FWS's Biological Opinion specifies the circumstances under which reinitiation of formal consultation is required. These conditions are if 1) the amount or extent of incidental take is exceeded, 2) new information reveals effects of the action agency that may affect listed species or critical habitat in a manner or to an extent not considered in the Biological Opinion, 3) the agency action is subsequently modified in a manner that causes an effect to listed [species] or critical habitat not considered in the Biological Opinion, or 4) a new species is listed or critical habitat designated that may be affected by the action.

Page 2 of the October 2002 Biological Opinion identified two species in or near the proposed lease sale area and that may be adversely affected by the proposed action: spectacled eider (*Somateria fischeri*) and Steller's eider (*Polysticta stelleri*).

Since that time, the Kittlitz's murrelet (*Brachyramphus brevirostris*) has been designated a candidate species under the ESA. The MMS received a letter from FWS on January 5, 2006, indicating that the Kittlitz's murrelet is "likely" to occur in the Beaufort Sea. The MMS, however, is unaware of any records of the Kittlitz's murrelet occurring in the Lease Sale 202 area and, consequently, believes the proposed action would not affect this species.

The Beaufort Sea Oil and Gas Lease Sale 186 took place on September 24, 2003, and 34 tracts were leased. The Beaufort Sea Oil and Gas Lease Sale 195 took place on March 30, 2005, and 117 tracts were leased. The area to be offered for lease in proposed Lease Sale 202 is the same as that described in the multiple-sale EIS. No new offshore activity associated with any of the leased tracts has occurred. The MMS recently sent FWS a Biological Evaluation for a proposed seismic survey effort in the Chukchi and Beaufort Seas for 2006 and those surveys are anticipated to be completed prior to proposed Lease Sale 202 in 2007.

The MMS hosted a Chukchi Sea Science Update last fall where FWS subject-matter experts gave a number of excellent presentations on resources in the Chukchi Sea, including threatened eiders. The information shared at this meeting had direct relevance to the Beaufort Sea Lease Sale 202. The MMS has also reviewed recent information specific to spectacled and Steller's eider use of the Beaufort Sea as well as recent studies on oil and gas development and other impacts to listed eiders or similar species. While technically considered "new" information, our review indicates that neither have conditions changed substantially, nor is there relevant recent information that leads us to conclude that impacts from the proposed action would differ substantially from those identified and discussed in our final EIS. In summary, we believe that none of the circumstances that require reinitiation of formal consultation has occurred.

Please let us know if you concur with our conclusion. If you do not concur, please provide us with the reasons for your conclusions (e.g., whether the conclusions, incidental-take statement, reasonable and prudent measures, conservations measures, or other portions of the Biological Opinion do not apply to proposed Lease Sale 202). If you believe that formal consultation should be reinitiated, we request that you specify which triggers for reinitiation have been met.

Additionally, if you do not concur and might recommend additional measures to minimize impacts to listed species, or if you believe a jeopardy situation may exist for all or part of the proposed action, we request that you respond to this letter in as timely a manner as possible, according to 50 CFR 40214(g)(5), to allow MMS and FWS time to discuss pertinent findings following initiation of formal consultation. We believe that such discussions will facilitate completion of formal consultation within specified timeframes so that a new or updated FWS Biological Opinion can be included in our final NEPA document in early July 2006, and will ensure effective protection of listed species. These discussions could also ensure that any alternate conservation measures are within our authority to control and implement, and are feasible, appropriate, and effective.

To facilitate timely consideration of our request for concurrence, we are sending a copy of this letter to the FWS Field Office in Fairbanks. If you have any questions on the ESA consultation issues raised in this letter, or if you require additional information, please call Mark Schroeder of my staff at 907-334-5247. Thank you for your review.

cc: Steve Lewis, FFWFO

United States Department of the Interior
U.S. FISH AND WILDLIFE SERVICE
Fairbanks Fish and Wildlife Field Office
101 12th Avenue, Room 110
Fairbanks, Alaska 99701
May 23, 2006

Memorandum

To: Thomas A. Readinger,
Associate Director for Offshore Minerals Management

From: Steve A. Lewis, Field Supervisor
Fairbanks Fish and Wildlife Field Office

Subject: Endangered Species Act, Section 7 Consultation, Proposed Beaufort Sea Lease Sale 202

The Service received a memorandum dated April 18, 2006 from the Minerals Management Service (MMS) asking for concurrence that the conclusions, incidental take statement, reasonable and prudent measures, conservation recommendations, and other sections contained in the amended October 22, 2002, Biological Opinion (BO) for Beaufort Sea Outer Continental Shelf (OCS) Oil and Gas Lease Sale 186 remain valid. The October 22, 2002 BO addressed impacts associated with leasing activities in the Beaufort Sea and covered three lease sale areas; 186, 195, and 202. In July 2004, the BO was amended in response to changes in information as MMS developed an updated environmental assessment prior to lease sale 196.

MMS is beginning to update the environmental assessment for proposed Lease Sale 202 scheduled for March 2007. The areas offered for lease will be the same as those described in the multiple-sale Environmental Impact Statement (EIS) and October 22, 2002 BO. No new offshore activity associated with any of the lease tracts has occurred. The Service is unaware of any new information or changes in the status of the listed species that would change the conclusions of the BO completed for these lease sales.

We conclude that the BO completed for Lease Sale 186 as amended for Lease Sale 195 is still valid and applies to proposed Lease Sale 202. We reaffirm that the Service has received no new information that would require re-initiation of formal consultation and to our knowledge, none of the circumstances that require re-initiation of formal consultation have occurred. The conclusions, incidental take statement, reasonable and prudent measures, and the terms and conditions detailed in the amended BO of 2004 all remain valid and in effect.

As described in the BO the most significant threat to listed species from the proposed action are collisions with infrastructure. In an effort to reduce incidental take the BO requires the following reasonable and prudent measures, and terms and conditions be followed:

"…the MMS and the Service will cooperatively develop a lighting protocol intended to reduce radiation of light outward from structures and to increase the visibility of structures to migrating eiders."

"The radiation of light outward from exploratory/delineation structures will be minimized. This will be achieved by shading and/or light fixture placement to direct light inward and downward to living and work surfaces while minimizing light radiating upward and outward."

The Service is looking forward to working closely with MMS to develop appropriate and effective lighting techniques for structures that will be used in the area to reduce collision risk for listed species. If you have any comments or concerns regarding this consultation, please contact Sarah Conn at (907) 456-0499.

APPENDIX F

COORDINATION MEETING FOR PROPOSED SALE 202

The Minerals Management Service (MMS) convened a meeting during late 2005 that updated our information on the Chukchi Sea. Much of the information was applicable also to the Beaufort Sea, because most species inhabit or migrate through both seas. The agenda is appended here, and electronic copies of the presented illustrations are available from MMS.

MMS CHUKCHI SEA SCIENCE UPDATE
3801 Centerpoint Drive, Anchorage

Monday October 31

Introduction

8:00 Welcome, meeting objectives, and time table (unless otherwise noted, each speaker would have 20 m to talk and 10 m to answer questions)
Dee Williams, MMS, Anchorage

Security measures in the MMS office
Karen Weerheim, MMS, Anchorage

8:10 Chukchi Sea Activity (1989-1991)
Dave Roby, MMS, Anchorage

8:20 Chukchi Sea Planning Area, Lease Sale 193, Proposed Scenario
Jim Lima, MMS, Anchorage

Oceanographic Conditions in the NE Chukchi

Chaired by Caryn Smith and Tom Dunning Newbury, MMS, Anchorage

8:30 Overview—Satellite Observed Variability of the Arctic Ice Cover
Josefino Comiso, NASA Goddard, Greenbelt, MD

9:00 Break

9:15 Circulation and Water Mass Modification Processes on the Chukchi Sea Shelf
Tom Weingartner, UAF Institute of Marine Science (IMS), Fairbanks

9:45 Chlorophyll Distributions and Surface Primary Productivity from Space
Josefino Comiso, NASA Goddard, Greenbelt, MD

10:15 Benthic Fauna in the Northeastern Chukchi Sea
Ken Dunton and Susan Schonberg, **University of Texas, Port Aransas**

11:15 General Discussion, chaired by Caryn Smith and Tom Dunning Newbury

11:30 Lunch break

Marine-Mammals in the NE Chukchi Sea

Chaired by Lisa Rotterman, MMS, Anchorage

1:00 Bowhead Whales in the Chukchi Sea
Craig George, NSB Dept. of Wildlife Management (DWM), Barrow

1:30 Beluga Whales
Robert Suydam, NSB DWM, Barrow

2:00 Ice Seals in the Chukchi Sea
Lori Quakenbush, AK Dept. of Fish and Game (ADF&G), Fairbanks

2:30 Pacific Walrus
Joel Garlich-Miller and John Trent, **USFWS, Anchorage**

3:00 Break

3:15 Pacific walrus and subsistence
Caleb Pungowiyi, Marine Mammal Commission Special Advisor on Native Affairs, former Chair of Eskimo Walrus Comm., Kotzebue

3:45 Chukchi Sea: Polar Bear Information
Scott Schliebe, USDOI, FWS, Anchorage

4:15 Polar Bears in the Chukchi Sea
George Durner, Steven Amstrup, Geoff York, Eric Regehr, Kristin Simac, Torsten Bentzen, and David Douglas, **USGS Alaska Science Center, Anchorage**

4:45 General Discussion, chaired by Lisa Rotterman

Tuesday November 1

8:00 Trace Metals in Sediments, Northeastern Chukchi Sea
Sathy Naidu, UAF-IMS, Fairbanks

<u>Marine and Freshwater Fishes in the NE Chukchi Sea</u>

Chaired by Jeff Childs, MMS, Anchorage

8:30 Fishes of the Northern Bering Sea and Chukchi Sea
Catherine Mecklenburg, Point Stephens Research, Auke Bay; David Stein, Smithsonian; Boris Sheiko and Natalia Chernova, Russian Academy of Sciences, St. Petersburg; and T. Anthony Mecklenburg, Pt. Stephens Research

9:00 Marine Fish Resources in the Chukchi Sea
Brenda Holladay, UAF, Fairbanks

9:30 Nearshore and Freshwater Fish of the Chukchi Region
Craig George, NSB DWM, Barrow

10:00 General Discussion, chaired by Jeff Childs (15 min)

10:15 Break

<u>Marine and Coastal Birds in the NE Chukchi Sea</u>

Chaired by Jeff Gleason, MMS, Anchorage

10:30 Steller's and Spectacled Eiders in the Northeast Chukchi Sea
Sarah Conn, USDOI, FWS, Fairbanks

11:00 King and Common Eiders
Robert Suydam, NSB DWM, Barrow; and Lori Quakenbush, ADF&G, Fairbanks

11:30 Migration Ecology of Loons in Northwest Alaska
Joel Schmutz, USGS Alaska Science Center, Anchorage

12:00 Lunch break

1:00 Status of Long-tailed Ducks in the Chukchi Sea
Paul Flint, USGS Alaska Science Center, Anchorage

1:30 Marine and Coastal Birds in the NE Chukchi Sea—Shorebirds
Richard Lanctot, USDOI, FWS, Anchorage, and Audrey Taylor, UAF, Fairbanks

2:30 General Discussion, chaired by Jeff Gleason, MMS, Anchorage

2:45 Break

Subsistence and Sociocultural Resources

Chaired by Mike Burwell and Dee Williams, MMS, Anchorage

3:30 Shishmaref—Recent Changes in a Chukchi Coastal Village
Josh Wisniewski, UAF Department of Anthropology, Fairbanks

4:00 General Discussion, chaired by Mike Burwell and Dee Williams, MMS, Anchorage

End of Chukchi Sea Science Update